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Sustainable World Trade

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Abstract

Sustainable world trade is the future, and it is important how companies act in the future regarding transportations to their customers.

In this thesis, I have chosen to focus on how Oy Prevex Ab preform their customer transportations today.

Furthermore, I will focus on how Oy Prevex Ab can perform in the future in a more sustainable way to minimize their CO2 footprint. In the theoretical part, I will describe what sustainability, regulation and GHG calculation are. I will also describe how the current situation looks like today at Prevex and how it could look like in the future. The thesis research component was conducted through discussions with keypersons and through a review of literature the aim of this study was to find out if Prevex can choose a more environmentally friendly way to transport their products in the further, and reduce their CO2 footprint, and if so, in what way can this be accomplished?

To be in the forefront of an industry, a company must reduce their CO2 footprint and achieve a more sustainability world trade. These goals/requirements can be challenging. But overwhelmingly positive.

My suggestion to companies that want to be in the forefront of their industry, is to perform a current situational analysis of the company's GHG emissions and after that, look into where they have to put in effort to minimize the CO2 footprint. It is also important for the management in the company to be involved in this work to be able to be in the front. This endeavor will take some time and effort, but it will be worth it.

Language: English
Key Words: CO2, company, sustainability, GHG (Greenhouse Gas Protocol)

ACKNOWLEDGEMENTS

The reason for applying to the Master in Maritime Management program is my interest in the sea, ships and navigation which started already in my childhood, when I was only 5 years old. The other reasons are that I have had a goal to apply these past 5 years to the Master program to learn a little more regarding the shore based maritime business. In 2021, I applied for the studies and got in. I have no regret at all. I only wonder way I had not done it sooner.

My thesis project is coming to an end, and I want to thank my family, my husband and my two boys for their patience and their understanding of me working full time and studying and writing my Master thesis. It has been challenging but I hope I can inspire my boys in the future, to see that everything is possible if there is a will. I also want to thank Oy Prevex Ab and Niclas Caldén, Mikael Gäddnäs, Martin Sundqvist for letting me do this research for Prevex and taking the time to help me with all the questions. And also, to Green Cargo Anders Ohlsén and First Row Shipping Jens Schrevelius for taking the time to discuss intermodal and multimodal solutions. And at last, I want to thank Dr. Thomas Finne who has been my supervisor during my thesis project.

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1 Introduction

What we do know about the future is that companies all around the world will still do business with each other. And that it is the responsibility of the companies, transporters, ports, and the shipping companies to perform in a sustainable and competitive way.

How these actors act in the future can have a major impact on the environment, people, companies, and partners. What is important to be able to build a sustainable world trade in the future, is that we need to review our methods of transport on land, at sea and in ports. To reach the climate goals by 2050.

Through as climate-smart way as possible to reduce the environmental impact. The problems we need to look at are how we strategically develop our ports and their infrastructure, while at the same time we need to optimize the flow of goods and how we manufacture products in industry. Therefore, we can reduce the environmental impact as much as possible.

The topic is important because we need to reduce the CO2 impact on the environment and start to look at how we can carry out transportation in a better and environmentally way now and in the future´s. That’s why I have cousin to do research about this topic for the company Oy Prevex Ab.

2 Research problem

I have chosen to collaborate with the company Prevex which manufactures water traps and has an export of 90%. Prevex is a leading supplier of water traps for the kitchen and bathroom industries. The company is located in Finland and Ostrobothnia. Prevex works for a carbon-neutral future in accordance with the Paris Agreement with a goal of limiting global warming to 1.5 degrees. The company gools for a total carbon emission decrease of 38% by the end of 2025. (Niclas Caldén Prevex,2023).

The research questions that I will try to help Prevex with are as follows.

1. Can Prevex choose an environmentally friendly way to transport their products in the future and reduce their CO2 footprint?

2. If so, in what way can this be accomplished?

I will answer these questions by using focus groups and literature. I will use a qualitative method. I will first preform a current situation analysis of the transports they do today and their CO2 emissions. Prevex have many countries they export to so I will focus on the areas of longest routes and most product to which Prevex exports.

The Limitation of the thesis is that I do not have a lot of time to do the research. Therefore, I have to reduce the research to one focus area that is the most important to Prevex. Based on this, I will research how Prevex can reduce the CO2 emissions on their transports.

3 Methodology

I have chosen a qualitative research method for collecting the information for my thesis. In the form of focus groups and discussions but also from content analysis of visual and textual materials. The focus groups consist of experts from Prevex, Green Cago and First Row Shipping. According to Bryman (2016), qualitative research is defined as a research strategy that emphasizes the ways in which individuals interpret their social world. A focus group is also one of the most common qualitative research methods for data collection. Research by using focus groups began in the late 1930s and became popular from the 1950s, owing particularly to the use of focus groups in marketing studies.

A focus group usually consists of a limited number of respondents. The main purpose of the focus group is to find answers to the questions "why", "what" and "how". One advantage of focus groups is that you don't necessarily have to interact with the group in person.

Common to most definitions of focus groups is that: (a) The purpose is to collect qualitative data. (b) Participants discuss based on a specific focus. The starting point for a focus group is always this common focus which collect qualitative data. (b) The group consists of people with something common. (c) Participants discuss based on a specific focus. The starting point for a focus group is always this common focus. (Bormann, 1972).

