COMBINE

Interreg Baltic Sea Region

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HCT as an enabler for Combined Transports - A Study on potentials of implementing HCT-vehicles in Sweden

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Executive summary

Results from this study proved different types of HCT-arrangements on road to be an enabler to increase efficiency in intermodal transport chains in terms of economic savings as well as ability to decrease environmental impact. Possible environmental improvement ranges between 5 up to 86 % depending on route, volume and energy source. Economic savings range between 13 to 25 %. In intermodal transport chains, road is often a vital transport mode especially in Sweden where the geographical catchment area is larger and the last mile transportation leg often is longer compered to central Europe. Often covering the last-mile distance in intermodal transport chains, road transports can be improved by transferring goods to HCT-arrangements. For transport mode road, HCT-arrangements has great potential to improve economics and environmental impact, specifically on long distances over 200 km where daily volumes are high in standardized transport arrangements.

CONTENT

First, we want to give a warm thank you to all participating stakeholders who has made this project possible. These are:

1 SUMMARY

The EU-funded project COMBINE aims to increase the proportion of combined transports (intermodal transports) in the Baltic Sea region, to make transports more efficient and environmentally friendly. A part of the focus of project COMBINE is to investigate the potential to introduce different types of High Capacity Transports (HCT) on roads in Sweden.

This study, initiated by Region Örebro, investigates the potential for implementing different types of HCT-solutions in Sweden within the region of Örebro and Stockholm. Eight companies within the road transport industry in Sweden are included as stakeholders within this study, with eight specific routes and transport arrangements to be investigated. For each specific case, the potential economic and environmental savings are calculated and analysed. Additionally, infrastructural prerequisites for each case is analysed.

Results proved an inherent potential to obtain both environmental and economic benefits to transfer freight volumes into various types of HCT-configurations. HCT-configurations proved to be of great benefit for standard transport arrangements with high daily freight volumes on longer distances above 200 km. Potential hinders for switch to HCT-configurations are mainly within the infrastructure; technical infrastructural limitations within cities and terminal areas can be troublesome for HCT-transports and administrative processes for dispensation is a barrier to effectively switch to and conduct HCT-transports.

Further studies might highlight the potential socio-economic savings of transferring road freight volumes to HCT-configurations as well as on how administration regarding infrastructure, road networks and HCT interact, together with the wear and tear on infrastructure as a result from HCT-transports.

2 INTRODUCTION

Region Örebro is a partner in the EU-funded project COMBINE, which aims to increase the proportion of combined transports (chains with more than one transport mode) in the Baltic Sea region and thereby make transports more efficient and environmentally friendly. As a part of that focus, Region Örebro aims to investigate the potential to introduce different types of High Capacity Transport (abbreviated HCT) for road transport in Sweden. The geographical location of the study is focused on specific road infrastructure in the region of Örebro and Stockholm.

Through an array of companies (commodity owners) active within different branches, several cases will set out to investigate the potential for HCT transport on road in Sweden in different HCT-configurations. The company will act as a stakeholder within in each case with specific technical prerequisites for each case, with an additional perspective on the potential of HCT for their specific case as well as what HCT-configuration that is most suitable for their current transport arrangement.

The infrastructure within region Örebro and Stockholm will, together with the companies and specific transport flows within the scope of the study, act as a pilot study to identify the potential to elevate current transport routes into HCT-configurations for estimated economic and environmental benefits.

2.1 Purpose

The purpose of this study is to analyse the potential to implement HCT vehicles in Sweden.

Further, the purpose is to, through actual cases, test the hypothesis that there exists a great untapped potential for road transports to be transferred to a HCT-configuration that implies economic and environmental benefits.

Lastly, the purpose is to analyse how HCT-arrangements can help improve intermodal transport chains and act as an enabler to increase the share of combined transports in the complete transport system.

2.2 Objectives

The objectives of this study are as follows;

1. Identify and map freight flows at selected transport operators that manage freight in the Örebro region and the Stockholm region for selected case companies
2. Based on identified freight flows of selected actors, analyse the environmental (CO_2 emissions) and economic conditions for the implementation of one or more of the following HCT-configurations:
    a. Heavy vehicles (up to 74 tons)
    b. Long vehicles (from 25,25 meters up to 34.5 m)
    c. Either one or two of the combinations above, with electricity as propellant through battery power or electrical road
3. Investigate the potential of changes in the physical infrastructure in / to and from nodes that may be needed for the implementation of the above-selected special vehicles to be possible. For example, between the city of Örebro and the Hallsberg terminal.
4. Investigate changes in legislation / regulations that are needed to make the implementation of the above-selected special vehicles possible.
5. Elevate the potential of HCT-transports on roads in Sweden in a multimodal system perspective, as an enabler to increase the share of combined transport arrangements within the complete transport system through increased efficiency, lowered costs and improved environmental footprint

2.3 Scope

The scope of this study will cover eight different cases with specific transport flows and various goods. Every case is qualified according to the following criteria listed below;

- The transport relation is a physical flow through the Örebro region or the Stockholm region
- The volume holds inherent possibility to switch to HCT-mode in terms of volumes per time unit (i.e., companies with transport volume of 1 truck per week from A to B is not subjected to be exchanged to HCT-configurations). Hence, companies transporting 5-10 truckloads per week for example, makes a good case
- The case will cover a part of the specific road infrastructure in the Örebro region (road E20) and Stockholm region (road 73) which are administrated by the Swedish Transport Administration and furthermore included as pilot sections for electric road.

Furthermore, the transport flows are;

- Validated by the company involved as a stakeholder within the project
- The company have verified their participation and role as a stakeholder with the purpose to increase efficiency, lower cost and improve logistics for the specific transport flow
- Some cases are actively chosen since goods are transhipped through major hubs, e.g. the Hallsberg terminal in the Örebro region to achieve coverage of locally important freight hubs

Each company has through dialogue could give their opinions and perspective as to what the potential for HCT implies for their business and the specific route and arrangement that is investigated. The perspective from the company as a stakeholder within the project act as the foundation with specific demands on HCT-configuration for every case.

In every case analysed, a specific haulage company is hired to conduct the transport. However, how the arrangement is set up varies from case to case. Some companies provide a complete planning procedure for the haulage company (e.g. Lidl) and others let freight forward companies handle the complete process (e.g. Elon).

2.4 Delimitations

For each case, only a specific transport route will be analysed. Distributed effects in a consolidated transport network resulting from changes made to a certain transport flow will not be taken into consideration and be accounted for.

Only directly connected empty transport for the specific routes will be analysed. Thus, every empty transport generated will be analysed as an included transport leg back to point of where cargo originated. For example, in the case of Norvik and Elon consisting solely of containers, two empty containers are assumed to be moved back to point of origin as of where transport started. This factor is also included in calculations. However, this might fall out differently when operating a larger fleet of trucks together, since these are a part of a larger transport network, which in this study is excluded as a factor of analysis.

Only the infrastructural prerequisites for the specific routes of each case will be analysed. Hence, this analysis will be geographically delimited to the local areas covering starting and endpoints, as well as major connecting roads, for each case specifically.

Specific delimitations are valid for the Norvik port case in the region of Stockholm. Since the case is fictive, assumptions by the authors of this report are made to construct the case. However, input data in terms of yearly volume in TEU is derived from Norvik port as a basis.

Finally, specific delimitations are also valid for two specific cases consisting of exclusively containerized goods, which is for cases Elon and Norvik. For these cases, only 40-foot containers will be included in the analysis; 20-foot containers will be excluded. For these two specific cases, it is also a high probability that max volume will be reached before max weight of a 40-foot container is reached. Thus, this might often result in a HCT-configuration where two fully loaded 40-foot containers still are within the current max limitation on public roads in Sweden, 64 ton.

2.5 List of definitions and abbreviations

This section describes the definitions and abbreviations used throughout the report.

Table 1 Definition and abbreviations

Definition/Abbreviation	Description	Comment
HCT	High Capacity Transport	A vehicle configuration longer than 25,25 meters and/or heavier than 64 tonnes
TEU	Twenty Foot Equivalent Unit	Standard 20-foot container
FEU	Forty Foot Equivalent Unit	Standard 40-foot container (One standard 40-foot container = 2 TEU)
BK1	Bärighetsklass 1	Roads in Sweden with a maximum vehicle weight of 64 tonnes
BK4	Bärighetsklass 4	Roads in Sweden with a maximum vehicle weight of 74 tonnes
Standard Swedish Truck	The standard vehicle length for trucks in Sweden, 24 m	Unique vehicle length for Sweden and considered an HCT-vehicle within Europe

2.6 Illustration of vehicle components and configurations

Following figure illustrates components and configurations of vehicle configurations and combinations highlighted in text throughout the report. At the top, different components that can possibly fit into a vehicle configuration is illustrated. Further, standard vehicle combinations for EU and Sweden as well as specific vehicle combinations for trucks up to 25,25 m, for certain countries mentioned, are illustrated. Lastly, HCT-combinations with a total length above 25,25 m are illustrated.

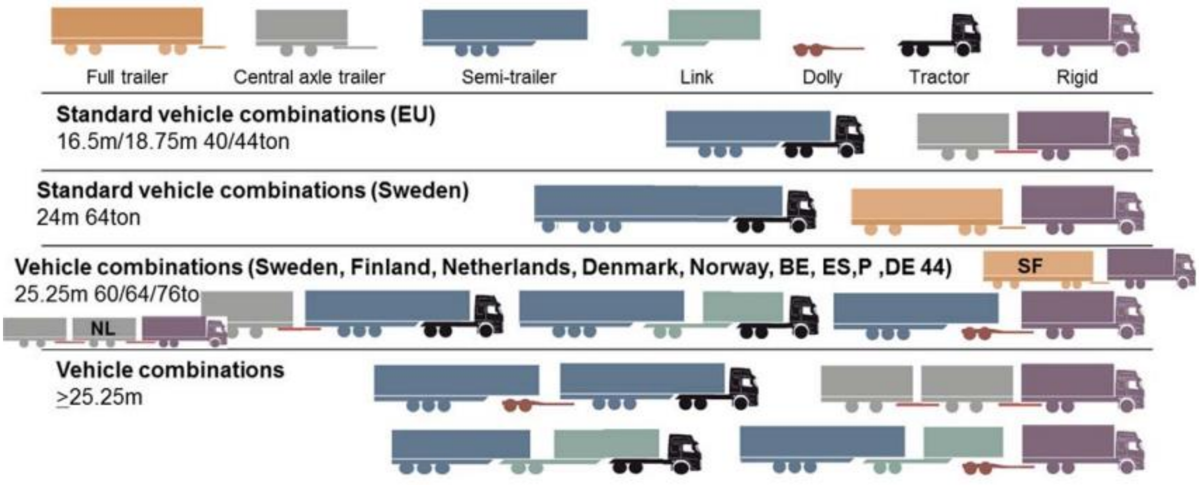

Figure 1 Standard and HCT-vehicle components and configurations

(Fordonsstrategisk Forskning och Innovation, 2017)

3 MAPPING OF INFRASTRUCTURAL PREREQUISITES

This section describes the infrastructural prerequisites that is valid for the cases within the scope of the project. As an introduction, the strategy for upgrading the road network to a higher bearing capacity will be explained, after that rules governing transport weight limitations on Swedish roads will be discussed. Called 'bärighetsklass' in Swedish and abbreviated BK, those are referred to as bearing capacity levels in the section below. Basic technical rules are covered, governing authorities and their respective roles are highlighted and the process to make dispensations to traffic certain road sections is described. Further, this information is discussed for every case, through specific mapping on infrastructural prerequisites on geographical sites and surrounding roads.

3.1 Review and effects of current legislation and regulations

In 2017 the Swedish parliament decided to introduce a new bearing capacity (later in this document referred to as BK4) in the Swedish road network. With this classification, it is possible to drive vehicles with a weight up to 74 tons on selected roads. In 2018 the first road with this higher weight capacity opened. Since 2018 a gradual development of the BK4 road network has taken place and in 2020 approximately 20 percent of the road network opened for BK4 vehicles without any upgrades or investments on existing infrastructure.

Between 2018-2029, a gradual upgrade of the road network (for heavy freight transports) will be carried out with the aim to have 70-80 percent of the most important roads upgraded to BK4 classification at the end of 2029. An upgrade would lead to more efficient freight transports, enable possibilities to reach the climate goals and strengthen competitiveness for Swedish trade and industry.

When prioritizing what measures that need to be implemented, specific stakeholders are the Swedish trade and industry. Their input is important when it comes decisions about where and when to upgrade the road network. (Eriksson, Natanelsson, 2020)

Below, a more detailed report on how the upgrading work is conducted in the Stockholm and the Örebro regions is highlighted, starting with Örebro.

3.1.1 Örebro Region

In this region, the aim of the upgrades has been to upgrade roads with strategical interest for heavy freight transports as well as connecting the upgraded roads with each other, which will, in 2022, lead to a connected BK4 road system. During the period between 2020-2022, 70 percent of the strategic road system for heavy freight vehicles will be upgraded to BK4 in the region, resulting in a total of 1800 km of BK4 classified roads. After that period, the upgrade pace will slow down and between 2022 and 2027, approximately 500 km of upgraded roads will open. The largest limitation when upgrading the road system is the low capacity of the bridges in the region. There are several bridges, for example on road E18 and E20, that limit the possibility of upgrading the road without further renovations and reinforcement work. To reach a higher efficiency in the upgraded roads, these bridges should be remedied to bear a higher load.

3.1.2 Stockholm Region

In Stockholm, the goal is to upgrade strategical road systems and thereby level up the capacity on these roads so they can include BK4-veichles. The biggest issue in the region is the many old and, for its purpose, undersized bridges. Most of the strategic important bridges needs to be upgraded/rebuilt. In addition, these bridges are, in many cases, parts of the region's through traffic. While doing the reinforcement work the bridges will suffer under a great traffic impact which would lead to socio-economics costs for the region. With that in mind, the plan is to upgrade roads connected to logistic hubs in the region and connect these roads with neighbouring BK4 roads in other regions. This will include parts of E4, E18 and E22. However, road 73 will not be upgraded, due to the 2020-2029 plan. Due to other big infrastructure projects in the region, upgrading the overall road network to BK4 will probably not be made before 2029. (Eriksson, Natanelsson, 2020)

3.2 Bearing capacity

There are four bearing capacity levels, starting from BK1, BK2, BK3 and lastly BK4. All public roads are categorized into either one of these levels. The levels determine vehicle weight limitations to a certain section of the road. Bearing capacity level 1 (BK1) and level 4 (BK4) is valid on approximately 94 % of Swedish public roads. All other roads hold bearing capacity level 2 (BK2) or level 3 (BK3) or specific local weight limitations (Transportstyrelsen, 2018). Table 2 Bearing capacity levels in Sweden 1: (Trafikverket, 2020) illustrates the bearing capacity levels in Sweden.

Level	**Maximum weight allowed**
BK1	64 tonnes
BK2	51,4 tonnes
BK3	37,5 tonnes
BK4	74 tonnes

Table 2 Bearing capacity levels in Sweden 1: (Trafikverket, 2020)

Throughout the text, bearing capacity is referred to the respective class, e.g. BK1 for bearing capacity level 1. Additionally, governing bodies are referred to as the Swedish transport administration (Transportstyrelsen) and Swedish road administration (Trafikverket) in following sections. Exceptions exist for each of the levels listed in the table above. Depending on the distance between axels as well as weight pressure on each axel, maximum weight might be lower that stated in this table. The basic rules are highlighted further down in this section.

BK4, or bearing capacity level 4, has been defined by the Swedish road administration as a road section on which traffic is allowed with a vehicle at a maximum weight of 74 tons, which the table above illustrates If the vehicle corresponds to the regulations set up by the Swedish transport administration, any HCT-vehicle up to 74 tons can traffic BK4-roads in Sweden. There are an array of regulations defining which type of vehicle that can traffic a BK4-road, which are defined as basic rules. The rules are defined, regulated and updated by the Swedish transport administration. Technically, the rules are set to define an allowed HCT-configuration vehicle for a BK 4 road by evaluating technical specifications such as number of axles, weight distribution for each axle and distance between axles at a given vehicle configuration. If a vehicle configuration meets the basic rules, and the specific road section of the transport are categorized as BK4-road, one can execute transports at a maximum weight of 74 tons.

However, even though most of the roads for each case are capable for a 74-ton vehicle, there exist several limitations as to where a 74-ton vehicle configuration can drive. Thus, different dispensations need to be issued for specific road sections to be able to perform the transport completely.

Dispensation

As a basic rule, a transport must have a valid dispensation on a specific road distance if the vehicle configuration exceeds either;

- If the vehicle exceeds a length of 25,25 meters
- If the vehicle exceeds weight limitations in terms of weight axle pressure, total weight pressure at multiple axels on one section of a vehicle, or total weight of vehicle configuration, defined by the basic rules of the Swedish transport administration as stated above

(Transportstyrelsen, 2020).

Exceptions for driving a 74-ton vehicle configuration on road sections which is not categorized as BK4 is done through the Swedish road administration. For example, a transport distance might have most of the section covered by a BK4 classification, thus enabling the vehicle to execute the transport according to rules. However, the last bit covering the distance from a major road to a warehouse site might be of another BK-level, hence not allowing the transport to cover that distance legally. Thus, dispensation needs to be issued to fulfil the transport in a full legal process. It is the Swedish road administration (Trafikverket) that issues dispensation for transports (Trafikverket, 2021).