3.1 Data collecting method

It is important for the researcher to understand when using data collection and data analysis for focus groups that it is more difficult compared to using surveys and interviews. The researcher must ensure that these difficulties are fully understood before the researcher makes the final choice of the current data collection method. (Business Rules Management (BRM), 2014 Focus Groups - Research-Methodology). The researcher often uses focus groups in studies that investigate an event or trend that occurs within a specific group/area. Focus group discussion requires a team consisting of a knowledgeable participant. (Burrows & Kendall, 1997; Krueger, 1994). The researcher is central to the discussion not only by managing existing relationships but also by creating a relaxed and comfortable environment for unfamiliar participants. Similarly, the role of the researcher

includes observing non-verbal interactions and influencing group dynamics and documenting the general content of the discussion, thereby supplementing the data as necessary (Kitzinger, 1994, 1995).

3.1.1 Data selection method

Firstly, the focus group were used and then from content analysis of visual and textual materials. Focus group discussions have four major steps as shown in Figure 1. These include (1) research design, (2) data collection, (3) analysis and (4) reporting of results (Morgan et al., 1998).

The key feature of a focus group is the interactive discussion between all participants and a team of facilitators as one group in one place. This is the most common and classical type of focus group discussion (Morgan, 1996).

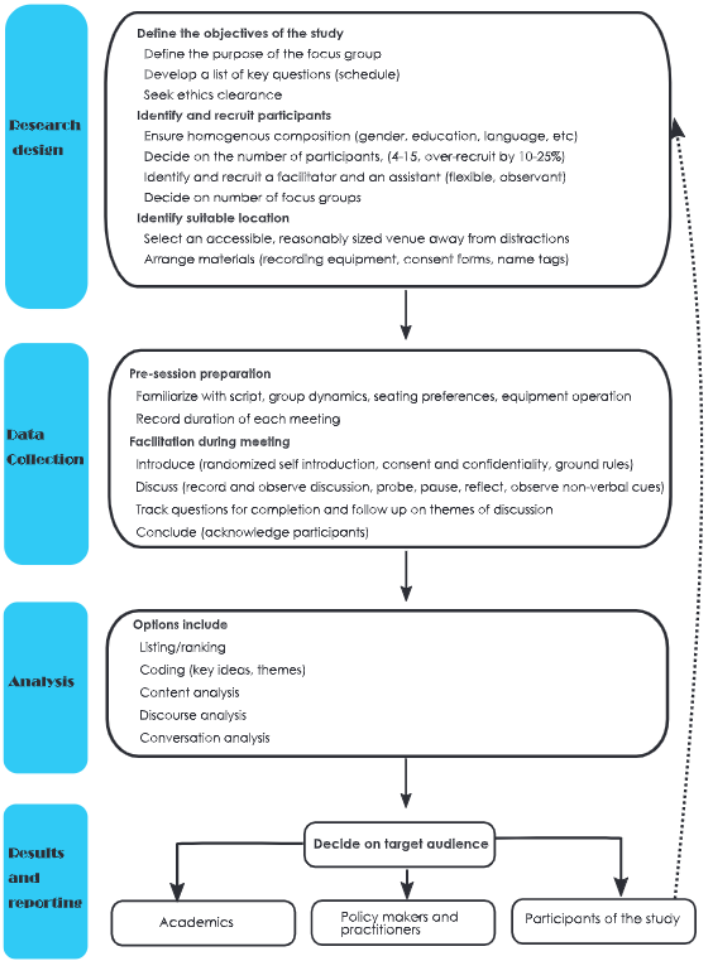


Figure 1. Flow chart of the steps of the focus group discussion technique. (Morgan et al., 1998).

3.1.2 Data analysis

A focus group discussion usually provides both good qualitative and good observational data where the analysis may be demanding before it is complete. According to Leech and Onwuegbuzie (2007, 2008), qualitative analysis techniques that can be used to analyze focus group data include grounded theory analysis (Charmaz, 2006; Glaser, 1978; Glaser & Strauss, 1967, Strauss, 1987). Content analysis (Morgan, 1988). And discourse analysis (Potter & Wetherell, 1987). Morgan (1988) recommends the use of content and ethnographic analysis techniques to analyze data from a focus group discussion because it provides the researcher for the research with an opportunity to obtain both qualitative and quantitative information.

3.1.3 Ethical issues

Ethical considerations are important in all areas of research, including qualitative research, especially when involving a specific focus group of participants. It is the qualitative researcher's responsibility to ensure that the participants in the group have the right to choose to be involved in the study, and to also protect the participants' identity throughout the research work. But also, to reflect and review the working methods that I, as a researcher, used during my dissertation research. I have become aware that ethnic issues in qualitative research are not as general as it appears in the literature. However, some modification may be needed during the process.

3.1.4 Summary

Choosing the qualitative focus group method was a good choice in my research for Oy Prevex Ab. All the participants have a long experience at Prevex and were, burning for the subject and the discussion that we have been having along the whole time. There were no ethical or confidential challenges. The challenges have been writing the notes and collection information alongside fulltime work and family. Respecting ethical standards is critical and the goal should be to follow the rules, not violating the ethics standards and gets a deeper knowledge on the topic one is researching. Checking of plagiarism is in many cases done using a computer software. (Elsevier, 2019).

4 Theoretical backgrounds to Sustainability and GHG scope calculation in a company and the CO2 regulation regarding the subject.

To understand the complexity, you must first understand the GHG scope calculation in a company and the legislation that will come in the future. These things will have a big impact on the world trade in the future. I divided the theoretical chapter in to three different sub chapters. Firstly, what is sustainability? Secondly, Carbon footprint calculation according to GHG Protocol. Finally, Regulation.

4.1 Sustainability

Today we talk about sustainability a lot, but what dos sustainability really means? Sustainability means that we are meeting our own needs without compromising the ability of future generations to meet their own needs. Sustainability is not just environmental. Embedded in most definitions of sustainability, we also find concerns for social equity and economic development. (Horton, Jocelyn ed. 2003).

In 1983, the United Nations tapped former Norwegian prime minister Gro Harlem Brundtland to run the new World Commission on Environment and Development. After decades of effort to raise living standards through industrialization, many countries were still dealing with extreme poverty. It seemed that economic development at the cost of ecological health and social equity did not lead to long-lasting prosperity. It was clear that the world needed to find a way to harmonize ecology with prosperity. After four years, the Brundtland Commission released its final report, *Our Common Future*. It famously defines sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The Commission successfully unified environmentalism with social and economic concerns on the world's development agenda. Sustainability is a holistic approach that considers ecological, social, and economic dimensions. This approach recognize that these three dimensions must be considered to lasting prosperity. (Horton, Jocelyn ed. 2003).

4.1.1 Environmental Sustainability

Environmental or ecological sustainability is about managing natural resources for us humans and organisms, without damaging the natural systems' ability to provide society and people with natural resources and ecosystem services in the long term.

4.1.2 Economic Sustainability

A sustainable company means that’s striving for a more efficient use of resources, which in turn can lead to reduced costs and higher profits. It is easier to get investors and capital with a company that has a good and realistic sustainability strategy.

4.1.3 Social sustainability

Social sustainability is about identifying and managing business impacts, both positive and negative, on people. The quality of a company´s relationships and engagement with its stakeholders is critical. Directly or indirectly, companies affect what happens to employees, workers in the value chain, customer and local communities, and it is important manage impacts proactively. (United Nations Global Compact, 2023).

4.2 Carbon footprint calculation according to GHG Protocol

The Greenhouse Gas (GHG) Protocol Corporate Standard provides standards and guidance for companies preparing a GHG emissions inventory and it is the most used basis for carbon footprint calculations. It covers the accounting and reporting of the seven greenhouse gases covered by the Kyoto Protocol — carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), Sulphur hexafluoride (SF6), and nitrogen trifluoride (NF3). The GHG Protocol focuses on the accounting and reporting of emissions, and it is designed to develop a verifiable inventory. However, verification of the calculations is not required and GHG Protocol does not provide a standard for how the verification process should be conducted. The GHG Protocol follows five main principles:

1. Relevance: GHG inventory should appropriately reflect the GHG emissions of the company and serve internal and external decision-making needs.

2. Completeness: All GHG emission sources and activities should be accounted and reported within the chosen inventory boundary. Any exclusions should be disclosed and justified.

3. Consistency: Consistent methodology should be used to allow for meaningful comparisons of emissions over time. Any changes to the data, inventory boundary, methods, or any other relevant factors should be transparently documented.

4. Transparency: All relevant issues should be addressed in a factual and coherent manner, based on a clear audit trail. Any relevant assumptions, calculation methodologies and used data sources should be disclosed.

5. Accuracy: The quantification of GHG emissions should be systematically neither over nor under actual emissions. Any uncertainties should be reduced as far as practicable. Sufficient accuracy allows users to make decisions with reasonable assurance as to the integrity of the reported information. Preparing a GHG emissions inventory gives the reporting company understanding of the global warming impact of its operations, helps to identify company's emission reduction potential, and enables to track the effectiveness of the taken actions. GHG emission accounting and reporting is part of the corporate sustainability reporting, and for example, widely accepted Global Reporting Initiative (GRI) refers to the GHG Protocol as a basis for GHG emission accounting and reporting.

4.2.1 Boundaries and selection of calculation variables

Organizational boundaries acording to GHG Protocol, the GHG accounting and reporting can be based on the equity share and the control approaches. Under the equity share approach, a company accounts for GHG emissions from operations according to its share of equity in the operation. Under the control approach, a company accounts for 100 percent of the GHG emissions from operations over which it has control. The control can be either financial or operational control or both. If the reporting company wholly owns all its operations, its organizational boundary will be the same whichever approach is used. Operational boundaries to help delineate direct and indirect emission sources, improve transparency, and provide utility for different types of organizations and different types of climate policies and business goals, three "scopes" (scope 1, scope 2, and scope 3) are

defined for GHG accounting and reporting purposes. (The GHG Protocol Corporate Accounting and Reporting Standard (2004).

Scope 1 consists of a company's direct emissions that occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, vehicles, etc.

Scope 2 accounts for GHG emissions from the generation of purchased electricity and heat consumed by the company.

Scope 3 emissions are a consequence of the activities of the company but occur from sources not owned or controlled by the company, such as extraction and production of purchased materials. At a minimum the company should account for and report on scope 1 and 2 separately when following standards and guidance of the GHG Protocol. Scope 3 is an optional reporting category. Setting and recalculating a base year A meaningful and consistent comparison of emissions over time requires that companies set a performance datum, "base year", with which to compare current emissions. A base year should represent the earliest relevant point in time for which the company has reliable data on emissions. Usually, a single year is chosen as a base year, but it is also possible to choose an average of annual emissions over several consecutive years.