The application for each dispensation is done either digitally or through a paper form provided by the Swedish road administration. Information such as company applying for dispensation, the route, information about the vehicle configuration and cargo and other information about the transport need to be issued to the Swedish road administration. The application is then evaluated.

4 CLIMATE GOALS FOR FREIGHT TRANSPORTATION IN EU AND SWEDEN

In this chapter, the overall climate goals for the European Union and Sweden as a nation are highlighted.

The European Union has a goal to implement a 60 % reduction of greenhouse emissions from transports towards year 2050, with base year 1990. This is to be achieved through measures such as optimization of transport networks, fuel improvements and transferring of goods towards more energy efficient transport modes, e.g. truck to rail for distances over 300 km where applicable (European Commission, 2021). Furthermore, Sweden also aim to lower emissions from goods transports through by, among other measures, transfer of goods from one transport mode to another and optimizing current structures. Towards the year of 2030, the aim is to lower greenhouse emissions from domestic transports (except air traffic) with a total of 70 % starting from base-year 2010 (Regeringen, Nationell godstransportstrategi, 2018).

As the environmental analysis of each case of this study will reveal, HCT-transports provide inherent possibilities to be a part of the work towards climate goals of the European Union and Sweden as a nation.

5 HCT-TRANSPORTS IN A MULTIMODAL TRANSPORT SYSTEMS PERSPECTIVE

As a part of this study, the results of the cases presented will elevate the potentials of HCT-transports into the complete transport system, with focused abilities to increase the share of combined transports in the geographical region of the Baltic sea. At first, a problematization and background of the issue is done. Second, the multimodal transport system perspective is related to the cases within this study. Lastly, the perspective will again be highlighted in conclusion and discussion section with coupling to the cases within this study.

As stated above, a part of the focus to reach climate goals for transports within the European union is to for example transfer goods from road to rail or sea for more energy efficient transports, since emissions and energy use from road transport in Europe is significantly higher compared to other modes of transport (European Commission, 2016). As much as 90 % of transport emissions in Sweden stems from transport mode road (Trafikverket, 2020). Different prerequisites are valid for various regions within Europe, resulting in a transport system where different approaches to the problem can contribute to a complete solution and thus support strategy and goals. Naturally, countries around the Baltic, specifically Sweden with its long coastline, benefit environmentally and in terms of transport efficiency of having goods transferred to transport mode sea, possibly furthermore rail, as a part of working towards reaching climate goals.

There are a lot of factors contributing to a high share of road transport use in Europe and Sweden. Basically, freight transport on road is very cheap. Identified barriers to transfer freight volumes from road to rail and sea are mainly cost and frequency. In Sweden, for example, road transports enable shorter lead times if compared to sea transport. Thus, the challenge for transport mode sea, as well as for rail, is to be able to compete with the flexibility and low price of truck transports. Further, barriers to switch to for example transport mode sea includes high costs in ports. It should also be mentioned that there exists an overcapacity in terms of shipping tonnage and port infrastructure simultaneously as roads and rail networks are congested (Carola Alzén, Mälarhamnar AB, 2020).

Thus, HCT-transports on roads should be viewed as an extension to first and foremost optimize road transports and further the complete multimodal transport system where geographical, business related and technical prerequisites allow HCT-arrangements to add value within the transport chain. HCT-arrangements on road should not be viewed as a competitor primarily towards transport mode rail, but rather a complementary arrangement to increase efficiency, specifically for the last mile distance in a complete multimodal transport arrangement. The risk with HCT-arrangements on road being a competitor should instead be viewed as an enabler for more effective complete transport chains.

The perspective of this study regarding HCT-arrangements on road in multimodal transport chains is not to specify a HCT-configuration, but rather to illustrate that various HCT-arrangements can enforce commercial interests and improve transport arrangements for the cases studied. Within this project, two cases will have a direct multimodal connection, specifically as the last mile transport leg of multimodal transport chains;

1. Case Elon for region Örebro: direct multimodal connection with transport mode rail and sea. Containers are imported to Gothenburg's harbor and transported by rail to the Hallsberg's

terminal where units are loaded onto a truck. Thus, the last mile leg of this transport consists of transport mode road is within the context of this study analysed in a HCT-configuration

2. Case Norvik for region Stockholm: direct multimodal connection with transport mode sea. Containers that arrive in Norvik port south of Stockholm are loaded onto trucks for further transport to greater Stockholm area for last mile transport coverage, for which HCT-analysis is done.

Beyond the cases with direct intermodal connection, there are indirect intermodal connections valid for an array of cases studied. Some have a strong indirect intermodal connection, some have close to zero intermodal connection as each case description will illustrate. Many of the cases analyses transports originating from central warehouse locations. Hence, these transport legs can be viewed as the last mile distances completing the transport chain, where goods have arrived at central warehouse locations by and intermodal transport arrangement consisting of both rail, sea and road. Thus, an intermodal connection of some sort is valid for almost every case studied.

6 SCENARIO ANALYSIS

In this chapter, every case is described and analysed with methods described below.

6.1 Transport operators and freight flows in the Örebro region

In total, six cases for the Örebro region have been studied. The cases are covering various distances, HCT-configurations, arrangements, infrastructure and geography. The flows include both A to B movement of goods, as well as transport loops, a so-called milk round – where goods are originating from a warehouse, transported by truck to several locations and back again to the same warehouse site. Below, each case for the region of Örebro is described in detail.

6.2 Transport operators and freight flows in the Stockholm region

In total, two cases were studied in the Stockholm region. The cases are Norvik port (part of Stockholm harbours) as well as the company Arla.

The case for Norvik port is a fictive case, due to the complexity of port operations with many different actors and stakeholders as well as no specific company included. However, data on yearly container volumes act as the basis for the case. These volumes have been provided by Stockholms Hamnar, the governing organization of Stockholms port infrastructure and services (Stockholms Hamnar, 2020).

Arla, however, is based on data retrieved through a dialog with employed people within the company, as well as operating haulage company, EA Skara.

6.3 Method description - case analysis

Each case is described in detail, with an executive summary and relevant information for the context of every case. Background information and prerequisites are described for each case. Further, the distance of the transport leg categorizes each case into short, intermediate or long distances. The distance categories are used to easily provide an overview of how HCT configurations affect transport legs of different distances, however with local infrastructural prerequisites. The distance categories are listed in Table 3 - Distance categories.

Table 3 - Distance categories

Category	Distance (in kilometres)
Short	0-100
Intermediate	100-400
Long:	>400

Throughout the report, the term truck is referred to the complete configuration of tractor and trailer and hence truckload equals its complete load capacity. Central for analysis in this study is the cargo weight or number of round trips, albeit truck configuration is important for complete HCT-analysis. In some cases, truck configuration is known and thus stated. Otherwise, weight is mentioned an analysed for. Final truck configuration is important for a second analysis outside the scope of this study.

For every case, infrastructural, environmental and economic analysis is done for switching the current transport set up and vehicle configuration into a HCT-configuration. The combined outcome of the analysis yields the possible savings to be obtain in number of round trips, emission and cost savings for respective case.

6.4 Method description - infrastructural impact of alternative transport arrangements

For each case the infrastructural conditions with bearing capacity will be illustrated in a map format with detailed descriptions of the route and road numbers.

Information regarding bearing capacity levels in Sweden with details for each case has been consulted together with Sebastian Hasselblom, traffic analysis expert at WSP. Through information obtained by each stakeholder within the project, as well as Google maps, the infrastructural conditions for HCT-transports have been evaluated around sites and routes for each case mainly through NVDB, the Swedish National Road Database (Nvdb, 2020). The database highlights bearing capacity levels in detail for the complete road network of Sweden.

When decision is made by the company and stakeholders to conduct HCT-transport, close evaluation of the route specifications and regulation need to be made. However, the aim with the infrastructural analysis is to add to the overall analysis of the inherent potential to conduct HCT-transports for the stakeholders on the specific routes.

All road sections classified as BK1 need to have dispensation to achieve a BK4 classified road level status respectively, to have ability to conduct HCT-transport with a maximum weight exceeding 64 tons or maximum length exceeding 25,25 meters. There are no limitations identified for any case in terms of tight corners, bridges or other obstacles which hinders an HCT-vehicle configuration to be used.

6.5 Method description - CO_2 emission calculations

As a start, input data mainly on fuel consumption has been obtained by key personnel at case companies. Hence, it is derived either from interviews or mail conversations with key people involved as stakeholders within this project, i.e. case companies, as well as key persons within haulage companies. Data also includes cargo volumes, current transport arrangement and desired arrangement for a HCT-configuration. Additionally, fuel consumption for HCT-vehicles have been estimated with direct input from haulage companies who have been engaged in pilot tests with HCT-configurations. Also, numbers have been verified with NTM (Nätverket för transporter och miljön – Network for transports and the environment) for fuel consumption for different types of vehicles configurations (NTM, 2021).

Depending on case, results on environmental analysis for desired HCT-configuration has been determined either by number of tonnes on each round trip, or number of possible round trips to be eliminated. Thus, the calculation has an inherent if/or logic that decides which input data the calculation should use. For example, a yearly volume for a specific case is divided by the number of tonnes in terms of cargo that an HCT-configuration can load (e.g. the case of S:T Eriks). Respectively, for the other input and as in the case of Norvik port, number of round trips are decreased as a starting point for the environmental calculations. The calculations can be found as attachments in this report. However, input data for the calculation is illustrated in the section below.

To estimate the potential savings for HCT-transports in terms of savings in emissions and fuel, two main factors are used as input to establish the approximate size of emissions; vehicle fuel consumption and emission factor related to the current fuel used. To approximate emissions even better, a simulation of the specific vehicle on the specific road section would be preferable. However, vehicle fuel consumption and emission factor of fuel used is the basis for this calculation.

Further, to calculate emissions, an established method created by the organisation NTM (Nätverket för transporter och miljön – Network for transports and the environment) has established emission factors for diesel fuel, which is used in the calculations, show in the table below.

[g/l]	CO_2 Svensk diesel	NOx	PM	HC	CH4	CO	SOx
Euro 5	2750	8,61	0,074	0,0445	0,00089	0,336	0,0083
Euro 6	2750	1,98	0,025	0,0126	0,00040	0,336	0,0083

Table 4 Emission factors for heavy Euro 5 & 6 diesel trucks for road traffic (Source: NTM, 2021)

Respectively for HVO, the Swedish Energy agency has established emission factors used in the calculation, illustrated in the following table.

Bränslekategori	Utsläpps-minskning (%)	Utsläpp (gCO_2ekv/l)
Biodiesel	43	1582
HVO	81	547

Table 5 CO_2 emissions for HVO (Source: Energimyndigheten, 2021)

Lastly, emission factors have also been established to be used specifically for the Norvik case, since the theoretical HCT-configuration for this case is driven by electricity. Thus, emissions facto, stated in [g/kWh], stemming from the mix of energy sources supplying the Swedish electricity grid is used specifically for the Norvik case. The emission factor for C02 for the standard Nordic electric mix will be used for calculations, which is estimated to be 125 g CO2 / kWh (IVL, Svenska Miljöinstitutet, 2012).

Distance in km, estimated fuel consumption in litre/km and information on volumes in tonnes, as well as number of roundtrips on each route is the input data to the analysis. With those inputs, together with number of tonnes or roundtrips for the respective case and transport mode (current configuration and HCT-configuration) as well as days or weeks per year, fuel consumption, emissions and number of roundtrips are calculated.

For every case, results are summarized as savings in percentage for the respective fuel type used, as well as estimated emissions on the route. Possible decrease in number of roundtrips is highlighted. The full version of each calculation is completed as an attachment for respective case. The possible savings is the theoretical number to be obtained if the current transport arrangement for the respective case is converted into a HCT-configuration.

6.6 Method description – Economical analysis

By using the online tool *SÅ-Webbkalkyl*, which is an online based calculation tool specifically made for Swedish haulage companies to calculate costs for their businesses, costs for each case have been generated and estimated. All fixed costs are generated in this tool where one provides the following input; general cost picture, known vehicle costs, estimated personnel costs and the specific assignment to be applied to the calculation (Sacalc, 2021).

Second, results from the online web-tool *SÅ-Webbkalkyl* is applied in an Excel-model, where general characteristics which is specific for each case, is applied. Calculations are then done for normal and HCT-configuration.

7 CASE #1 SVENSK GLASÅTERVINNING (SWEDISH GLASS RECYCLING)

7.1 Background and prerequisites

Information below have been obtained from dialogue with Peter Trimmel, business area manager at Svensk Glasåtervinning. Complementary information has been derived from by Tomas Pettersson, CEO at ALI frakt AB.

Svensk Glasåtervinning specializes in collecting, organizing, transporting and recycling used glass throughout Sweden with around 6 000 points of collection of used glass material. The company receives in total approximately 700 tons of glass every workday. The material is sorted, refined and made into new glass raw material.

The case is based on the outbound flow from their site in Hammar to Ardaghs production facility located in Limmared, further south in Sweden, southeast of the city of Borås. At the facility of Ardagh, recycled glass material is reworked into new usable glass units.

On the studied route, approximately 83 000 ton of recycled glass is transported between Hammar and Limmared yearly. At the company's site in Hammar, located in the south part of Region Örebro near lake Vättern, consolidated glass material arrives with 7-9 trucks daily. This constitutes the approximate volume of 355 tons that arrive on a normal workday for the specific route (Svensk glasåtervinning, 2020). The volume is transported on a (Swedish) standard vehicle combination most of the time and occasionally transported with slightly higher load capacity of 45 tons (Peter Trimmel, Svensk Glasåtervinning, 2020). However, an average load weight of 42 tons is used for this case. A summary of the company's transport information is shown in Table 6 Overview of Svensk Glasåtervinning.

Distance (category and kilometres)	Intermediate: 200 – 400 km
Route (origin to destination)	Hammar to Limmared
Road(s)	50, E4
Current transport volume (per unit of time)	7 - 9 trucks daily, with an average cargo load of 42 tonnes per truck load
Suggested HCT-configuration	Longer and heavier vehicle with 50 tonnes of cargo per truck load

Table 6 Overview of Svensk Glasåtervinning

7.1.1 Infrastructural conditions

As shown in Figure 2 Route map Svensk glasåtervinning, the route originates from the site in Hammar, moves along road 50 and E4, through cities of Jönköping and Borås to its destination Limmared. No tight corners, nor any bridges are identified as limitations to a HCT-transport on the route. Dispensation need to be evaluated along the route and be applied for. Additionally, local roads within municipalities need to be checked for to certify that the total distance of the transport leg can be utilized in a HCT-configuration.

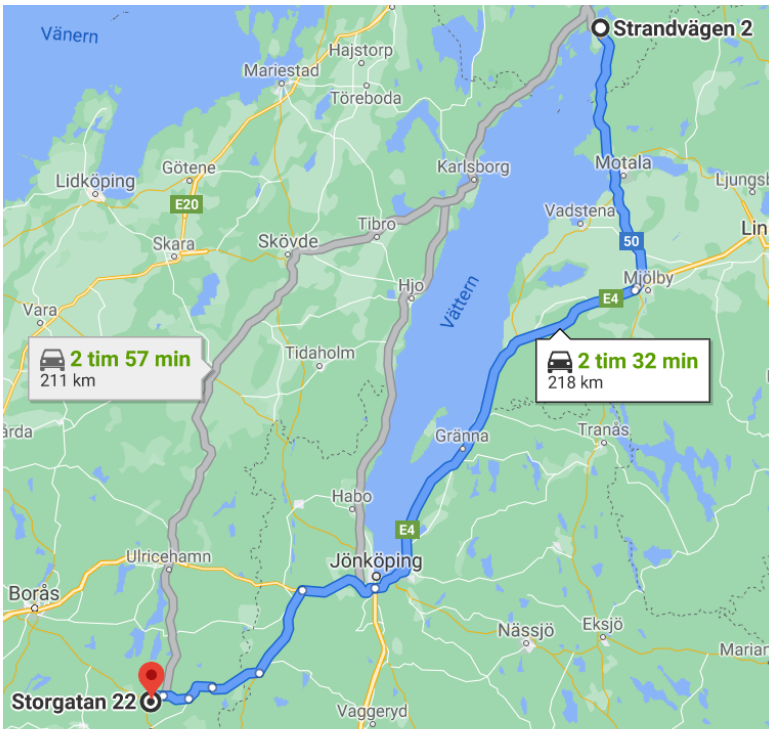

Figure 2 Route map Svensk glasåtervinning (Google Maps)

In Table 7 Overview of infrastructure Svensk glasåtervinning, an overview of the route is shown.

Route		**Road(s)**	**Bearing capacity**		**Limitations**	**Other**

Hammar-Limmared		50, E4	BK4, BK1		None	Dispensation need to be applied for

Table 7 Overview of infrastructure Svensk glasåtervinning

7.2 HCT-potential and configuration for Svensk Glasåtervinning

For Svensk Glasåtervinning, there is a possibility to improve transports by transferring the current volumes into a HCT-configuration. Today, the average volume is approximately 42 tons per truckload. Ambition is to increase load capacity to 50 tons for one truckload, resulting in fewer round trips among improvements in environmental performance and costs.

7.2.1 Environmental calculations Svensk Glasåtervinning

Input for the analysis is the number of tonnes transported on the route yearly. On the route, 83 000 tonnes and 38 tonnes per truck yield an estimated 2184 roundtrips yearly. Respectively for a HCT-configuration, 50 tonnes are transported resulting in 1660 roundtrips. Thus, following savings can be obtained (The calculation is based on 240 workdays a year):

	Diesel consumption (m^3)	**CO_2 emissions diesel (kg)**	**HVO consumption (m^3)**	**CO_2 emissions HVO (Kg)**	**Number of roundtrips**	**Overall environmental improvement (%)**
Normal configuration	569	1 565 715	569	311 435	2 184	**12,3**
HCT configuration	499	1 372 543	499	273 011	1 660	
Saving	**70**	**193 172**	**70**	**38 424**	**524**	

Table 8 Emission calculations Svensk glasåtervinning

7.2.2 Transport economic analysis Svensk glasåtervinning

Economic calculations for case Svensk glasåtervinning yields possible saving of 13 %, when reducing number of transports daily from two to one. The total possible saving to be made is estimated to be approximately 2,2 million SEK on a yearly basis. The full calculation can be found as an attachment.

8 CASE #2 ELON GROUP

8.1 Background and prerequisites

Information below have been obtained from dialogue with Markus Luthman within logistics development at Elon. Complementary information has been provided by Johan Gabrielsson, forwarding agent at Geodis Wilson.

Elon is one of Sweden's major companies that specializes in selling a wide range of home appliances, from washing machines and fridges to hair dryers and coffee makers. Elon has around 300 owned stores scattered around Sweden (Elon Group, 2020). The central warehouse for the Swedish market is located outside Örebro, right next to road 51 and approximately 1 kilometre from E20. With a total warehouse space of 55 000 square meters, the site distributes home appliances all around Sweden (Transportnytt, 2015).

The specific transport flow to be investigated in this study is a container import flow between Hallsberg terminal and Elon's central warehouse mentioned above. The transport-leg consists of a short hop from Hallsberg terminal to Elon's central warehouse, located approximately 25 kilometres to the north. The goods are imported through Gothenburg's container harbor Skandiahamnen via an intermodal train arrangement to Hallsberg terminal.

Specifically, for this flow, there are several three 40-foot containers transported along the route daily, making it equivalent to roughly 15 containers weekly. The containers are high cube FCL (Full Capacity Load) containers. For Elon, a truck equals a tractor and a trailer with load capacity of 1 40-foot container. A summary of the company's transport information is shown in Table 9 Overview of Elon group.

Distance (category and kilometres)	Short: 25 km
Route (origin to destination)	Hallsberg to Örebro
Road(s)	50, E20, 51
Current transport volume (per unit of time)	3 trucks per workday, with one 40-foot container per truck load, 15 40-foot containers per week
Suggested HCT-configuration	Longer vehicle, in a configuration with two 40-foot containers per truck load

Table 9 Overview of Elon group

8.1.1 Infrastructure analysis Elon group

As shown in Figure 3 Route map Elon, the approximate distance between Hallberg's terminal and Elon's central warehouse, covering about 25 km, is mainly done on major roads (road 50, E20 and road 51). No bridges nor tight corners limiting potential HCT-transports are identified. Dispensation needs to be issued to cover the distance legally with a HCT-configuration.

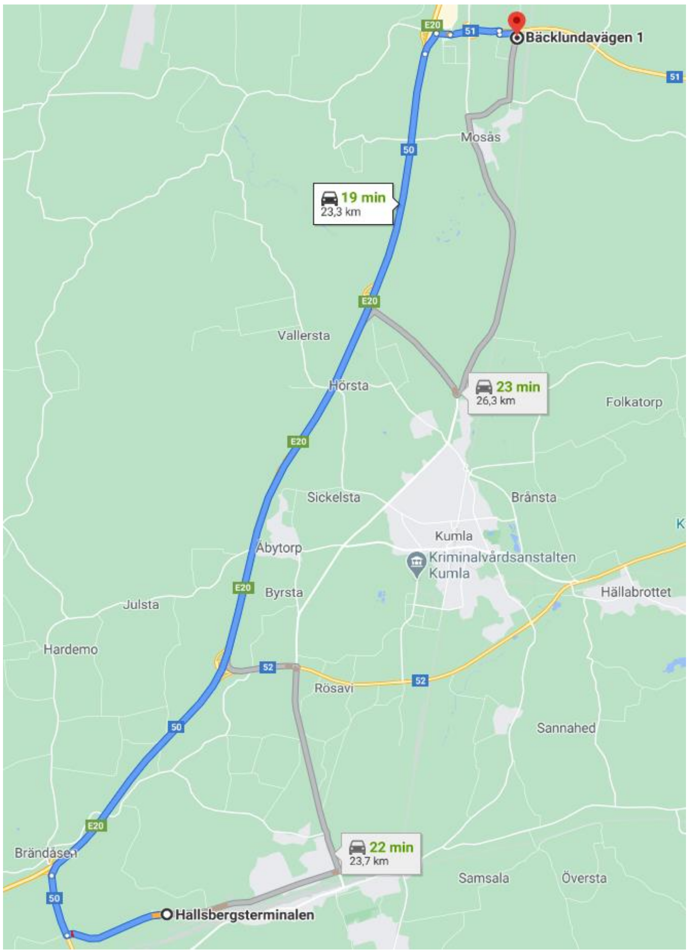

Figure 3 Route map Elon (Google maps)

Route	Road(s)	Bearing capacity	Limitations	Other
Hallsbergs terminal to Elon central warehouse	50, E20, 51	BK1, BK2, BK4	None	Dispensation need to be applied for

Table 10 Overview of infrastructure Elon

8.2 HCT-potential and configuration for Elon

The aim is to transfer the daily volume of three 40-foot containers, loaded onto three trucks daily, to a HCT configuration. After dialog with Elon, a preferable set up would be to use a HCT-configuration with ability to transport two 40-foot containers in one truckload. Thus, this would result in an improvement yielding a decrease in the number of weekly transports from 15 trucks to 8 trucks a week.

8.2.1 Environmental calculations Elon Group

Input for the analysis is number of round trips on the specific route. Normally, three trucks transport one 40-foot container each daily on the route. The desired HCT-configuration would yield a transport arrangement where two containers can be transported at the same time. Calculating with these numbers on a yearly basis results in following savings (The calculation is based on 240 workdays a year):

	Diesel consumption (m^3)	CO_2 emissions diesel (kg)	HVO consumption (m^3)	CO_2 emissions HVO (Kg)	Number of roundtrips	Overall environmental improvement (%)
Normal configuration	14	39 435	14	7 844	720	**14,9**
HCT configuration	12	33 550	12	6 673	480	
Saving	**2**	**5 885**	**2**	**1 171**	**240**	

Table 11 Emission calculations Elon

8.2.2 Transport economic analysis Elon

Economic calculations for case Elon yields possible saving of 13 %, when reducing number of transports daily from three to two. The total possible saving to be made is estimated to be roughly 100 000 SEK on a yearly basis. The full calculation can be found as an attachment.

9 CASE #3 LIDL GROUP

9.1 Background and prerequisites

Information below have been obtained from dialogue with Carl Ceder, logistic manager at Lidl.

The German grocery store Lidl has a wide network of grocery stores throughout Sweden, in total of 195 stores (Lidl, 2020). Inbound transport flows for all Lidl's stores are intermodal and arrives to either one of Lidl's central warehouses in Sweden, three to the number. From those sites, goods are distributed to the whole grocery store network in Sweden, resulting in long transport legs with distances over 1000 km for a specific route, e.g. the greater area of Stockholm to Skellefteå in the north of Sweden.

However, for the case of Lidl, a specific outbound flow from the central warehouse located in Örebro is studied. Lidl's central warehouse in the Örebro region is located south west of the city of Örebro along the road E18, close to where the highway connects to E20. The trucks used is a standard Swedish truck of 24 meter.

The transport flow consists of a milk round connecting three Lidl stores in Småland, Sweden. The transport initially leaves the central warehouse going south to the city of Vetlanda, about 230 km. Further, the transport heads east to the city of Oskarshamn, covering about 97 km for the second leg. Turning north, the last stop on the route is Västervik adding another 68 km for the third leg. The truck then returns to the central warehouse in Örebro, covering a final distance of approximate 227 km. The total distance for the transport is around 621 km.

Each store has an estimated daily demand of 20 Euro pallets per store per day, an estimated 20 000 Euro pallets yearly. The average volume on the route is 60,3 Euro pallets per day, based on Q3 numbers 2020. A summary of the company's transport information is shown in Table 12 Overview of Lidl group

Distance (category and kilometers)	Long: 620 km
Route (origin to destination)	Örebro, via Småland, to Örebro
Road(s)	50, 32, 47, E22, 35, 34, 51
Current transport volume (per unit of time)	1 fully loaded truck 6-7 times a week, with additional 1-2 trucks per week to cover demand with an average of 60,3 Euro pallets per truckload
Suggested HCT-configuration	Longer and heavier vehicle with a double-trailer configuration, enabling a cargo load of 66 Euro pallets per truckload

Table 12 Overview of Lidl group

9.1.1 Infrastructure analysis Lidl group

The transport arrangement for case Lidl implies that the transport moves in city environment, several times during the transport route, as shown in Figure 4 Route map Lidl Group. At first, the area from where the transport originates in Örebro is mainly an industrial area, located close to where major roads E18 and E20 connects. No limitations in terms of tight corners, bridges or connections to major roads E18 and E20 are identified. Dispensation need to be to be issued to cover the complete distance.

The transport does its first stop in Vetlanda in Småland. No limitations are identified along the distance from Örebro to Vetlanda. Dispensation to BK4 classification need to be issued on certain distances along the route, as well as within the city of Vetlanda. Thus, the distance needs to be evaluated with a complete analysis of where dispensation is needed. However, no limitations are identified within the city.

The same goes for the remaining distance of the road from Vetlanda to Oskarshamn, within the city of Oskarshamn, from Oskarshamn to Västervik as well as within the city of Västervik. There are no limitations in terms of corners, bridges or tunnels along the route. However, the route needs to be closely examined to evaluate dispensation sections.

Figure 4 Route map Lidl Group (Google maps)

In Table 13 Overview of infrastructure Lidl , an overview of the route is shown.

Route	Road(s)	Bearing capacity	Limitations	Other
Örebro to Örebro, via three Lidl stores in Småland	E18, E20, 50, 32, 31, 47, E22, 35, 34, 51	BK1, BK2, BK4	None	Dispensation need to be applied for

Table 13 Overview of infrastructure Lidl Group

9.2 HCT-potential and configuration for Lidl Group

Today, the demand for the three stores located along the route described above need 1 daily truckload 6-7 days a week. Additionally, 1-2 times a week an extra transport covers the excess demand not covered.

The preferable HCT-configuration for Lidl would be a HTC configuration with ability to load 66 pallets in total on two separate trailers, each containing 33 pallets (double trailer configuration). The reason for this sectioning is to have the ability to decouple one trailer to enter an unloading site more easily. Hence, one trailer can be left on a side location while loading/unloading and be picked up when moving on to the next destination. Additionally, the configuration need to include temperature controlled transport abilities and preferably biogas or HVO as fuel alternatives.

Also, if a HCT-configuration with 66 pallets is used, Lidl has calculated that at least 30 804 km can be saved yearly on the specific route, the direct effect. However, it is estimated that indirect effects will show further down in the supply chain, yielding an even greater total save according to Lidl.

9.2.1 Environmental calculations Lidl Group

In the case for Lidl Group, input data is the volume in term of tonnes transported on the route over one year. The total volume is estimated to be 8000 tonnes of cargo. An approximate weight of 20,4 tonnes of cargo is on average transported on the route today. In a HCT-configuration, approximately the volume would be equal to 26,4 tonnes, based on that each roundtrip has a possibility to carry 6 pallets more of cargo in HCT-mode. Originating from this input data, the possible savings are (The calculation is based on a full year, 52 weeks):

	Diesel consumption (m^3)	**CO_2 emissions diesel (kg)**	**HVO consumption (m^3)**	**CO_2 emissions HVO (Kg)**	**Number of roundtrips**	**Overall environmental improvement (%)**
Normal configuration	95	262 066	95	52 127	392	**5**
HCT configuration	91	248 889	91	49 506	303	
Saving	**5**	**13 177**	**5**	**2 621**	**89**	

Table 14 Emission calculations Lidl Group

9.2.2 Transport economic analysis Lidl

Economic calculations for case Lidl yields possible saving of 14 %, with one transport daily in both cases. The total possible saving to be made is estimated to be roughly 500 000 SEK on a yearly basis. The full calculation can be found as an attachment.

10 CASE #4 S:T ERIKS

10.1 Background and prerequisites

Information below have been obtained from dialogue with Petter Bäckström, strategic purchaser at S:T Eriks.

S:T Eriks is a company specialized in production deliveries of various stone and concrete material such as plates, decoration stones, wall elements and boulders. The company has been active in the business for around a century and has currently a lot of production and warehouse facilities around Sweden. Two of these is in the city of Vara, northeast of Gothenburg, and the city of Uppsala, north of Stockholm (S:T Eriks, 2020).

The case to be studied is an internal stock transfer between different production and warehouse sites. As mentioned above, the yearly stock transfer between Vara and Uppsala will be studied. This flow is relevant as being a transport flow to be transferred to an HCT-configuration in order make the flow more efficient. The company's site in Vara is located south of the city a couple of kilometres from E20. The site in Uppsala is located northwest of the city, just north of road 55.

The yearly volume of the flow is approximately 4000 tonnes, distributed over the whole year with peaks in the summer months. As example year, 2017 consisted of two peaks periods of transports for stock transfer, in May and June. Distributed over 52 yearly weeks yields a volume of 77 tonnes, as an average weekly volume. However, the volumes are not distrusted evenly. In a typical peak week in the year of 2017 had a volume of approximately 320 tonnes. A typical week outside summers peak period typically yields a volume of between 50 – 150 tonnes.

The goods consist of concrete products and is thus rather sensitive – this means that the goods are not stackable. Also, the trailers transporting the products reach their weight maximum before reaching volume maximum, due to the nature of the cargo. A summary of the company's transport information is shown in Table 15 Overview of S:T Eriks.

Distance (category and kilometres)	Intermediate: 360 km
Route (origin to destination)	Vara to Uppsala
Road(s)	E20, E18, 55
Current transport volume (per unit of time)	1 – 2 trucks weekly with an average cargo weight of 64 tonnes
Suggested HCT-configuration	Heavier vehicle, with a maximum cargo weight of 74 tonnes

Table 15 Overview of S:T Eriks

10.1.1 Infrastructure analysis S:T Eriks

The route for this case is illustrated Figure 5 Route map S:T Eriks. Dispensation need to be applied for on the road section from S:T Eriks site southeast of Vara to reach main road E20. No limitations exist on the road to Uppsala, dispensation does however need to be issued to traffic the distance legally, since sections of E20 are within BK1 classification. Also on local roads within Uppsala, dispensation is demanded in order to traffic roads within Uppsala to S:T Eriks site. Further, no limitations exist on the complete route for transporting goods with HCT.

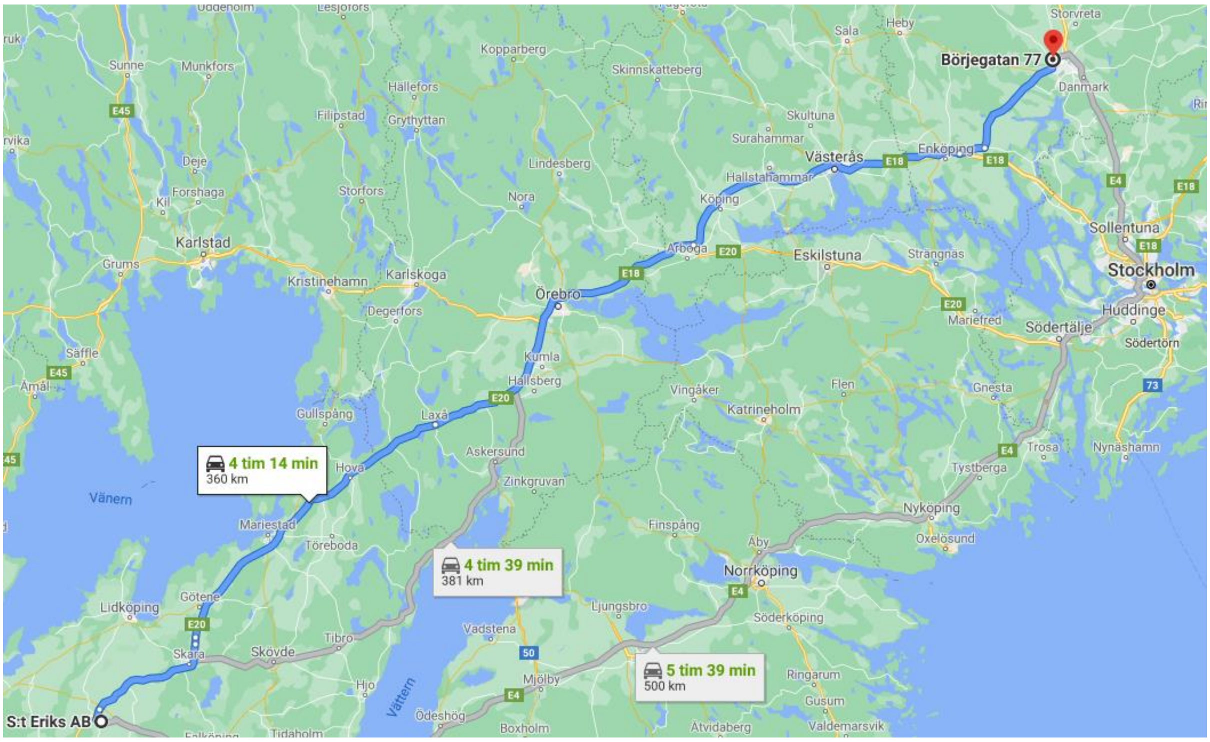

Figure 5 Route map S:T Eriks (Google maps)

In Table 16 Overview of infrastructure S:T Eriks, an overview of the route is shown.