This helps to smooth out unusual fluctuations in GHG emissions. Companies may consider using a rolling target base year if obtaining and maintaining reliable and verifiable data for a fixed base year is likely to be challenging (for example, due to frequent acquisitions). With a rolling base year, the base year rolls forward at regular time intervals, usually one year, so that emissions are always compared against the previous year. For consistent tracking of emissions over time, the base year emissions may need to be recalculated as companies undergo significant structural changes such as acquisitions, divestments, and mergers.

The basis and context for any recalculations need to be clearly articulated. A company should determine a significance threshold that will trigger the base year emissions recalculations. Changes in calculation methodology or improvements in the accuracy of data, and discovery of significant errors in calculation or structural changes in the reporting organization can trigger the recalculation if they have a significant impact on the company's base year emissions. The GHG Protocol does not define what is considered as a significant change, so the reporting company will need to define and enclose it. Information on the

causes of emission changes that did not trigger a base year emission recalculation should be enclosed and justified. Also details of any reasons for recalculations should be enclosed. Emission factors, emission factors should be chosen in a way that promotes enhanced accuracy, and therefore, supplier specific emission factors are recommended to be used. If it is not possible to acquire supplier-specific emission factors, then published local, national, or international emission factors may be used. In the coming calculation years, if more accurate emission factors are obtained and the differences in emissions resulting from such a change are significant, historic data is recalculated applying the new data. Emission factors may be updated annually, or the emission factors may be kept constant for a certain time and updated in (Ecobio,2020).

4.3 Regulations and directive

Regulations and directives regarding CO2 emissions will have a big impact for the company's, in the near future. One of the directives is the Corporate Sustainability Reporting Directive (CSRD). The CSRD is part of sustainable finance and a key component in achieving corporate goals. The purpose of the directive is to increase information about how companies affect people and the environment and how companies are affected by sustainability issues. The CSRD directive means that companies and organizations must report according to European sustainability reporting standards (ESRS).

The reporting will increase transparency and comparability because companies will have to provide more comprehensive disclosures and information linked to sustainability than what is required by today's reporting.

A major change is that more companies in the EU will be covered by the CSRD than by the NFRD (Non-Financial Reporting Directive). From approximately 11,700 companies that need sustainability reporting today to approximately 49,000 companies when CSRD is fully implemented. The CSRD will be implemented progressively based on the size of the companies starting from the financial year 2024, i.e., report released in 2025. The (European Commission,2023). Application of the directive takes place in four stages:

• In 2025, companies already covered by the directive on non-financial reporting must report the financial year 2024

• In 2026, large companies that are not currently covered by the directive on non-financial reporting must report the financial year 2025

• In 2027, listed small and medium-sized companies (not micro-enterprises), small and non-complex credit institutions and captive insurance companies must report the financial year 2026

• In 2029, non-European companies with a net turnover of more than EUR 150 million in the EU and with at least one subsidiary or branch in the EU that exceeds certain thresholds must report for the financial year 2028. (European Commission,2023).

4.3.1 EU ETS for buildings and road transport and fuels for additional sectors

The Council and Parliament agreed to create a new, separate emissions trading system for the buildings and road transport sector and fuels for additional sectors, in order to ensure cost-efficient emissions reductions in these sectors that have been difficult to decarbonize so far. The new system will apply to distributors that supply fuels to the buildings, road transport and certain other sectors. Part of the revenues from the auctioning will be used to support vulnerable households and micro-enterprises through a dedicated Social Climate Fund.

The co-legislators agreed that the system will start in 2027.The linear reduction factor was set at 5.15 from 2024 and 5.43 from 2028. The Council and Parliament agreed to auction an additional 30% of the auction volume for the first year of the launch of the system, so that it runs smoothly (“frontloading”).

The agreement extends the scope of the system to fuels used in certain industrial sectors. Therefore, it has been agreed to increase the size the Social Climate Fund correspondingly.

The co-legislators agreed on a temporary possibility for member states to exempt suppliers from surrendering allowances until December 2030, if they are subject to a carbon tax at national level, the level of which is equivalent to or higher than the auction price for allowances in the new emission trading system.

There will be a simplified monitoring reporting and verification requirements for small fuel suppliers. In case the energy prices are exceptionally high, the start of the new ETS will be delayed until 2028.

Once the system has started, if the price of allowances exceeds € 45 over a certain period, additional allowances will be released increasing the supply on the market. (Fit for 55, 2022).

The current situation with emissions trading is that the EU countries, the European Parliament and the European Commission have reached a preliminary agreement on a reform of the EU's emissions trading in December. It also means a completely new emissions trading system that applies, among other things, to emissions from road traffic, heating of buildings and emissions from industry, which no longer belong to the current emissions trading system.

Emissions trading in these sectors is to start in 2027, but there is a special emergency braking mechanism, which means that trading will start in 2028 if the prices of natural gas or crude oil are very high. Both the European Parliament and the Council must now accept the agreement officially. The legislation should be completed by the end of June 2024. The Ministry of Labor and Employment is responsible for the legislation. (Valtteri Härmälä, 2023 Ministry of Communications). The following regulations need to be considered by Prevex in order to determine how they can carry out transportation in the future.

5 Carbon footprint calculation of Oy Prevex Ab

In this chapter I will describe how Prevex have done their carbon footprint calculation and how they have calculated scope1, scope 2, and scope 3. And the boundaries they have taken in to cpnsiduration.