Route	Road(s)	Bearing capacity	Limitations	Other
Vara to Uppsala	E20, E18, 55	BK1, BK2	None	Dispensation need to be applied for

Table 16 Overview of infrastructure S:T Eriks

10.2 HCT-potential and configuration for S:T Eriks

The main potential gained by moving the volume over to an HCT-configuration is to be able to transport greater volumes on each stock transfer. As of today, a typical truck and trailer configuration has a weight of 64 tonnes, consisting of 35 full EU-pallets, equally to a standard Swedish truck of 24 meters. If HCT was to be implemented, the maximum weight could be raised to 74 tonnes, thus with ability to include more EU-pallets. It is estimated that both environmental and economic savings will be made in a HCT-configuration.

10.2.1 Environmental calculations S:T Eriks

For S:T Eriks, input data consists of the number of tonnes transported on a yearly basis. 4000 tonnes are transported every year, normally on a truck with a load capacity of 38 tonnes. Re-configuring this arrangement to a HCT-configuration, an estimated 50 tonnes of cargo would be transported on each roundtrip. Thus, the calculations yield the possible savings (The calculation is based on 240 workdays a year):

	Diesel consumption (m^3)	**CO_2 emissions diesel (kg)**	**HVO consumption (m^3)**	**CO_2 emissions HVO (Kg)**	**Number of roundtrips**	**Overall environmental improvement (%)**
Normal configuration	31	84 604	31	16 828	105	**12,8**
HCT configuration	27	73 803	27	14 680	80	
Saving	**4**	**10 801**	**4**	**2 148**	**25**	

Table 17 Emission calculations S:T Eriks

10.2.2 Transport economic analysis S:T Eriks

Economic calculations for case S:T Eriks yields possible saving of 13 %, with two transports weekly in both ordinary and HCT-setup. The total possible saving to be made is estimated to be roughly 220 000 SEK on a yearly basis. The full calculation can be found as an attachment.

11 CASE #5 ELEKTROSKANDIA

11.1 Background and prerequisites

Information below have been obtained from dialogue with David Hjälmarlycka, transport manager at Elektroskandia.

Elektroskandia is a wholesale company in Sweden with focus on distribution of electrical and technical material and equipment. Customers include one-man firms as well as global international companies.

For this project, one specific transport flow will be investigated involving both Region Örebro as well as Region Stockholm. Four fully loaded trucks deliver goods every workday, originating from the company's central warehouse in Örebro, Lindvallsgatan 1, to serve the greater Stockholm area with electrical and technical products. The central warehouse is located right next the road of E18, northeast of Örebro. The goods arrive at BDX terminal (terminal of the haulage company) in Hägersten, south of Stockholm. A summary of the company's transport information is shown in Table 18 Overview of Elektroskandia.

Distance (category and kilometers)	Intermediate: 185 km
Route (origin to destination)	Örebro to Stockholm
Road(s)	E18, E20
Current transport volume (per unit of time)	4 trucks daily, 80 loading meters equal to an average of 36,5 tonnes of cargo weight
Suggested HCT-configuration	Longer and heavier vehicle, with an average cargo weight of 50 tonnes preferred

Table 18 Overview of Elektroskandia

11.1.1 Infrastructure analysis Elektroskandia

The site of Elektroskandia in Örebro is located right next to major road E20/E18, shown in Figure 6 Route map Elektroskandia. However, there is a short distance covered by roads maintained by the municipally. The roads are classified as BK1, thus there is a need for dispensation to traffic this distance. Further, BK1 classification is valid on the route between Örebro and Stockholm. Hence, dispensation is needed for this route as well.

In Stockholm, a short distance from E20/E18 is covered by BK1 roads maintained by the municipality. Dispensation need to be issued for this distance. No limitations for an HCT-vehicle configuration exist on the route.

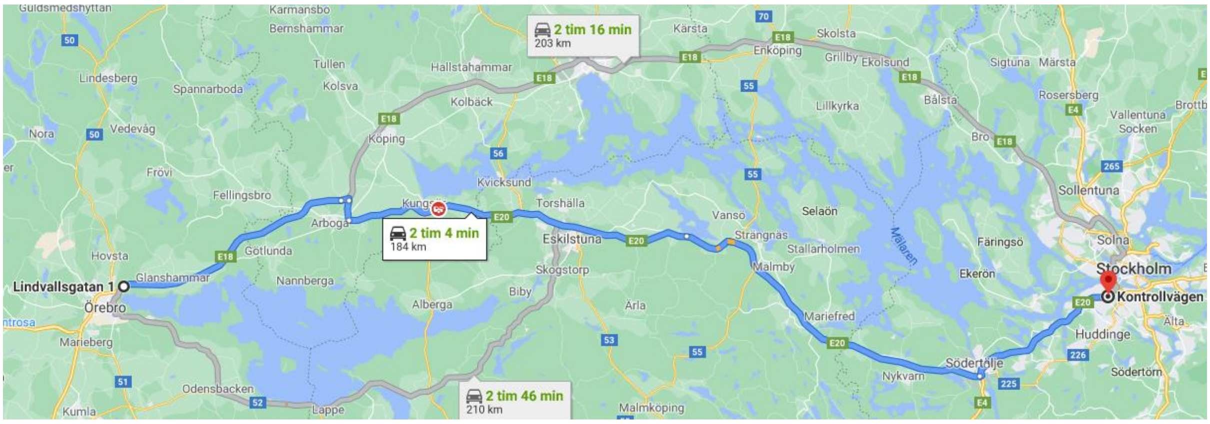

Figure 6 Route map Elektroskandia (Google maps)

In Table 19 Overview of infrastructure Elektroskandia, an overview of the route is shown.

Route	Road(s)	Bearing capacity	Limitations	Other
Örebro to Stockholm	E20/E18	BK1, BK2	None	Dispensation need to be applied for

Table 19 Overview of infrastructure Elektroskandia

11.2 HCT-potential and configuration for Elektroskandia

Elektroskandia has noted that there exists potential for all types of HCT-configurations for the current transport flow based on the current volume of 4 daily trucks on the route. 80 load-meters are transported on 4 trucks daily on the route as of today. Converted, the volume equals 36,5 tonnes per truck and a total of 146 tonnes per day. In turn, this yields a volume of approximately 35 000 tonnes per year. For the HCT case, a configuration with capacity to bring 50 tonnes would be preferred.

11.2.1 Environmental calculations Elektroskandia

For Elektroskandia, number of round trips act as input data for the analysis. On the route, it is estimated that the number of roundtrips (as of today equalling 4 based on a daily cargo volume of 80 loading meters) can be decreased to 3 when switching to a HCT-configuration. Thus, this is the input for the environmental calculations. Calculations yield following possible savings (The calculation is based on 240 workdays a year).

	Diesel consumption (m3)	CO2 emissions diesel (kg)	HVO consumption (m3)	CO2 emissions HVO (Kg)	Number of roundtrips	Overall environmental improvement (%)
Normal configuration	141	387 596	141	77 096	960	**13,7**
HCT configuration	122	334 653	122	66 566	720	
Saving	**19**	**52 943**	**19**	**10 531**	**240**	

Table 20 Emission calculations Elektroskandia

11.2.2 Transport economic analysis Elektroskandia

Economic calculations for case Elektroskandia yields a possible saving of 16 %. For this case, it is estimated that the number of roundtrips is in total four for two vehicles. Switching to HCT, it is estimated only one of the vehicles can do two loops, whereas one vehicle does one loop. The total possible saving to be made is estimated to be approximately 850 000 SEK on a yearly basis. The full calculation can be found as an attachment.

12 CASE #6 ICA

12.1 Background and prerequisites

Information below have been obtained from dialogue with Marcus Gustafsson, logistic developer at ICA.

The Swedish grocery company ICA is a major player in grocery retail with focus on food and health, covering approximately 50 % of the Swedish grocery store market. At the end of 2019 there were 1937 wholly owned or retailer owned stores and pharmacies within the group. Each store is locally owned and driven, however still connected to a national network, enabling, among many disciplines, support to effective logistic services to support core business. Thus, the group has a large logistics network with warehouses around Sweden (ICA, 2020).

The specific transport flow to be studied is one of ICA's major flows originating from Västerås to Helsingborg in the South of Sweden. The transport flow is a central warehouse flow, meaning that the flow is an integral part of ICA's logistical infrastructure: the flow is important and the daily volumes are high. The goods cover approximately 550 km on the route. ICA's central warehouse in Västerås is located west of the city, a couple of kilometres south of road E18. Corresponding location of the central warehouse in Helsingborg is just beside E6, around 5 km south of where road E4 intercepts road E6.

A total of 15 vehicles departs daily on the route, where a typical vehicle configuration has a total weight of around 60 – 65 tonnes with an average cargo weight of 37,3 tonnes per truck. For this case, it is a standard Swedish 24-meter truck. The case will only analyse the cargo volume that is transported from A to B in the specific relation, hence from Västerås to Helsingborg. This is done since ICA themselves does not fully control the empty transport back to where the goods originate. Also, there is no information on the potential return cargo along to route back to point of origin. A summary of the company's transport information is show in Table 21 Overview of ICA.

Distance (category and kilometers)	Long: 542 km
Route (origin to destination)	Västerås to Helsingborg
Road(s)	E18, E20, 50 E4
Current transport volume (per unit of time)	15 fully loaded trucks daily, with an average of 37,4 tonnes of cargo weight per truckload
Suggested HCT-configuration	Heavier and longer vehicle; up to 34,5 meters with a maximum cargo weight capacity of 50-55 tonnes

Table 21 Overview of ICA

12.1.1 Infrastructure analysis ICA

The route for the ICA case is illustrated in Figure 7 Route map ICA. Originating from ICA's site in Västerås, BK1 classification of the roads are valid into E18. Thus, dispensation is needed. Further, the suggested route is along roads E18, E20, road 50 and E4. However, there is also an alternative route along road 56 to Norrköping and then E4 to Helsingborg.

Originating from the suggested route, the route is almost completely covered by BK4 classification. However, a short section between two traffic locations east of Örebro implies the need for dispensation in order to traffic the route with HCT. If this permit is easy to gain, this route is the favourable one from Västerås to Örebro.

If not, the alternative route described above is more favourable. This route is mainly BK4 classification, except a short distance were road 56 intercepts E4 in Norrköping, where dispensation need to be issued.

Further, dispensation need to be issued along certain distances along road E4 to Helsingborg, to have HCT-coverage on the complete route. Lastly, no limitations to HCT-configurations exist on the route.

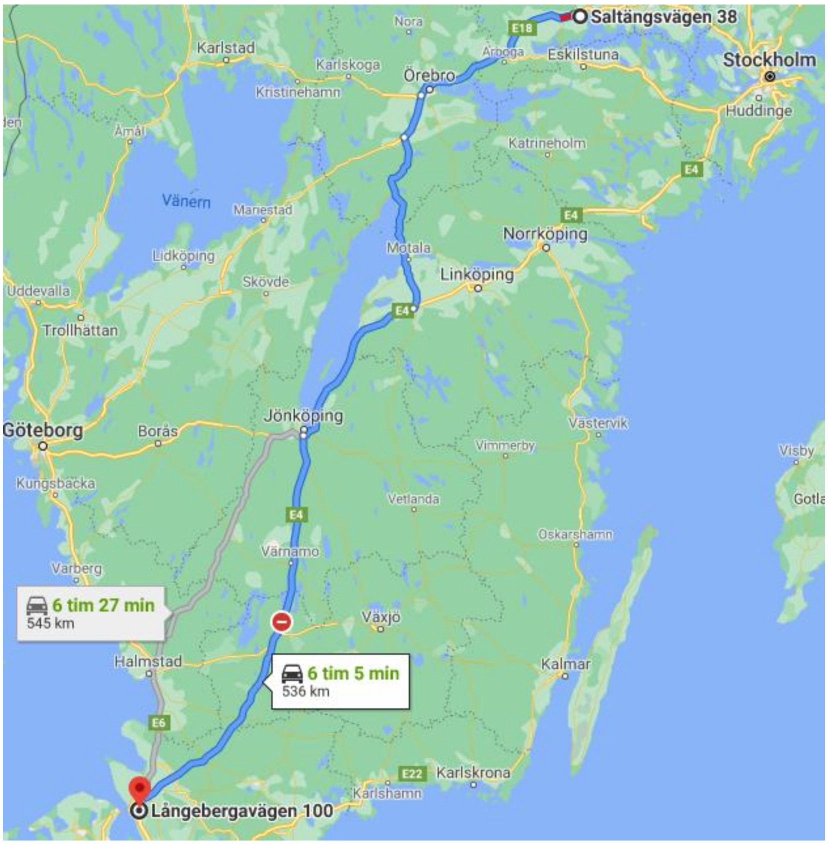

Figure 7 Route map ICA (Google maps)

In Table 22 Overview of infrastructure ICA, an overview of the route is shown.

Route	Road(s)	Bearing capacity	Limitations	Other
Västerås to Helsingborg	E18, E20, 50, E4	BK1, BK2	None	Dispensation need to be applied for

Table 22 Overview of infrastructure ICA

12.2 HCT-potential and configuration for ICA

The nature of the goods does almost in every case reach maximum volume level for each transport. The average weight of the loaded cargo in the current state over a normal week is 37,3 tonnes. The desired state in a HCT-configuration would be to have a total vehicle configuration weight of 70-78 tonnes in total, yielding an approximate cargo weight of 50-55 tonnes. Further, the vehicle will also be longer than normal at a length of 34,5 meters, involving a truck with two trailers.

12.2.1 Environmental calculations ICA

For ICA, number of round trips on the specific route is the input for the calculation. A total number of 15 trucks traffic the route daily. The average cargo weight of a truck on an average week is 37,3 tonnes. The desired HCT-configuration would instead have ability to carry 55 tonnes of cargo for one round trip. Calculating with these numbers, it is estimated that following savings can be obtained (The calculation is based on 240 workdays a year):

	Diesel consumption (m^3)	**CO_2 emissions diesel (kg)**	**HVO consumption (m^3)**	**CO_2 emissions HVO (Kg)**	**Number of roundtrips**	**Overall environmental improvement (%)**
Normal configuration	1 629	4 478 375	1 629	890 790	3 750	**18,4**
HCT configuration	1 330	3 656 308	1 330	727 273	2 500	
Saving	**299**	**822 067**	**299**	**163 517**	**1 250**	

Table 23 Emission calculations ICA

12.2.2 Transport economic analysis ICA

Economic calculations for case ICA yields possible saving of 25 %, with an estimated decrease in number of transports daily from 15 to 10. The total possible saving to be made is estimated to be approximately 12,7 million SEK on a yearly basis. The full calculation can be found as an attachment.

13 CASE #7 NORVIK PORT TO GREATER STOCKHOLM AREA

Important to note for this case is that the case is based on assumptions listed below. However, basic data on yearly volumes is derived from Nicklas Ebersson, marketing manager of goods at Stockholm harbors, governing organization of the Norvik port.

13.1 Background and prerequisites

The Norvik port is a recently completed container terminal located south of Stockholm near the city Nynäshamn. The primary focus of the harbour is container and RoRo goods. The harbour was built primarily to serve the greater Stockholm area (including the region of Mälardalen), first and foremost with consumer goods.

For year 2020, the port handled 50 000 TEU. For year 2021, the port has a focused strategy to grow this cargo segment with 20-30%. The container terminal in Norvik port is operated by Hutchison Ports, making the port integrated in a huge global network of harbours (52 to the number) in 27 different countries (Stockholm Hamnar, 2020).

50 000 TEU, the cargo volume of operational year 2020, will be the baseline for this case. A first assumption is made that the volume of 50 000 TEU equals to 25 000 40-foot containers. The estimated volume increase for year 2021 will not be calculated.

For Norvik port, the truck used equals a tractor together with a trailer with load capacity of 1 40-foot container. For the respective HCT-configuration, 1 additional trailer with 1 40-foot container is added.

An executive summary of the case is shown in Table 24 Overview of Norvik port.