5.1 Background

Prevex has calculated their scope 1 and 2 emissions for the years 2018 and 2019 beforehand, but the need to understand the emissions from the whole value chain has been growing, and therefore Prevex has chosen to calculate their emissions from scopes 1, 2, and 3 in 2021 the calculation year being 2020. (Niclas Caldén Prevex,2023).

5.2 Calculation boundaries

Prevex has conducted its carbon footprint calculation according to the standards and guidance described in the GHG Protocol (version 2004, amendment 2013). For scope 3 emissions, a separate scope 3 emission calculation standard (20112) and a technical guide (20133) (The GHG Protocol Corporate Accounting and Reporting Standard (2004).

That supplement, the GHG Protocol were also applied. Prevex has set the organizational boundaries under the control approach, and therefore accounts for 100 percent of the GHG emissions from operations over which it has control. The calculation concerns Prevex locations: the Finnish sites in Nykarleby and Jakobstad and the Polish site in Poznan. Prevex has set the operational boundaries to include scopes 1, 2, and 3 in the calculation. Corporate Value Chain (Scope 3).

5.2.1 Scope 1

Consists of direct GHG emissions that occur from sources that are owned or controlled by the company, such as company owned vehicles. Scope 2 accounts for GHG emissions from the generation of purchased electricity and heat consumed by the company. Scope 3 emissions are other indirect emissions originating from the company’s supply chain. Scope 3 comprises 15 different emission categories that you can see in tabell 1. Of which categories 1, 2, 4, 5, 6, 7, 9, and 12 were observed in Prevex’s carbon footprint calculation for the year 2020.

Scope 3 category	Observed in Prevex Group's calculations
1. Purchased goods and services	X
2. Capital goods	X
3. Emissions from fuels and energy that are not included in scope 1 or scope 2 emissions	
4. Upstream transportation and distribution	X
5. Waste generated in operations	X
6. Business travel	X
7. Employee commuting	X
8. Upstream leasing-commodities	
9. Downstream transportation and distribution	X
10. Processing of sold products	
11. Use of sold products	
12. End-of-life treatment of sold products	X
13. Downstream leasing-commodities	
14. Franchisee's emissions	
15. Investments	

Tabell 1. Scope 3 categories observed in Prevex emissions calculation for year 2020, carried out 2021. (Ecobio, 2020).

Coverage and variables of the calculation Prevex has carried out its first carbon footprint calculation in year 2020 with Ecobio Oy. At the time, the calculation only concerned scopes 1 and 2 emissions at the Finnish locations in Nykarleby and Jakobstad. The first calculation was done for the year 2019, but after that Prevex has updated their scope 1 and 2 emission calculation to cover the Polish site and the reporting for years 2018, 2019 and 2020. In 2021, Prevex expanded the 2020 calculation to cover scope 3 emissions, too. (Niclas Caldén Prevex, 2023).

The actual calculation was carried out with an Excel-based calculation tool that has been tailored to fit Prevex needs and operations. The tool is made by Ecobio Oy. The most accurate information available was used in the calculations. Since this was Prevex first´s carbon footprint calculation with scope 3, the base year has not yet been set but it will be set at a later time.

The base year should represent a typical year of operation and represent the earliest relevant point in time for which Prevex has reliable data on emissions. If there are large fluctuations in GHG emissions between years, Prevex may use an average of annual emissions over several consecutive years or set a rolling base year. Scope 1 In 2020, Prevex scope 1 emissions consisted of fuel use in cars and machines, and self-produced energy.

No refrigerant leaks were detected in 2020. Energy is self-produced only in Nykarleby and it is solar power. The emission factors of fuels were based on Finnish national fuel classification that is updated annually by Statistics Finland and United States Environmental Agency (EPA) database that is updated frequently. Emissions from refrigerant losses were calculated based on the Global Warming Potential (GWP) of the refrigerant agents published on IPCC's climate reports. (Ecobio, 2020).

5.2.2 Scope 2

Scope 2 emissions were generated indirectly from electricity and heat production. Two different emission values were calculated according to the GHG-protocol: market- and location-based emissions. The market-based emissions were calculated using emission factors provided by the electricity and heat producers. This enables consideration of the impacts specifically from the company's selected method of energy generation as opposed to location-based emission factors. Which are national averages and as such represent the state of the electricity and heat network on the national level. The national state is considered because usually fossil based energy is required to ensure electrical security even if a company purchases green energy. Location-based emissions also offer a national benchmark for the environmental friendliness of the energy the company has bought. In Prevex cases, only market-based emissions are included in the company's carbon footprint and location-based emissions are reported separately.

The emission factors used for calculating energy indirect emission are supplier-specific and requested straight from the suppliers. In Poznan the specific emission factor for electricity was not known, so the national emission factor was used. Also, heat in Poznan is produced with natural gas, so the market-based emissions were calculated with a suitable emission factor for natural gas. However, for location-based calculations an emission factor for Polish district heating was used.

5.2.3 Scope 3

8 categories out of 15 were identified to be relevant for Prevex scope 3 inventories: categories 1, 2, 4, 5, 6, 7, 9, and 12. The assumptions used in different categories are reported below.

Category 1 consists of all products and services purchased during the reporting year. It includes all raw materials, such as different plastics and metals Prevex had purchased during the year. All purchases are reported in kilograms so the emission calculation could be done with accurate kilogram-based emission factors, many of which were acquired straight from Prevex. Some emission factors were taken from environmental product declarations and some from research literature.

Category 2 consists of the long-life purchases that a company needs to produce their products, such as machinery or new facilities. In 2020, a new office building was built in Nykarleby. The emissions for the building, renovation and some other purchases were calculated based on their monetary value which is a typical way of calculating emissions.

Category 4 includes transportation and distribution of purchased products between company's suppliers and its own operations in vehicles not owned or operated by the reporting company. According to the GHG Protocol, also outbound transportation and distribution that is paid by Prevex is considered in this category, and transportation and distribution paid by someone else is calculated in category 9.

The emissions from transportation were calculated based on ton-kilometers. This means that one-way distance of transportation route is multiplied by the mass transported on that specific route. Routes were categorized by the import and export country and the transport distances were estimated between Prevex locations and the middle point of the import or export country. In reality, most purchases are transported by, for example, road and sea, but in carbon footprint calculation the transportation was generalized to be done only by road or by sea. Internal shipments between Nykarleby and Jakobstad were calculated more precisely and also the drive back to the point of departure was taken into account.

Emission factors used for calculating emissions from transportation and distribution were taken from GLEC Framework which is a globally recognized methodology for harmonized reporting of the logistic sector's greenhouse gas emissions. (Technical Guidance for Calculating Scope 3 Emissions (2013).

Category 5 includes emissions from third-party disposal and treatment of waste generated in the reporting company's owned or controlled operations during the reporting year. Category includes emissions from disposal of both solid waste and wastewater. However, wastewater emissions were not calculated for Prevex as the amount of wastewater

produced yearly is so insignificant regarding the emissions. Emission factors were taken from EPA's database that is updated frequently.

Category 6 consists of emissions from the transportation of employees for business related activities in vehicles owned or operated by third parties, such as aircrafts, trains, buses, and passenger cars. The emissions were calculated based on kilometers travelled by different types of transportation. Emissions were calculated based on Defra's (Department for environment, food and rural affairs) GHG conversion factors for company level reporting.

Category 7 includes emissions from the transportation of employees between their homes and their worksites by car, public transport, or by walking and bicycling. The emissions were calculated based on kilometers travelled by different types of transportation. The commuting distances were based on estimations. The Covid-19 pandemic affected the working days at the office, so estimations of office and factory working days were used. Emissions were calculated based on Defra's (Department for environment, food and rural affairs) GHG conversion factors for company level reporting.

Category 12 includes the emissions from the assumed waste treatment processes of sold products after their use. Emissions were calculated using the methods as in category 5. The amount of waste treated was the amount of different plastic materials sold by Prevex in 2020. The treatment methods of Prevex materials were estimated based on usual waste treatment practices in Europe. (Ecobio, 2020).

Category 8. Results of the calculation To calculate Prevex carbon footprint in accordance with the standards and guidelines set by the GHG Protocol. All the relevant GHG emission sources and Prevex facilities were included in the calculation. In total, Prevex carbon footprint in 2020 was 16 655,1 t CO2e.

Scope 1 and 2 emissions were relatively small compared to scope 3 emissions that accounted for 96% of all emissions. (Figure 2). The emissions of an average Finn are 10,3 t CO2e in a year 5 so Prevex emissions was equal to 1 617 Finns' yearly emissions. (Aalto-yliopiston taloustieteellinen työryhmä (2019). Compared to the average emissions related to car transportation on household level, which is about 2 t CO2 per household annually in Finland, Prevex emissions equal to 8 328 households' driving emissions. (Ecobio, 2020).

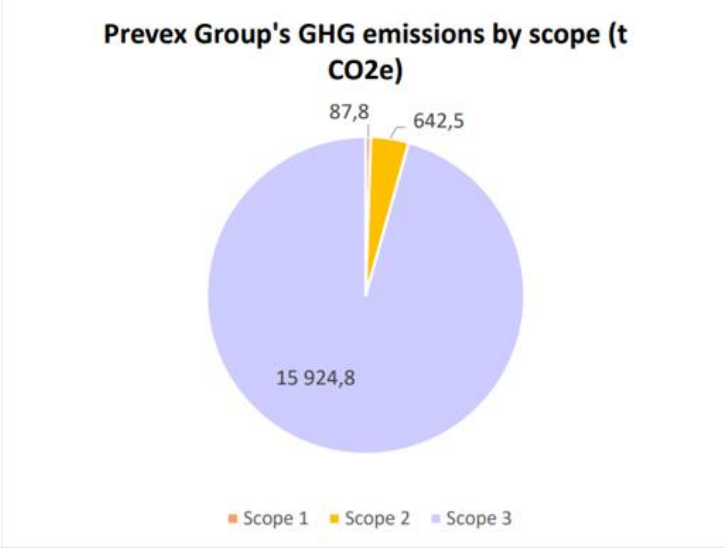


Figure 2. Prevex greenhouse gas emission in 2020. Scope 3 emissions accounted for 96% of all emissions. (Ecobio, 2020).

5.3 Scope 1 results

Prevex scope 1 emissions consisted of fuel use, refrigerant leaks, and self-produced energy. (Figure 3). As there were no refrigerant leaks in 2020 and the self-produced energy is solar power which does not cause greenhouse gas emissions in the production phase, the only emissions were generated by the use of fuel. Prevex's fuel use generated 87,8 t CO2e emissions. (Figure 4). The majority of fuel is used in Poznan, so most emissions were generated there (Ecobio, 2020).