Distance (category and kilometers)	Short: approximately 50 km
Route (origin to destination)	Norvik port to south of Stockholm
Road(s)	73
Current transport volume (per unit of time)	An assumed volume of 6 40-foot containers daily, assumed to translate to 6 trucks daily
Suggested HCT-configuration	Longer vehicle with electric / electric-hybrid propulsion in a configuration with 2 40-foot containers per truck load, equal to 3 trucks daily

Table 24 Overview of Norvik port

Thus, based on the numbers described above and together with the assumptions listed below, the case for Norvik port is made below.

List of assumptions:

- 5 % of imported volume to Norvik port is estimated to be delivered to the greater area of Stockholm

- Calculations are based on 225 yearly workdays
- 95 % of transports are estimated to be max volume capacity for assumed HCT-configuration of 2 trailers with two 40-foot containers respectively
- Every truck is estimated to bring two empty 40-foot containers back to Norvik port for reloading

13.2 Case description

Following text define the case for Norvik port together with assumptions listed above. 5 % of the total TEU volume imported to Norvik port is estimated to be delivered to the greater Stockholm are to serve customers and consumers in this area. For the volume derived in 2020, 50 000 TEU, this equals approximately six 40-foot containers from Norvik port to the greater Stockholm area each day over the course of one year, based on 225 workdays for one year.

In addition, it is approximated that 95 % of the transports will include some type of cargo which implies that the vehicle reaches its max volume capacity. Thus, it is estimated that the remaining 5 % of transport has cargo characteristics yielding max weight capacity. Hence, it will essentially mean that 95 % of the transport can be directly transported in a HCT-configuration of 2 trailers with two 40-foot containers each. Max weight capacity transports, the remaining 5 %, will imply one 40-foot FCL-load and one empty 40' container in order not to override the overall allowed vehicle configuration weight (truck, trailer and semi lift included). Lastly, it is always estimated that 2 empty 40-foot containers are transported back to Norvik port for reloading.

The case will be constructed in two phases. Phase one will analyse, with energy source unchanged, the effects of transferring cargo from a single trailer configuration to a HCT-configuration with two trailers.

Second, the HCT-configuration with traditional diesel power as energy source will be compared to a HCT-configuration where the truck is an electric/electric hybrid as energy source, instead of conventional diesel power.

13.2.1 Infrastructure analysis Norvik port

Initially, there are no limitations identified for any case in terms of tight corners, bridges or other obstacles which hinders a HCT-vehicle configuration to be used. From road 73, there is BK1 classification towards the harbor area of Norvik port. However, this section need to be analysed for dispensation needs. Additionally, the route along road 73 towards Stockholm have BK1 classification. As mentioned previously, the Stockholm Region has not yet upgraded their road network to BK4 levels where this is applicable. Thus, dispensation is needed for this route, also depending on the exact destination of the goods. The route, illustrated below, has a set destination being Årsta combi terminal, as a common location for reloading of containerized goods in the south of Stockholm.

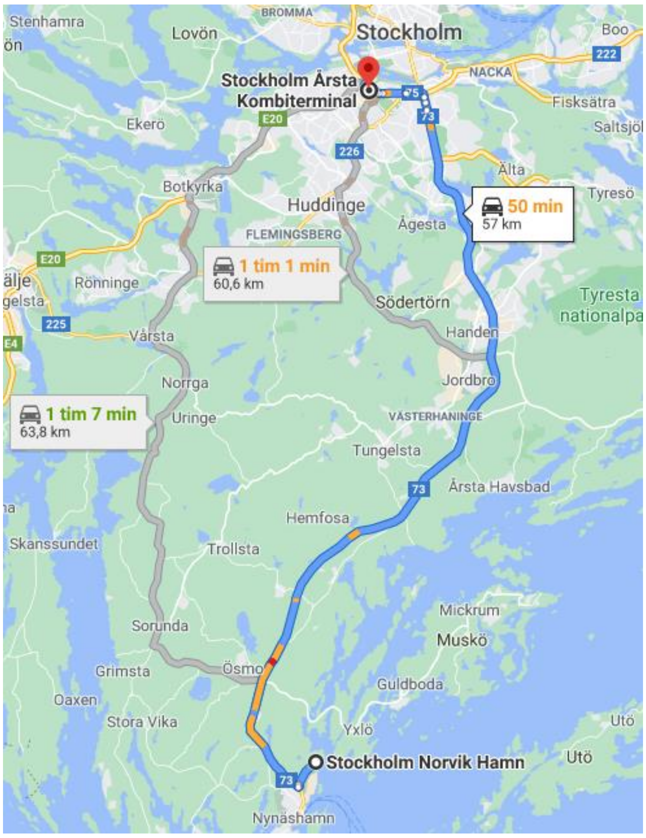

Figure 8 Route map Norvik port (Google maps)

In Table 25 Overview of infrastructure Norviks , an overview of the route is shown.

Route	Road(s)	Bearing capacity	Limitations	Other
Norvik to Stockholm	73	BK1, BK2	None	Dispensation need to be applied for

Table 25 Overview of infrastructure Norviks port

13.3 HCT potential and configuration

By applying an HCT-configuration as stated above with two trailers carrying one 40-foot containers each, this will essentially imply that the number of transports on a daily basis can be halved. Thus, according to case estimations and attached calculations, this implies that the number of transports can be cut from todays 6 to 3 transports daily to cover the estimated volume, based on the volumes during the year of 2020.

13.3.1 Environmental calculations Norvik

For case Norvik, number of roundtrips is the basis for the environmental calculation. In normal configuration with 50 000 TEU as a basic volume together with set assumptions, number of roundtrips on the specific route for the case is 6 daily roundtrips. Moving to a HCT-configuration, it is estimated that this number can be halved to 3 daily trips covering the same volume respectively.

The environmental calculations for Norvik port is done in two steps, as shown in table below. At first, the potential to move current vehicle configuration to a HCT-configuration is estimated. Second, the derived HCT-case for a conventional diesel vehicle configuration is compared against a HCT-configuration that is propelled by electricity, either through an electricity road or through equivalent battery charge needed from the electric grid. Lastly, the total saving is calculated.

HCT-configuration	**CO_2 emissions [kg]**	**Emission saving [%]**
Diesel – current configuration	163020	42,70%
Diesel – HCT configuration	93390	
HCT configuration diesel truck	93390	75%
HCT configuration electric truck (based on emission factor of 125 g CO2/kWh)	23 329	
	Total saving	**86%**

Table 26 Emission calculations Norviks

13.3.2 Transport economic analysis Norvik

Economic calculations for case Norvik yields a possible cost saving of 41 % for current setup with diesel as fuel, towards HCT-configuration with diesel as fuel. Further, the possible cost saving for current setup with diesel as fuel towards HCT-configuration with electricity as propellant is even greater; 45 %.

Respectively for an HCT-configuration, it is estimated that six roundtrips can be reduced to three roundtrips daily. The respective total yearly cost saving for switching to HCT mode on electricity is estimated to be 1 million SEK on a yearly basis. The full calculation can be found as an attachment.

14 CASE #8 ARLA

14.1 Background and prerequisites

Information below have been obtained from dialogue with Eric Wärnhem at Arla. Complementary information has been derived from by Stefan Ohlmander, CEO at haulage company EA Skara.

Arla is a Danish/European dairy products company, with connected farmers throughout many European countries. Approximately 10 300 partners (farmers), spread across seven countries: Sweden, Denmark, UK, Germany, Belgium, Luxemburg and The Netherlands, are connected to the consortia. The company is producing and distributing dairy products for grocery stores (Arla, 2020).

The specific case to be studied for Arla includes daily transports originating from Götene in the west of Sweden, with greater Stockholm as destination. Two trucks, 24-meter Swedish standard, with full load depart daily from the company's site in Götene, carrying dairy products, with destination Kallhäll, north of Stockholm for distribution in the capital. Arla's site in Götene is located west of the road E20 and the destination site is located north of Stockholm in Kallhäll, west of E18. The transports are carried out by a local haulage company close to Götene, EA Skara. A summary of the company's transport information is shown in Table 27 Overview of Arla

Distance (category and kilometres)	Intermediate: 320 km
Route (origin to destination)	Götene to Kallhäll
Road(s)	E20, E18
Current transport volume (per unit of time)	4 trucks daily, with an average cargo weight of 38 tonnes
Suggested HCT-configuration	Longer and heavier vehicle, with an average cargo weight of 50 tonnes

Table 27 Overview of Arla

14.1.1 Infrastructure analysis Arla

The route for Arla originates in Götene in the west of Sweden, see Figure 9 Route map Arla. As well as with Stockholm, the area of west Sweden (Västra Götaland) has not yet updated the road network and made BK4 classification where applicable. Thus, BK1 is valid on the distance from Arlas production site and onto E20, where BK1 classification continues until certain sections are reached in the region of Örebro, where BK4 is valid. Hence, dispensation is needed for the sections where BK1 classification exist. Along the remaining route road classification varies between BK1 and BK4 classification. Thus, dispensation analysis need to be done to cover the complete route with a HCT-vehicle configuration. Lastly, no physical limitations to HCT-operation exist on the route.

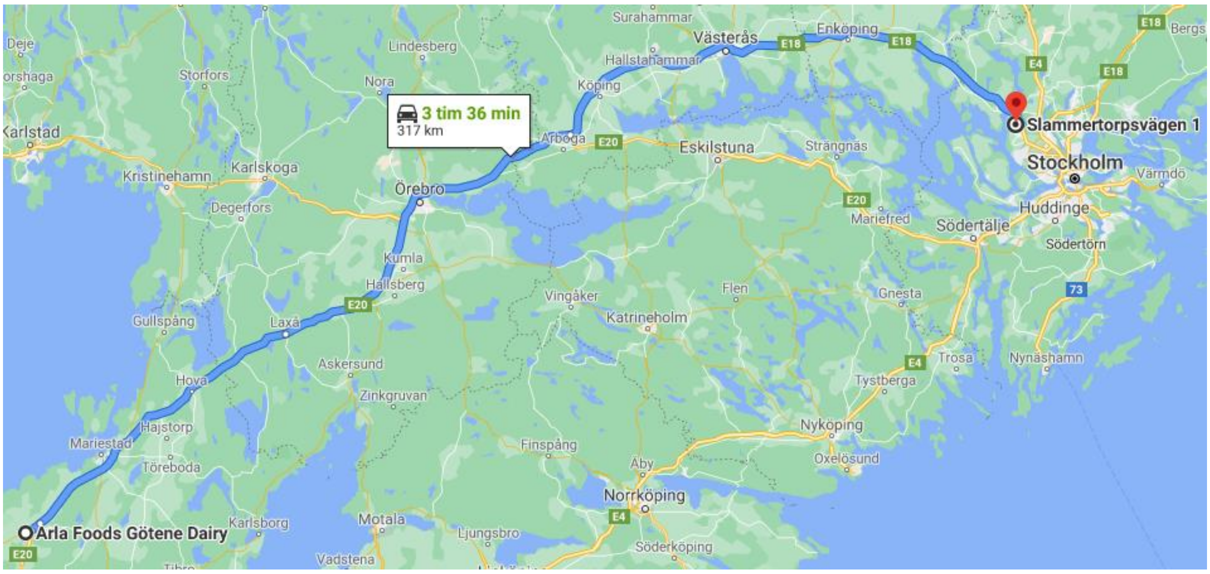

Figure 9 Route map Arla (Google maps)

In Table 28 Overview of infrastructure Arla, an overview of the route is shown.

Route	Road(s)	Bearing capacity	Limitations	Other
Götene to Kallhäll	44, E20, E18	BK1, BK2	None	Dispensation need to be applied for

Table 28 Overview of infrastructure Arla

14.2 HCT-potential and configuration for Arla

The potential HCT-configuration for Arla would imply a fewer round trips on the specific route. It is estimated that four round trips can be covered by three round trips with a HCT-vehicle configuration.

14.2.1 Environmental calculations Arla

For case Arla, number of round trips is the foundation of the environmental analysis. 4 trucks conduct the transport daily, with a cargo weight of 38 tonnes. If moving to a HCT-configuration, 50 tonnes of cargo weight would result in 3 trucks transporting the respective volume on the route. Using this numbers, following savings can be obtained (see Table 29 Emission calculations Arla) (The calculation is based on 240 workdays a year):

	Diesel consumption (m^3)	CO_2 emissions diesel (kg)	HVO consumption (m^3)	CO_2 emissions HVO (Kg)	Number of roundtrips	Overall environmental improvement (%)
Normal configuration	312	857 560	312	170 576	1 200	**13,9**
HCT configuration	268	738 210	268	146 837	900	
Saving	**43**	**119 350**	**43**	**23 740**	**300**	

Table 29 Emission calculations Arla

14.2.2 Transport economic analysis Arla

Economic calculations for case Arla yields a possible saving of 15 %. For this case, it is estimated that the number of roundtrips is in total four for two vehicles. Switching to HCT, it is estimated only one of the vehicles need to do two loops, whereas one vehicle does one loop. The total possible saving to be made is estimated to be approximately 1,35 million SEK on a yearly basis. The full calculation can be found as an attachment.

15 CONCLUSIONS AND RECOMMENDATIONS

15.1 HCT-transports on road

First, (shown in Table 30 Summarized key data) this section summarizes the findings of the study for the eight different cases respectively. Relevant information together with derived numbers from calculations are listed as a table to recap each case and provide overview for easy comparison. Second, conclusions and recommendations are made and discussed, based on the findings within each case.

Case	Region	Goods / Type of transport	Distance (km)	Transport arrangement	Intermodal connection	Possible yearly environmental saving with HCT (%)	Possible yearly economic saving with HCT (%)	Possible yearly economic saving with HCT (SEK)
Svensk Glasåtervinning	Örebro	Recycled glass / bulk	220	Daily A to B flow	No	12,3	13	2,2 million
Elon Group	Örebro	Home appliances/ container	25	Daily A to B flow	Yes	14,9	13	100 000
Lidl Group	Örebro	Colonial & dairy / pallets & wagons	650	"Milk round"	Yes	5	14	500 000
S:T Eriks	Örebro	Concrete material & stones / pallets	360	Weekly stock balancing between warehouses	No	12,8	13	220 000
Elektroskandia	Örebro	Wholesale (electrical engineering) / pallets	185	Daily A to B flow	No	13,7	16	850 000
ICA	Örebro	Colonial & dairy / pallets	540	Daily warehouse movement A to B	No	18,4	25	12,7 million
Norvik	Stockholm	Consumer goods / container	60	Daily A to B flow	Yes	86	41	1 million
Arla	Stockholm	Dairy / pallets & wagons	320	Daily A to B flow	No	13,9	15	1,35 million

Table 30 Summarized key data

HCT-transports are suitable for setups where more than one transport is deployed along a route daily. For example, an optimal case would be a route where three daily transports can be reduced to two transports on the very same route. For HCT-transports to entail benefits in terms of economy and environment, the distances of the transports need to be relatively long with continuously high volumes transported daily. In addition, the arrangement should preferably be laid out so that there are rather levelled time intervals for an even number of truck drivers, to eliminate overtime costs. Thus, this benefit both drivers and trucks where enough time for rest is included in a profitable arrangement where all involved vehicles are utilized to their fullest potential. Important to remember is also that the level of specialization of any HCT-vehicle can affect the utilization degree of that same vehicle, and thus the fleet and network in which the HCT-vehicle is active within.

As this study reveals, HCT-transports are best suited for a standardized transport arrangement with high volumes over longer distances, e.g. on a route longer than 200 km. The gain per kilometre driven for these types of transport arrangements can more easily be realized for a HCT-arrangement, then, for example, a much shorter distance, e.g. shorter than 50 km. For short distances, the time for marshalling a HCT-truck configuration is more prominent. Hence, it is more difficult to realize, or at least to a higher extent, the benefits that HCT-transports might bring.

As calculations in this study have shown, both benefits in terms of economic and environmental impact are within the same range of almost all cases studied, namely within 10 – 20 %. These are the potential savings, directly linked to the transport arrangement, to be realized for switching to HCT-mode. Nevertheless, there are also indirect factors to benefit from, however with very great uncertainty:

- Moving into HCT-configurations will theoretically result in fewer vehicles on the road
- Fewer vehicles implies less congestion on roads and potentially lower number of accidents
- Fewer vehicles potentially lower wear and tear on infrastructure
- Production volume and respective transport of fuel is lowered due to decrease in demand of fuel volume

As stated, these factors are hard to estimate and might be subject to further studies within the potential of HCT.

HCT-arrangements can be more complicated to traffic within the current road network and infrastructure. There are no direct limitations (i.e. no direct hinders) within the infrastructure studied in this project, however, within the aim of scaling up HCT-transports in Sweden, infrastructural limitations might manifest. On long transport routes, bridges, tight corners or corridors might hinder HCT-transports. On last mile distances covering municipal road networks, or within terminal areas, HCT-arrangements might be difficult to operate and marshal effectively.

To effectively gain benefits from switching to a HCT-transport arrangement, it requires long-term commercial commitment within a transport arrangement and concerned stakeholders. This is vital since HCT-arrangements have, due to higher investment costs as well as higher fixed costs, than ordinary rigs. If the HCT-vehicle is not utilized to a desired level within a given fleet and network, it might be difficult for haulage companies to realize potential environmental and economic savings which HCT-transports seems to provide.