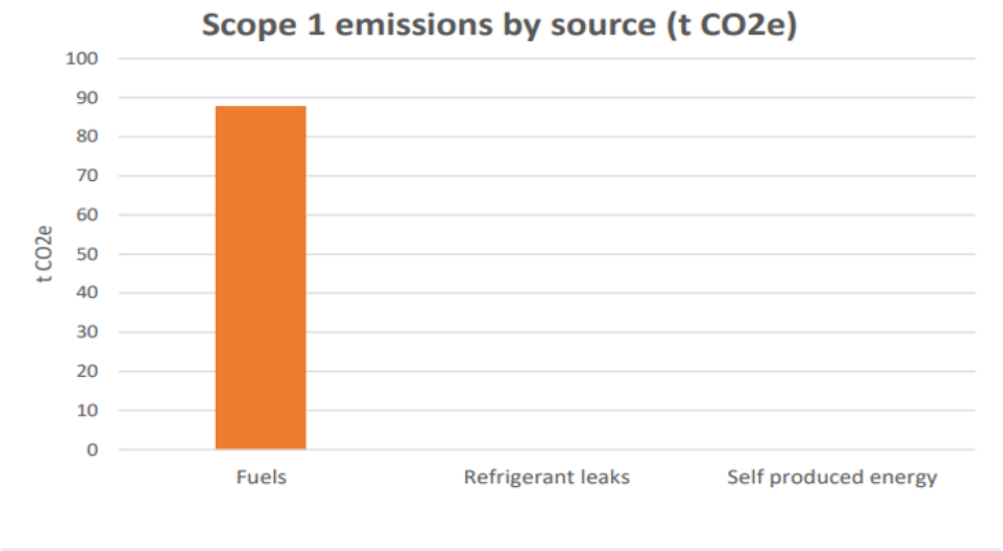


Figure 3. Prevex scope 1 emissions. No refrigerant leaks were detected in 2020, and the self-produced energy was solar power which dos does not cause greenhouse gas emission. (Ecobio, 2020).

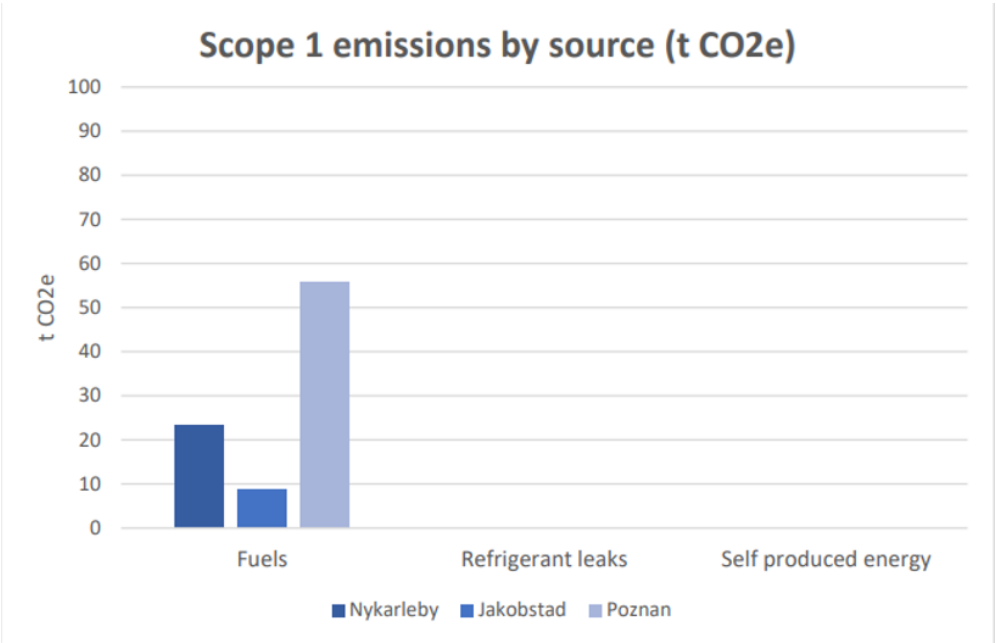


Figure 4. Scope 1 emission between sites. (Ecobio, 2020).

5.3.1 Scope 2 results

Prevex scope 2 emissions resulted from the use of electricity and heat. The market-based scope 2 emissions were 642,5 t CO2e of which electricity generated 466,5 t CO2e and heat 176,1 t CO2e (figure 5). Emissions from electricity use were largest in Poznan as the national average emission factor had to be used in the emission calculation.

Electricity production is quite carbon intensive in Poland and therefore Poznan's electricity emissions seem relatively high (figure 6). The additional information reported separately from the carbon footprint are the location-based emissions that represent the national energy grid's average emissions. The location-based scope 2 emissions were 1 667,6 t CO2e. This means that the energy Prevex uses is less carbon intensive than the national average. Also, Prevex buys district heating produced partly with biomass in Nykarleby and Jakobstad. Only methane and nitrous oxide emissions are considered for calculation of carbon footprint according to GHG Protocol and carbon dioxide emissions are reported separately. The carbon dioxide emissions from burning of biomass were 1 156,4 t. (Ecobio, 2020).