15.2 HCT-transports on road in a multimodal transport system perspective

As stated in the introduction, HCT-transports on road should act as a complementary solution to improve intermodal transport chains, specifically for first and last mile distances. The results discussed above should be viewed as enablers to improve the efficiency of intermodal transport arrangements and in a longer extent help contribute to climate goals within the transport sector.

HCT-arrangements on road is a direct optimization of road transports but and indirect contributor to optimized multimodal transport networks in a system perspective. All transport modes in an intermodal transport chain need to evolve simultaneously to become an integral enabler to a complete an efficient combined transport system. By shifting road transports to HCT-arrangements, there are opportunities to optimize road transports as well as simultaneously developing other transport modes respectively.

Even though transfer of goods is viewed as an effective enabler to reach climate goals by improving efficiency of transport chains, this is by no means the complete solution – road transport need to have inherent development as an integral part of maintaining efficiency in intermodal transport chains.

Rather to become a competitor to e.g. transport mode rail, as well as not to become too beneficial towards rail and sea, financial incentives need to be balanced with efficiency and sustainability as main factors of optimization. HCT-transports on road should not be a competition towards multimodality, but instead a solution to optimize specifically first and last mile distances, and as seen within cases above, lower emissions and reduce costs.

For Sweden, with specific geographical prerequisites, road transports are and is going to be of high importance for the transport network in order maintain service levels, lead times and transport capacity. Thus, HCT-arrangements on roads are supposedly of high importance to maintain and develop the transport network.

Finally, the cases in thus study have illustrated the potential of HCT-arrangements on road as enablers of a more effective, more sustainable, and complete intermodal transport network for Sweden. If HCT-arrangements on road are developed and customized towards specific intermodal transport flows, together with development within truck and fuel technology with adapted infrastructure, HCT has the potential to contribute to a more sustainable and efficient transport network.

16 FURTHER STUDIES

Following section will highlight relevant future studies, to further deepen the conclusions and discussions of this study.

Results from calculations are isolated to the specific routes highlighted in every case for each stakeholder. Thus, one future study could focus on investigating the HCT-potential for a complete fleet of trucks. Also, distributed network effects of making HCT-changes to one or a couple of transport routes is of interest.

The potential socio-economic savings in the larger context of society is of interest to study. First and foremost, if these can be identified and if so, what these savings consists of and how great these are.

Another study might take on an infrastructure perspective on how infrastructure and administration around it could easily be adapted for stakeholders to perform HCT-transports in Sweden. Moreover, how HCT-transports affect wear and tear on infrastructure as well as and how durable infrastructure is, might be subject of study.

Further, economics and environmental savings between transport modes, e.g. HCT-trucks and railroad might be of interest to study to investigate where and when either railroad or HCT-trucks are of interest to transport stakeholders. Also, if applicable, shipping as a mode of transport might be included in the analysis.

Lastly one might conclude that, in general, a scale up of this study to holistically investigate effects of switching to HCT-configurations are of interest to all stakeholders active within and dependent on the transport industry, to harvest the untapped potential within HCT highlighted in this study.

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Niklas Fröjd, Emil Pettersson, Lena Larsson, Lennart Cider, HCT Typfordonskombinationer, 2017-09-15, 2015-02327

Meetings (Either online through Teams, Skype or on telephone)

Meeting with Peter Trimmel, Svensk Glasåtervinning, (2020-11-18)

Meeting with Marcus Luthman, Elon. (2020-11-26)

Meeting with Carl Ceder, Lidl (2020-12-14)

Meeting with Petter Bäckström, S:T Eriks (2020-12-10)

Meeting with Marcus Gustafsson, ICA (2020-12-14)

Meeting with Nicklas Ebersson, Stockholms Hamnar (2020-11-11)

Meeting with Eric Wärnhem, Arla (2020-11-30)

Meeting with Stefan Ohlmander, EA Skara (2020-12-15)

Email conversations

Mail conversation and meeting with Peter Trimmel, Svensk Glasåtervinning, (2020-11-18)

Mail conversation with Tomas Petterson, ALI frakt AB (2020-12-16)

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Mail conversation with Johan Gabrielsson, Geodis Wilson (2020-12-16)

Mail conversation with Carl Ceder, Lidl (2020-12-22)

Mail conversation with Petter Bäckström, S:T Eriks (2020-12-11)

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Mail conversation with David Hjälmarlycka, Elektroskandia (2020-12-16)

Interviews

Interview with Carola Alzén, CEO at Mälarhamnar AB. (2020-04-07)

18 ATTACHMENTS

18.1 Calculations and assumptions for Norvik Port case

Following calculations estimates, together with assumptions listed in the description of the Norvik port case, the expected volume per day in terms of 40-foot containers. Calculations are made based on the TEU volume of year 2020, 50 000 TEU.

TEU volume in 2020 = 50 000 TEU

50 000 twenty-foot containers equal 25 000 forty-foot containers, theoretically.

- ➔ 50 000 TEU = 25 000 FEU

25 000 * 0,05 = 1250 (an estimated 5 % of imported volumes to Norvik port has a destination to Stockholm)

1250 / 225 = 5.55 → Yielding approximately 6 containers transported on the route daily

18.2 Environmental calculations for Svensk Glasåtervinning

Emissionsberäkning transporter

Körsituation utgångsläget:

Körsträcka fullastad:	250	km	Förbrukning fullastad:	0,52	liter/km
Körsträcka returtransport:	250	km	Förbrukning returtransport:	0,52	liter/km
Tid tomgångskörning vid last	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid loss	10	minuter			
			Summa förbrukning per rundtur:	**260,7**	**liter**

Körsituation HCT:

Körsträcka fullastad:	250	km	Förbrukning fullastad:	0,6	liter/km
Körsträcka returtransport:	250	km	Förbrukning returtransport:	0,6	liter/km
Tid tomgångskörning vid last	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid loss	10	minuter			
			Summa förbrukning per rundtur:	**300,7**	**liter**

Ange 0 eller 1 beroende på alt 1 eller 2

1	**Trafikvolym per år alt 1:**			0	**Trafikvolym per år alt 2:**			**Alt 1**	**Alt 2**	
	volym gods (ton per år):	83	kton						
	Lastvikt per nuläges-transport	38	ton		Antal turer per dag (normal)		Ant dagar per år	2 184	0	**2 184**
	Lastvikt per HCT-transport:	50	ton		Antal turer per dag (HCT)		240	1 660	0	**1 660**

Diesel

	[g/l]	CO_2 Svensk diesel	NOx	PM	HC	CH4	CO	SOx	
	Euro 6	2750	1,98	0,025	0,0126	0,00040	0,336	0,0083	
Utgångsfallet (kg):		1 565 715	1 127	14	7	0	191	5	**569 Total förbrukning (m^3)**
HCT-fallet (kg):		1 372 543	988	12	6	0	168	4	**499 Total förbrukning (m^3)**

Utsläpp Co_2 med HVO / **Utsläpp Co_2 med RME**

	[g/l]	CO_2 HVO	[g/l]	CO_2 RME	
	Euro 6	547	Euro 6	1485	
Utgångsfallet (kg):		311 435		845 486	**569 Total förbrukning (m^3)**
HCT-fallet (kg):		273 011		741 173	**499 Total förbrukning (m^3)**

		Saving	
		Numbers	%
Diesel	Consuption(m3)	70	TRUE
Diesel	CO2-utsläpp [kg]	193 172	12,3
HVO	Förbrukning (m3)	70	12,3
HVO	CO2-utsläpp [kg]	38 424	12,3
RME	Förbrukning (m3)	70	12,3
RME	CO2-utsläpp [kg]	104 313	12,3
		Antal rundturer att spara	
		524	

	Diesel consumption (m3)	CO2 emissions diesel (kg)	HVO consumption (m3)	CO2 emissions HVO (Kg)	Number of roundtrips	Overall environmental improvement (%)
Normal configuration	569	1 565 715	569	311 435	2 184	
HCT configuration	499	1 372 543	499	273 011	1 660	**12,3**
Saving	**70**	**193 172**	**70**	**38 424**	**524**	

18.3 Environmental calculations for Elon Group

Emissionsberäkning transporter

Körsituation utgångsläget:					
Körsträcka fullastad:	25	km	Förbrukning fullastad:	0,49	liter/km
Körsträcka tomtransport:	25	km	Förbrukning tomtransport:	0,28	liter/km
Tid tomgångskörning vid lastning:	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid lossning:	10	minuter			
			Summa förbrukning per rundtur:	**19,9**	**liter**
Körsituation HCT:					
Körsträcka fullastad:	25	km	Förbrukning fullastad:	0,58	liter/km
Körsträcka tomtransport:	25	km	Förbrukning tomtransport:	0,41	liter/km
Tid tomgångskörning vid lastning:	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid lossning:	10	minuter			
			Summa förbrukning per rundtur:	**25,4**	**liter**

Ange 0 eller 1 beroende på alt 1 eller 2

0	**Trafikvolym per år alt 1:**			1	**Trafikvolym per år alt 2:**			**Alt 1**	**Alt 2**
	volym gods (ton per år):	900	kton						
	Lastvikt per nuläges-transport:	42	ton		Antal turer per dag (normal)	3	Ant dagar per år	-	720	720
	Lastvikt per HCT-transport:	50	ton		Antal turer per dag (HCT)	2	240	-	480	480

Diesel

[g/l]	CO_2 Svensk diesel	NOx	PM	HC	CH4	CO	SOx		
Euro 6	2750	1,98	0,025	0,0126	0,00040	0,336	0,0083		
Utgångsfallet (kg):	39 435	28	0	0	0	5	0	14	**Total förbrukning (m^3)**
HCT-fallet (kg):	33 550	24	0	0	0	4	0	12	**Total förbrukning (m^3)**

	Utsläpp Co_2 med HVO		**Utsläpp Co_2 med RME**		
[g/l]	CO_2 HVO	[g/l]	CO_2 RME		
Euro 6	547	Euro 6	1485		
Utgångsfallet (kg):	7 844		21 295	14	**Total förbrukning (m^3)**
HCT-fallet (kg):	6 673		18 117	12	**Total förbrukning (m^3)**

		Besparing	
		Siffror	%
Diesel	Förbrukning (m3)	2	14,9
Diesel	CO2-utsläpp [kg]	5 885	14,9
HVO	Förbrukning (m3)	2	14,9
HVO	CO2-utsläpp [kg]	1 171	14,9
RME	Förbrukning (m3)	2	14,9
RME	CO2-utsläpp [kg]	3 178	14,9
		Antal rundturer att spara	
		240	

	Diesel consumption (m3)	CO2 emissions diesel (kg)	HVO consumption (m3)	CO2 emissions HVO (Kg)	Number of roundtrips	Overall environmental improvement (%)
Normal configuratio	14	39 435	14	7 844	720	
HCT configuration	12	33 550	12	6 673	480	**14,9**
Saving	**2**	**5 885**	**2**	**1 171**	**240**	

18.4 Environmental calculations for S:T Eriks

Emissionsberäkning transporter

Körsituation utgångsläget:					
Körsträcka fullastad:	360	km	Förbrukning fullastad:	0,46	liter/km
Körsträcka tomtransport:	360	km	Förbrukning tomtransport:	0,35	liter/km
Tid tomgångskörning vid lastning:	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid lossning:	10	minuter			
			Summa förbrukning per rundtur:	**292,3**	**liter**

Körsituation HCT:					
Körsträcka fullastad:	360	km	Förbrukning fullastad:	0,55	liter/km
Körsträcka tomtransport:	360	km	Förbrukning tomtransport:	0,38	liter/km
Tid tomgångskörning vid lastning:	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid lossning:	10	minuter			
			Summa förbrukning per rundtur:	**335,5**	**liter**

Ange 0 eller 1 beroende på alt 1 eller 2

1	**Trafikvolym per år alt 1:**			0	**Trafikvolym per år alt 2:**			**Alt 1**	**Alt 2**	
	volym gods (ton per år):	4	kton							
	Lastvikt per nuläges-transport:	38	ton		Antal turer per dag (normal)	4	Ant dagar per år	105	0	105
	Lastvikt per HCT-transport:	50	ton		Antal turer per dag (HCT)	3	240	80	0	80

Diesel

	[g/l]	CO_2 Svensk diesel	NOx	PM	HC	CH4	CO	SOx		
	Euro 6	2750	1,98	0,025	0,0126	0,00040	0,336	0,0083		
Utgångsfallet (kg):		84 604	61	1	0	0	10	0	**31**	**Total förbrukning (m^3)**
HCT-fallet (kg):		73 803	53	1	0	0	9	0	**27**	**Total förbrukning (m^3)**

	Utsläpp Co_2 med HVO		**Utsläpp Co_2 med RME**		
[g/l]	CO_2 HVO	[g/l]	CO_2 RME		
Euro 6	547	Euro 6	1485		
Utgångsfallet (kg):	16 828		45 686	**31**	**Total förbrukning (m^3)**
HCT-fallet (kg):	14 680		39 853	**27**	**Total förbrukning (m^3)**

		Besparing	
		Siffror	%
Diesel	Förbrukning (m3)	4	12,8
Diesel	CO2-utsläpp [kg]	10 801	12,8
HVO	Förbrukning (m3)	4	12,8
HVO	CO2-utsläpp [kg]	2 148	12,8
RME	Förbrukning (m3)	4	12,8
RME	CO2-utsläpp [kg]	5 832	12,8
		Antal rundturer att spara	
		25	

	Diesel consumption (m3)	CO2 emissions diesel (kg)	HVO consumption (m3)	CO2 emissions HVO (Kg)	Number of roundtrips	Overall environmental improvement (%)
Normal configuratio	31	84 604	31	16 828	105	12,8
HCT configuration	27	73 803	27	14 680	80	
Saving	**4**	**10 801**	**4**	**2 148**	**25**	

18.5 Environmental calculations for Elektroskandia

Emissionsberäkning transporter

Körsituation utgångsläget:

Körsträcka fullastad:	185	km	Förbrukning fullastad:	0,44	liter/km
Körsträcka tomtransport:	185	km	Förbrukning tomtransport:	0,35	liter/km
Tid tomgångskörning vid lastning:	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid lossning:	10	minuter			
			Summa förbrukning per rundtur:	**146,8**	**liter**

Körsituation HCT:

Körsträcka fullastad:	185	km	Förbrukning fullastad:	0,53	liter/km
Körsträcka tomtransport:	185	km	Förbrukning tomtransport:	0,38	liter/km
Tid tomgångskörning vid lastning:	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid lossning:	10	minuter			
			Summa förbrukning per rundtur:	**169,0**	**liter**

Ange 0 eller 1 beroende på alt 1 eller 2

0	**Trafikvolym per år alt 1:**			1	**Trafikvolym per år alt 2:**			**Alt 1**	**Alt 2**	
	volym gods (ton per år):	35	kton							
	Lastvikt per nuläges-transport:	36,5	ton		Antal turer per dag (normal)	4	Ant dagar per år	-	960	960
	Lastvikt per HCT-transport:	48	ton		Antal turer per dag (HCT)	3	240	-	720	720

Diesel

[g/l]	CO_2 Svensk diesel	NOx	PM	HC	CH4	CO	SOx		
Euro 6	2750	1,98	0,025	0,0126	0,00040	0,336	0,0083		
Utgångsfallet (kg):	387 596	279	3	2	0	47	1	**141**	**Total förbrukning (m^3)**
HCT-fallet (kg):	334 653	241	3	2	0	41	1	**122**	**Total förbrukning (m^3)**

	Utsläpp Co_2 med HVO		**Utsläpp Co_2 med RME**		
[g/l]	CO_2 HVO	[g/l]	CO_2 RME		
Euro 6	547	Euro 6	1485		
Utgångsfallet (kg):	77 096		209 302	**141**	**Total förbrukning (m^3)**
HCT-fallet (kg):	66 566		180 713	**122**	**Total förbrukning (m^3)**

		Besparing	
		Siffror	%
Diesel	Förbrukning (m3)	19	13,7
Diesel	CO2-utsläpp [kg]	52 943	13,7
HVO	Förbrukning (m3)	19	13,7
HVO	CO2-utsläpp [kg]	10 531	13,7
RME	Förbrukning (m3)	19	13,7
RME	CO2-utsläpp [kg]	28 589	13,7
		Antal rundturer att spara	
		240	

	Diesel consumption (m3)	CO2 emissions diesel (kg)	HVO consumption (m3)	CO2 emissions HVO (Kg)	Number of roundtrips	Overall environmental improvement (%)
Normal configurati	141	387 596	141	77 096	960	
HCT configuration	122	334 653	122	66 566	720	**13,7**
Saving	**19**	**52 943**	**19**	**10 531**	**240**	

18.6 Environmental calculations for ICA

Emissionsberäkning transporter

Körsituation utgångsläget:

Körsträcka fullastad:	542	km	Förbrukning fullastad:	0,45	liter/km
Körsträcka tomtransport:	542	km	Förbrukning tomtransport:	0,35	liter/km
Tid tomgångskörning vid lastning:	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid lossning:	10	minuter			
			Summa förbrukning per rundtur:	**434,3**	**liter**

Körsituation HCT:

Körsträcka fullastad:	542	km	Förbrukning fullastad:	0,58	liter/km
Körsträcka tomtransport:	542	km	Förbrukning tomtransport:	0,4	liter/km
Tid tomgångskörning vid lastning:	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid lossning:	10	minuter			
			Summa förbrukning per rundtur:	**531,8**	**liter**

Ange 0 eller 1 beroende på alt 1 eller 2

0	**Trafikvolym per år alt 1:**			1	**Trafikvolym per år alt 2:**				**Alt 1**	**Alt 2**	
	volym gods (ton per år):		kton								
	Lastvikt per nuläges-transport:	37,3	ton		Antal turer per dag (normal)	15	Ant dagar per år		-	3750	**3 750**
	Lastvikt per HCT-transport:	55	ton		Antal turer per dag (HCT)	10	250		-	2500	**2 500**

Diesel

	[g/l]	CO_2 Svensk diesel	NOx	PM	HC	CH4	CO	SOx		
	Euro 6	2750	1,98	0,025	0,0126	0,00040	0,336	0,0083		
Utgångsfallet (kg):		4 478 375	3 225	40	20	1	547	14	**1 629**	**Total förbrukning (m^3)**
HCT-fallet (kg):		3 656 308	2 633	33	17	1	447	11	**1 330**	**Total förbrukning (m^3)**

Ant ton/år 139 875

137 500 HCT 34,5 n

Utsläpp Co_2 med HVO / **Utsläpp Co_2 med RME**

	[g/l]	CO_2 HVO	[g/l]	CO_2 RME		
	Euro 6	547	Euro 6	1485		
Utgångsfallet (kg):		890 790		2 418 323	**1 629**	**Total förbrukning (m^3)**
HCT-fallet (kg):		727 273		1 974 407	**1 330**	**Total förbrukning (m^3)**

		Besparing	
		Siffror	%
Diesel	Förbrukning (m3)	299	18,4
Diesel	CO2-utsläpp [kg]	822 067	18,4
HVO	Förbrukning (m3)	299	18,4
HVO	CO2-utsläpp [kg]	163 517	18,4
RME	Förbrukning (m3)	299	18,4
RME	CO2-utsläpp [kg]	443 916	18,4
		Antal rundturer att spara	
		1 250	

	Diesel consumption (m3)	CO2 emissions diesel (kg)	HVO consumption (m3)	CO2 emissions HVO (Kg)	Number of roundtrips	Overall environmental improvement (%)
Normal configuratio	1 629	4 478 375	1 629	890 790	3 750	
HCT configuration	1 330	3 656 308	1 330	727 273	2 500	**18,4**
Saving	**299**	**822 067**	**299**	**163 517**	**1 250**	

18.7 Environmental calculations for Lidl Group

Örebro – Vetlanda

Emissionsberäkning transporter

Körsituation utgångsläget:

Körsträcka fullastad:	230	km	Förbrukning fullastad:	0,42	liter/km
Körsträcka tomtransport:	230	km	Förbrukning tomtransport:	0,35	liter/km
Tid tomgångskörning vid lastning:	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid lossning:	10	minuter			
			Summa förbrukning per rundtur:	**177,8**	**liter**

Körsituation HCT:

Körsträcka fullastad:	230	km	Förbrukning fullastad:	0,45	liter/km
Körsträcka tomtransport:	230	km	Förbrukning tomtransport:	0,38	liter/km
Tid tomgångskörning vid lastning:	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid lossning:	10	minuter			
			Summa förbrukning per rundtur:	**191,6**	**liter**

Ange 0 eller 1 beroende på alt 1 eller 2

1	**Trafikvolym per år alt 1:**			0	**Trafikvolym per år alt 2:**			**Alt 1**	**Alt 2**	
	volym gods (ton per år):	8	kton							
	Lastvikt per nuläges-transport:	42	ton		Antal turer per dag (normal)	1	Ant dagar per år	190	0	**190 S:a årliga r**
	Lastvikt per HCT-transport:	50	ton		Antal turer per dag (HCT)	1	240	160	0	**160 S:a årliga r**

Diesel

[g/l]	CO_2 Svensk diesel	NOx	PM	HC	CH4	CO	SOx		
Euro 6	2750	1,98	0,025	0,0126	0,00040	0,336	0,0083		
Utgångsfallet (kg):	93 116	67	1	0	0	11	0	34	**Total förbrukning (m^3)**
HCT-fallet (kg):	84 289	61	1	0	0	10	0	31	**Total förbrukning (m^3)**

Fordon HCT: Duo trailer mec

Utsläpp Co_2 med HVO / **Utsläpp Co_2 med RME**

[g/l]	CO_2 HVO	[g/l]	CO_2 RME		
Euro 6	547	Euro 6	1485		
Utgångsfallet (kg):	18 522		50 283	34	**Total förbrukning (m^3)**
HCT-fallet (kg):	16 766		45 516	31	**Total förbrukning (m^3)**

Vetlanda – Oskarshamn

Emissionsberäkning transporter

Körsituation utgångsläget:

Körsträcka fullastad:	97	km	Förbrukning fullastad:	0,4	liter/km
Körsträcka tomtransport:	97	km	Förbrukning tomtransport:	0,35	liter/km
Tid tomgångskörning vid lastning:	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid lossning:	10	minuter			
			Summa förbrukning per rundtur:	**73,4**	**liter**

Körsituation HCT:

Körsträcka fullastad:	97	km	Förbrukning fullastad:	0,44	liter/km
Körsträcka tomtransport:	97	km	Förbrukning tomtransport:	0,38	liter/km
Tid tomgångskörning vid lastning:	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid lossning:	10	minuter			
			Summa förbrukning per rundtur:	**80,2**	**liter**

Ange 0 eller 1 beroende på alt 1 eller 2

1	**Trafikvolym per år alt 1:**			0	**Trafikvolym per år alt 2:**			**Alt 1**	**Alt 2**	
	volym gods (ton per år):	8	kton							
	Lastvikt per nuläges-transport:	42	ton		Antal turer per dag (normal)	1	Ant dagar per år	190	0	**190 S:a årliga r**
	Lastvikt per HCT-transport:	50	ton		Antal turer per dag (HCT)	1	240	160	0	**160 S:a årliga r**

Diesel

[g/l]	CO_2 Svensk diesel	NOx	PM	HC	CH4	CO	SOx		
Euro 6	2750	1,98	0,025	0,0126	0,00040	0,336	0,0083		
Utgångsfallet (kg):	38 456	28	0	0	0	5	0	14	**Total förbrukning (m^3)**
HCT-fallet (kg):	35 291	25	0	0	0	4	0	13	**Total förbrukning (m^3)**

Utsläpp Co_2 med HVO / **Utsläpp Co_2 med RME**

[g/l]	CO_2 HVO	[g/l]	CO_2 RME		
Euro 6	547	Euro 6	1485		
Utgångsfallet (kg):	7 649		20 766	14	**Total förbrukning (m^3)**
HCT-fallet (kg):	7 020		19 057	13	**Total förbrukning (m^3)**

Oskarshamn – Västervik

Emissionsberäkning transporter

Körsituation utgångsläget:

Körsträcka fullastad:	68 km		Förbrukning fullastad:	0,38 liter/km
Körsträcka tomtransport:	68 km		Förbrukning tomtransport:	0,35 liter/km
Tid tomgångskörning vid lastning:	10 minuter		Förbrukning tomgångskörning:	2 liter/timme
Tid tomgångskörning vid lossning:	10 minuter			
			Summa förbrukning per rundtur:	**50,3 liter**

Körsituation HCT:

Körsträcka fullastad:	68 km		Förbrukning fullastad:	0,42 liter/km
Körsträcka tomtransport:	68 km		Förbrukning tomtransport:	0,38 liter/km
Tid tomgångskörning vid lastning:	10 minuter		Förbrukning tomgångskörning:	2 liter/timme
Tid tomgångskörning vid lossning:	10 minuter			
			Summa förbrukning per rundtur:	**55,1 liter**

Ange 0 eller 1 beroende på alt 1 eller 2

1	**Trafikvolym per år alt 1:**		0	**Trafikvolym per år alt 2:**			**Alt 1**	**Alt 2**	
	volym gods (ton per år):	8 kton							
	Lastvikt per nuläges-transport:	42 ton		Antal turer per dag (normal)	1	Ant dagar per år	190	0	190 S:a årliga r
	Lastvikt per HCT-transport:	50 ton		Antal turer per dag (HCT)	1	240	160	0	160 S:a årliga r

Diesel

[g/l]	CO_2 Svensk diesel	NOx	PM	HC	CH4	CO	SOx	
Euro 6	2750	1,98	0,025	0,0126	0,00040	0,336	0,0083	
Utgångsfallet (kg):	26 351	19	0	0	0	3	0	10 **Total förbrukning (m^3)**
HCT-fallet (kg):	24 229	17	0	0	0	3	0	9 **Total förbrukning (m^3)**

Utsläpp CO_2 med HVO / **Utsläpp CO_2 med RME**

[g/l]	CO_2 HVO	[g/l]	CO_2 RME	
Euro 6	547	Euro 6	1485	
Utgångsfallet (kg):	5 241		14 230	10 **Total förbrukning (m^3)**
HCT-fallet (kg):	4 819		13 084	9 **Total förbrukning (m^3)**

Västervik – Örebro

Emissionsberäkning transporter

Körsituation utgångsläget:

Körsträcka fullastad:	226 km		Förbrukning fullastad:	0,35 liter/km
Körsträcka tomtransport:	226 km		Förbrukning tomtransport:	0,35 liter/km
Tid tomgångskörning vid lastning:	10 minuter		Förbrukning tomgångskörning:	2 liter/timme
Tid tomgångskörning vid lossning:	10 minuter			
			Summa förbrukning per rundtur:	**158,9 liter**

Körsituation HCT:

Körsträcka fullastad:	226 km		Förbrukning fullastad:	0,38 liter/km
Körsträcka tomtransport:	226 km		Förbrukning tomtransport:	0,38 liter/km
Tid tomgångskörning vid lastning:	10 minuter		Förbrukning tomgångskörning:	2 liter/timme
Tid tomgångskörning vid lossning:	10 minuter			
			Summa förbrukning per rundtur:	**172,4 liter**

Ange 0 eller 1 beroende på alt 1 eller 2

1	**Trafikvolym per år alt 1:**		0	**Trafikvolym per år alt 2:**			**Alt 1**	**Alt 2**	
	volym gods (ton per år):	8 kton							
	Lastvikt per nuläges-transport:	42 ton		Antal turer per dag (normal)	4	Ant dagar per år	190	0	190 S:a årliga r
	Lastvikt per HCT-transport:	50 ton		Antal turer per dag (HCT)	3	240	160	0	160 S:a årliga r

Diesel

[g/l]	CO_2 Svensk diesel	NOx	PM	HC	CH4	CO	SOx	
Euro 6	2750	1,98	0,025	0,0126	0,00040	0,336	0,0083	
Utgångsfallet (kg):	83 216	60	1	0	0	10	0	30 **Total förbrukning (m^3)**
HCT-fallet (kg):	75 868	55	1	0	0	9	0	28 **Total förbrukning (m^3)**

Utsläpp CO_2 med HVO / **Utsläpp CO_2 med RME**

[g/l]	CO_2 HVO	[g/l]	CO_2 RME	
Euro 6	547	Euro 6	1485	
Utgångsfallet (kg):	16 552		44 937	30 **Total förbrukning (m^3)**
HCT-fallet (kg):	15 091		40 969	28 **Total förbrukning (m^3)**

18.8 Environmental calculations for Norvik

Emissionsberäkning transporter

Körsituation utgångsläget:

Körsträcka fullastad:	50 km	Förbrukning fullastad:	0,46 liter/km
Körsträcka tomtransport:	50 km	Förbrukning tomtransport:	0,35 liter/km
Tid tomgångskörning vid lastning:	10 minuter	Förbrukning tomgångskörning:	2 liter/timme
Tid tomgångskörning vid lossning:	10 minuter		
		Summa förbrukning per rundtur:	**41,2 liter**

Körsituation HCT:

Körsträcka fullastad:	50 km	Förbrukning fullastad:	0,55 liter/km
Körsträcka tomtransport:	50 km	Förbrukning tomtransport:	0,38 liter/km
Tid tomgångskörning vid lastning:	10 minuter	Förbrukning tomgångskörning:	2 liter/timme
Tid tomgångskörning vid lossning:	10 minuter		
		Summa förbrukning per rundtur:	**47,2 liter**

Ange 0 eller 1 beroende på alt 1 eller 2

0	**Trafikvolym per år alt 1:**		1	**Trafikvolym per år alt 2:**			**Alt 1**	**Alt 2**	
	volym gods (ton per år):	900 kton							
	Lastvikt per nuläges-transport:	42 ton		Antal turer per dag (normal)	6	Ant dagar per år	-	1440	1 440
	Lastvikt per HCT-transport:	50 ton		Antal turer per dag (HCT)	3	240	-	720	720

Diesel

	[g/l]	CO_2 Svensk diesel	NOx	PM	HC	CH4	CO	SOx		
	Euro 6	2750	1,98	0,025	0,0126	0,00040	0,336	0,0083		
Utgångsfallet (kg):		163 020	117	1	1	0	20	0	59	**Total förbrukning (m^3)**
HCT-fallet (kg):		93 390	67	1	0	0	11	0	34	**Total förbrukning (m^3)**

Utsläpp Co_2 Elmix Källa1

	[g/kWh]	$CO_{2\,Elmix}$
		125
Utgångsfallet (kg):		N.a.
HCT-fallet (kg):		23 329

Se stödkalkyl energimängder nästa flik

		Besparing Siffror	
Diesel - utgångsfallet	CO2-utsläpp [kg]	163 020	
Diesel - HCT	CO2-utsläpp [kg]	93 390	
Besparing utgångsfallet		43	%
Diesel HCT	CO2-utsläpp [kg]	93 390	
Elväg - HCT	CO2-utsläpp [kg]	23 329	
Besparing HCT el v s diesel		75	%
Besparing HCT el kontra ordinär HCT-dieseltransport		86	%

Källa1 https://ei.se/sv/for-energiforetag/el/ursprungsmarkning-av-el/
Källa2 https://www.miljofordon.se/bilar/miljoepaaverkan/

18.9 Environmental calculations for Arla

Emissionsberäkning transporter

Körsituation utgångsläget:

Körsträcka fullastad:	320	km	Förbrukning fullastad:	0,46	liter/km
Körsträcka tomtransport:	320	km	Förbrukning tomtransport:	0,35	liter/km
Tid tomgångskörning vid lastning:	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid lossning:	10	minuter			
			Summa förbrukning per rundtur:	**259,9**	**liter**

Körsituation HCT:

Körsträcka fullastad:	320	km	Förbrukning fullastad:	0,55	liter/km
Körsträcka tomtransport:	320	km	Förbrukning tomtransport:	0,38	liter/km
Tid tomgångskörning vid lastning:	10	minuter	Förbrukning tomgångskörning:	2	liter/timme
Tid tomgångskörning vid lossning:	10	minuter			
			Summa förbrukning per rundtur:	**298,3**	**liter**

Ange 0 eller 1 beroende på alt 1 eller 2

0	**Trafikvolym per år alt 1:**			1	**Trafikvolym per år alt 2:**				**Alt 1**	**Alt 2**	
	volym gods (ton per år):	900	kton								
	Lastvikt per nuläges-transport:	38	ton		Antal turer per dag (normal)	4	Ant dagar per år		-	1200	1 200
	Lastvikt per HCT-transport:	50	ton		Antal turer per dag (HCT)	3	300		-	900	900

Diesel

		CO_2 Svensk diesel	NOx	PM	HC	CH4	CO	SOx		
	[g/l]									
	Euro 6	2750	1,98	0,025	0,0126	0,00040	0,336	0,0083		
Utgångsfallet (kg):		857 560	618	8	4	0	105	3	312	**Total förbrukning (m^3)**
HCT-fallet (kg):		738 210	532	7	3	0	90	2	268	**Total förbrukning (m^3)**

Utsläpp Co_2 med HVO / **Utsläpp Co_2 med RME**

	[g/l]	CO_2 HVO	[g/l]	CO_2 RME		
	Euro 6	547	Euro 6	1485		
Utgångsfallet (kg):		170 576		463 082	312	**Total förbrukning (m^3)**
HCT-fallet (kg):		146 837		398 633	268	**Total förbrukning (m^3)**

		Besparing	
		Siffror	%
Diesel	Förbrukning (m3)	43	13,9
Diesel	CO2-utsläpp [kg]	119 350	13,9
HVO	Förbrukning (m3)	43	13,9
HVO	CO2-utsläpp [kg]	23 740	13,9
RME	Förbrukning (m3)	43	13,9
RME	CO2-utsläpp [kg]	64 449	13,9
		Antal rundturer att spara	
		300	

	Diesel consumption (m3)	CO2 emissions diesel (kg)	HVO consumption (m3)	CO2 emissions HVO (Kg)	Number of roundtrips	Overall environmental improvement (%)
Normal configuration	312	857 560	312	170 576	1 200	
HCT configuration	268	738 210	268	146 837	900	**13,9**
Saving	**43**	**119 350**	**43**	**23 740**	**300**	

18.10 Economic calculations for Svensk Glasåtervinning

Case: Svensk Glasåtervinning

	Ekipage; case	# kalkylerade likartade ekipage	Antal kördagar per vecka för uppdraget	Antal kör-veckor per år i uppdraget	Totalt antal kördagar per år för uppdraget	Antal turer per dag/ekipage	Approx. körtsträcka per omlopp (mil) för resp ekipage	Total årlig körsträcka för uppdraget (mil)	Andel av fordon (fasta kostnader) knutet till uppdraget (%)	Fast fordons-kostnad per år (fr SÅ Calc)	Fast fordons-kostnad för upp-draget per år	Personalkostnad per vecka för uppdraget (fr SÅ Calc)	Total personal-kostnad per år för uppdraget	Rörlig milkostnad (fr Så Calc)	Varav bränsle-kostnad	Total årlig rörlig milkostnad	Summa kostnader per år	Total milkostnad
Nuläge	1	4	5	50	250	2	50	25 000	100%	546 525,0 kr	546 525,0 kr	23 000,0 kr	1 150 000,0 kr	79,1 kr	57,5 kr	1 977 500 kr	14 696 100 kr	147,0 kr
	2	1	5	50	250	1	50	12 500	70%	546 525,0 kr	382 567,5 kr	11 368,0 kr	568 400,0 kr	82,7 kr	57,5 kr	1 033 500 kr	1 984 468 kr	158,8 kr
																Totalt	16 680 568 kr	
HCT	1 HCT	3	5	50	250	2	50	25 000	100%	679 068,0 kr	679 068,0 kr	23 000,0 kr	1 150 000,0 kr	90,6 kr	66,3 kr	2 265 000 kr	12 282 204 kr	163,8 kr
	2 HCT	1	5	50	250	1	50	12 500	70%	679 068,0 kr	475 347,6 kr	11 368,0 kr	568 400,0 kr	94,9 kr	66,3 kr	1 186 250 kr	2 229 998 kr	178,4 kr
											6,0 kr							
																Totalt	**14 512 202 kr**	
																Differens	**2 168 366 kr**	13%

Notering: Årligt tonnage ca 83 kton. Idag ca 9 transporter per dag, vardagar, 38 ton per lass. Med HCT ca 50 ton ger det istället 7 dagliga transporter.

18.11 Economic calculations for Elon Group

Case: Elon

	Ekipage; case	# kalkylerade likartade ekipage	Antal kördagar per vecka för uppdraget	Antal kör-veckor per år i uppdraget	Totalt antal kördagar per år för uppdraget	Antal turer per dag/ekipage	Approx. körtsträcka per omlopp (mil) för resp ekipage	Total årlig körsträcka för uppdraget (mil)	Andel av fordon (fasta kostnader) knutet till uppdraget (%)	Fast fordons-kostnad per år (fr SÅ Calc)	Fast fordons-kostnad för upp-draget per år	Personalkostnad per vecka för uppdraget (fr SÅ Calc)	Total personal-kostnad per år för uppdraget	Rörlig milkostnad (fr Så Calc)	Varav bränsle-kostnad	Total årlig rörlig milkostnad	Summa kostnader per år	Total milkostnad
Nuläge	1	1	5	48	240,0	3	5	3 600	50%	358 687,0 kr	179 343,5 kr	5 552,0 kr	266 496,0 kr	67,1 kr	43,1 kr	241 560 kr	687 400 kr	190,9 kr
																Totalt	687 400 kr	
HCT	1 HCT	1	5	48	240	2	5	2 400	40%	495 213,0 kr	198 085,2 kr	4 164,0 kr	199 872,0 kr	82,3 kr	54,2 kr	197 520 kr	595 477 kr	248,1 kr
							0											
																Totalt	595 477 kr	
																Differens	91 922 kr	13%

Notering: Idag körs tre omlopp med vardera 1 st 40 fots container.

Med HCT (duotrailer) bedöms antalet turer kunna reduceras till 2 per dag, förutsatt att det viktmässigt går att ta två containers tillsammans.

Då fordonen nyttjas ca 4 resp 3 timmar per dag måste annat uppdrag vara med och bära fasta kostnader. Därav 50 resp 40 % i rött ovan.

18.12 Economic calculations for Lidl Group

Case: Lidl

	Ekipage; case	# kalkylerade likartade ekipage	Antal kördagar per vecka för uppdraget	Antal kör-veckor per år i uppdraget	Totalt antal kördagar per år för uppdraget	Antal turer per dag/ekipage	Approx. körtsträcka per omlopp (mil) för resp ekipage	Total årlig körsträcka för uppdraget (mil)	Andel av fordon (fasta kostnader) knutet till uppdraget (%)	Fast fordons-kostnad per år (fr SÅ Calc)	Fast fordons-kostnad för upp-draget per år	Personalkostnad per vecka för uppdraget (fr SÅ Calc)	Total personal-kostnad per år för uppdraget	Rörlig milkostnad (fr Så Calc)	Varav bränsle-kostnad	Total årlig rörlig milkostnad	Summa kostnader per år	Total milkostnad
Nuläge	1	1	7,55	52	392,6	1	62	24 341	130%	448 050,0 kr	582 465,0 kr	22 571,0 kr	1 173 692,0 kr	66,1 kr	44,2 kr	1 608 953 kr	3 365 110 kr	138,2 kr
																Totalt	3 365 110 kr	
HCT	1 HCT	1	5,83	52	303,2	1	62	18 796	100%	495 213,0 kr	495 213,0 kr	18 434,0 kr	958 568,0 kr	77,3 kr	53,0 kr	1 452 925 kr	2 906 706 kr	154,6 kr
							0											
																Totalt	**2 906 706 kr**	
																Differens	**458 405 kr**	14%

Notering: Lidl kör en distributionsslinga från Örebro ner i Småland. I dagsläget med 24 meters ekipage 7-8 per vecka. Fasta kostnader för nulägesuppdraget får räknas upp då mer än ett ekipage tas i anspråk

Med HCT (duo-trailer) blir motsvarande knappt 5 körningar per vecka

Snittförbrukning nuläge 3,9

Snittförbrukning HCT 4,8

18.13 Economic calculations for S:T Eriks

Case: St Eriks

	Ekipage; case	# kalkylerade likartade ekipage	Antal kördagar per vecka för uppdraget	Antal kör-veckor per år i uppdraget	Totalt antal kördagar per år för uppdraget	Antal turer per dag/ekipage	Approx. körtsträcka per omlopp (mil) för resp ekipage	Total årlig körsträcka för uppdraget (mil)	Andel av fordon (fasta kostnader) knutet till uppdraget (%)	Fast fordons-kostnad per år (fr SÅ Calc)	Fast fordons-kostnad för upp-draget per år	Personalkostnad per vecka för uppdraget (fr SÅ Calc)	Total personal-kostnad per år för uppdraget	Rörlig milkostnad (fr Så Calc)	Varav bränsle-kostnad	Total årlig rörlig milkostnad	Summa kostnader per år	Total milkostnad
Nuläge	1	1	2,333	45	105,0	2	72	15 118	50%	448 049,0 kr	224 024,5 kr	10 384,0 kr	467 280,0 kr	65,0 kr	44,2 kr	982 660 kr	**1 673 964 kr**	110,7 kr
																Totalt	**1 673 964 kr**	
HCT	1 HCT	1	1,77	45	79,65	2	72	11 470	40%	545 304,0 kr	218 121,6 kr	7 716,0 kr	347 220,0 kr	77,5 kr	53,0 kr	888 665 kr	**1 454 006 kr**	126,8 kr
							0											
																Totalt	**1 454 006 kr**	
																Differens	**219 958 kr**	13%

Notering: Årligt tonnage ca 4 kton. Idag ca 105 rundturer per år, 38 ton per lass. Med 45 transportveckor per år ger det 2,33 trp/vecka, d v s 7 transporter per treveckorsperiod.
Med HCT ca 50 ton ger det istället ca 80 rundturer per år, d v s ca 1,77 trp/vecka eller 7 transporter per 4-veckorsperiod.

18.14 Economic calculations for Elektroskandia

Case: Elektroskandia

	Ekipage; case	# kalkylerade likartade ekipage	Antal kördagar per vecka för uppdraget	Antal kör-veckor per år i uppdraget	Totalt antal kördagar per år för uppdraget	Antal turer per dag/ekipage	Approx. körsträcka per omlopp (mil) för resp ekipage	Total årlig körsträcka för uppdraget (mil)	Andel av fordon (fasta kostnader) knutet till uppdraget (%)	Fast fordons-kostnad per år (fr SÅ Calc)	Fast fordons-kostnad för upp-draget per år	Personalkostnad per vecka för uppdraget (fr SÅ Calc)	Total personal-kostnad per år för uppdraget	Rörlig milkostnad (fr Så Calc)	Varav bränsle-kostnad	Total årlig rörlig milkostnad	Summa kostnader per år	Total milkostnad
Nuläge	1	2	5	48	240	2	37	17 760	100%	448 049,0 kr	448 049,0 kr	23 000,0 kr	1 104 000,0 kr	66,1 kr	44,2 kr	1 174 646 kr	5 453 391 kr	153,5 kr
	2				0			-			- kr		- kr			- kr	- kr	
																Totalt	5 453 391 kr	
HCT	1 HCT	1	5	48	240	2	37	17 760	100%	545 304,0 kr	545 304,0 kr	23 000,0 kr	1 104 000,0 kr	75,3 kr	50,8 kr	1 337 328 kr	2 986 632 kr	168,2 kr
	2 HCT	1	5	48	240	1	37	8 880	70%	545 304,0 kr	381 712,8 kr	11 368,0 kr	545 664,0 kr	77,5 kr	50,8 kr	688 200 kr	1 615 577 kr	181,9 kr
																Totalt	**4 602 209 kr**	
																Differens	**851 182 kr**	16%

Notering: Trafik körs för Elektroskandia 5 dagar i veckan, totalt 240 dagar per år. I dagsläget med två ekipage som gör två omlopp vardera per dygn. Med HCT bedöms ett av ekipagen kunna gå endast ett omlopp per dygn.

18.15 Economic calculations for ICA

Case: ICA

	Ekipage; case	# kalkylerade likartade ekipage	Antal kördagar per vecka för uppdraget	Antal kör-veckor per år i uppdraget	Totalt antal kördagar per år för uppdraget	Antal turer per dag/ekipage	Approx. körtsträcka per omlopp (mil) för resp ekipage	Total årlig körsträcka för uppdraget (mil)	Andel av fordon (fasta kostnader) knutet till uppdraget (%)	Fast fordons-kostnad per år (fr SÅ Calc)	Fast fordons-kostnad för upp-draget per år	Personalkostnad per vecka för uppdraget (fr SÅ Calc)	Total personal-kostnad per år för uppdraget	Rörlig milkostnad (fr Så Calc)	Varav bränsle-kostnad	Total årlig rörlig milkostnad	Summa kostnader per år	Total milkostnad
Nuläge	1	15	5	50	250,0	1	108	27 000	100%	448 049,0 kr	448 049,0 kr	23 000,0 kr	1 150 000,0 kr	64,7 kr	44,2 kr	1 746 900 kr	**50 174 235 kr**	123,9 kr
																Totalt	**50 174 235 kr**	
HCT	1 HCT	10	5	50	250	1	108	27 000	100%	495 213,0 kr	495 213,0 kr	23 000,0 kr	1 150 000,0 kr	77,9 kr	55,3 kr	2 103 300 kr	**37 485 130 kr**	138,8 kr
							0											
																Totalt	**37 485 130 kr**	
																Differens	**12 689 105 kr**	25%

Notering: Ica kör 15 avgående 24 meters-ekipage per vardag 50 veckor om året. Dessa är volymmaxade. P g a omloppets längd fordras två förare för att klara det per dygn.
Med HCT (duotrailer och dolly bedöms antalet avgångar kunna minskas ned till 10 dagligen.

18.16 Economic calculations for Norvik

Case: Norvik

	Ekipage; case	# kalkylerade likartade ekipage	Antal kördagar per vecka för uppdraget	Antal kör-veckor per år i uppdraget	Totalt antal kördagar per år för uppdraget	Antal turer per dag/ekipage	körtsträcka per omlopp (mil) för	Total årlig körsträcka för uppdraget (mil)	Andel av fordon (fasta kostnader) knutet till uppdraget (%)	Fast fordons-kostnad per år (fr SÅ Calc)	Fast fordons-kostnad för upp-draget per år	Personalkostnad per vecka för uppdraget (fr SÅ Calc)	Total personal-kostnad per år för uppdraget	Rörlig milkostnad (fr Så Calc)	Varav bränsle-kostnad	Total årlig rörlig milkostnad	Summa kostnader per år	Total milkostnad
Nuläge	1	1	5	48	240,0	6	10	14 400	100%	429 330,0 kr	429 330,0 kr	18 240,0 kr	875 520,0 kr	68,3 kr	45,3 kr	983 520 kr	2 288 370 kr	158,9 kr
HCT	1 HCT diesel	1	5	48	240	3	10	7 200	70%	514 142,0 kr	359 899,4 kr	8 328,0 kr	399 744,0 kr	82,6 kr	51,9 kr	594 720 kr	1 354 363 kr	188,1 kr
	2 HCT el/hybrid	1	5	48	240	3	10	7 200	70%	604 642,0 kr	423 249,4 kr	8 328,0 kr	399 744,0 kr	59,6 kr	26,9 kr	429 120 kr	1 252 113 kr	173,9 kr

Differens nuläge v s HCT diesel	934 007 kr	41%
Differens nuläge v s HCT el	1 036 257 kr	45%

Notering: Idag körs sex omlopp med vardera 1 st 40 fots container. Varje rundtur inkl lossning etc bedöms ta 2 timmar.

Med HCT (duotrailer) bedöms antalet turer kunna reduceras till 3 per dag, förutsatt att det viktmässigt går att ta två containers tillsammans.

Stödkalkyl för energianvändning diesel och el

Bränsle	Energiinnehåll kWh/m3							
Motorbensin uta	9 100	Energibehov HCT med diesel/mil	Baserat på	4,9	liter/mil ger	47,9	kWh/mil
Motorbensin me	8 940						
Etanol	5 900	Verkningsgrad med dieselmotor	45%				
Etanol E85, Somi	6 300						
Etanol E85, Vinte	6 650	**Nyttig framdrivningsenergi**	**21,5**	**kWh/mil**			
Alkylatbensin	8450						
Flygfotogen, JET	9 600						
Diesel – Mk1	9 800	Verkningsgrad för elmotor i lastbil	80%				
Diesel – Mk2	9 800						
Diesel – Mk3 (EU	9 950	**Energibehov HCT fordon på el**	**26,9**	**kWh/mil**			
FAME	9 150						
HVO	9 450						
Diesel – Mk1 me	9 770						
Diesel – Mk2 me	9 770						
Diesel – Mk3 (EU	9 910						
Eldningsolja 1							

18.17 Economic calculations for Arla

Case: Arla

	Ekipage; case	# kalkylerade likartade ekipage	Antal kördagar per vecka för uppdraget	Antal kör-veckor per år i uppdraget	Totalt antal kördagar per år för uppdraget	Antal turer per dag/ekipage	Approx. körtsträcka per omlopp (mil) för resp ekipage	Total årlig körsträcka för uppdraget (mil)	Andel av fordon (fasta kostnader) knutet till uppdraget (%)	Fast fordons-kostnad per år (fr SÅ Calc)	Fast fordons-kostnad för upp-draget per år	Personalkostnad per vecka för uppdraget (fr SÅ Calc)	Total personal-kostnad per år för uppdraget	Rörlig milkostnad (fr Så Calc)	Varav bränsle-kostnad	Total årlig rörlig milkostnad	Summa kostnader per år	Total milkostnad
Nuläge	1	1	6	50	300	2	64	38 400	100%	476 492,0 kr	476 492,0 kr	33 399,2 kr	1 669 960,0 kr	63,9 kr	44,2 kr	2 453 760 kr	4 600 212 kr	119,8 kr
	2	1	6	50	300	2	64	38 400	100%	476 492,0 kr	476 492,0 kr	33 399,2 kr	1 669 960,0 kr	63,9 kr	44,2 kr	2 453 760 kr	4 600 212 kr	119,8 kr
																Totalt	9 200 424 kr	
HCT	1 HCT	1	6	50	300	2	64	38 400	100%	573 747,0 kr	573 747,0 kr	33 399,2 kr	1 669 960,0 kr	74,8 kr	53,0 kr	2 872 320 kr	5 116 027 kr	133,2 kr
	2 HCT	1	6	50	300	1	64	19 200	80%	573 747,0 kr	458 997,6 kr	16 702,0 kr	835 100,0 kr	74,8 kr	53,0 kr	1 436 160 kr	2 730 258 kr	142,2 kr
																Totalt	**7 846 285 kr**	
																Differens	**1 354 139 kr**	15%

Notering: Trafik körs för Arla 6 dagar i veckan. I dagsläget med två ekipage som gör två omlopp vardera per dygn. Med HCT bedöms ett av ekipagen kunna gå endast ett omlopp per dygn.