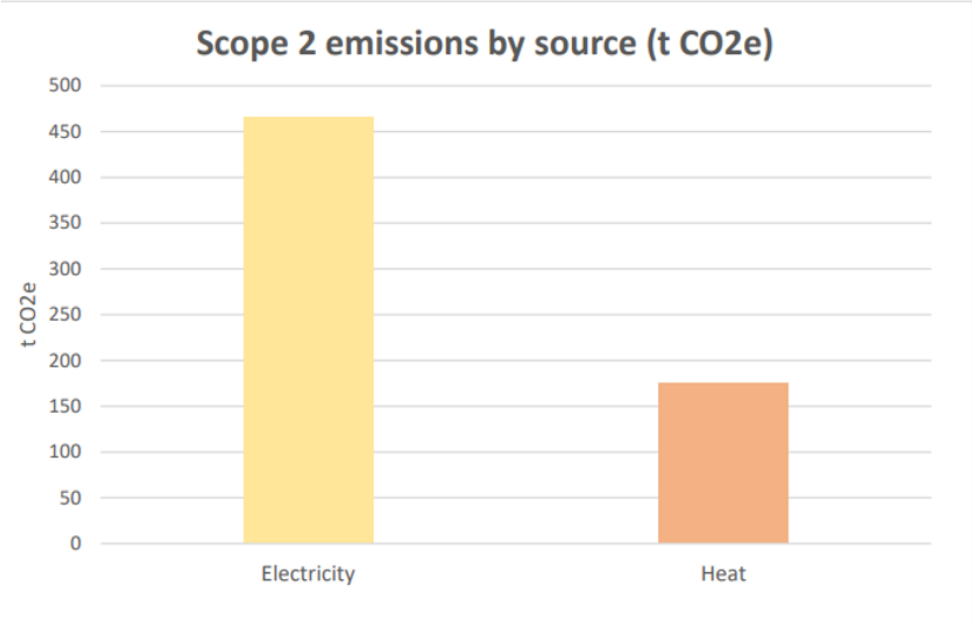


Figure 5. Prevex scope 2 emission in 2020. (Ecobio, 2020).

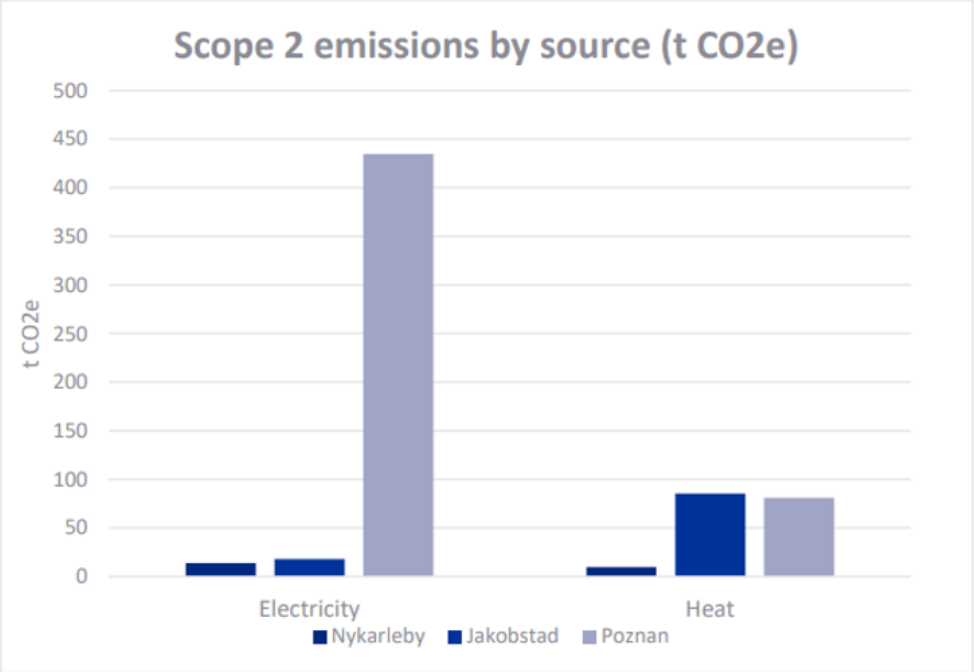


Figure 6. Scope 2 emissions by site in 2020. Emission from electricity in Poland seem high because national average emission factor was used and electricity production in Poland is very carbon intensive. (Ecobio, 2020).

5.3.2 Scope 3 results

Prevex's scope 3 emissions were 15 924,8 t CO2e in 2020 (figure 6) of which the vast majority were generated in Nykarleby where the largest production facilities are located (figure 7). On a group leve (figure8), most emissions were generated in the production of raw materials (category 1; 9 655,9 t CO2e) and end of-life treatment of sold products (category 12; 3 052,3 t CO2e). The third largest emission category was category 2 (capital goods) which had emissions of 2 107,5 t CO2e. In category 2, most emissions were generated in building the new office in Nykarleby. Less emissions were generated in other operations of the value chain. Upstream transportation and distribution (category 4) resulted in emissions of 472,7 t CO2e and the downstream transportation and distribution (category 9) in emissions of 250,0 t CO2e. The waste treatment (category 5) created 131,7 t CO2e, and employee commuting 245,7 t CO2e. Business travel was heavily affected by the Covid-19 pandemic in 2020, so emissions from category 6 were only 8,9 t CO2e. (Ecobio, 2020).

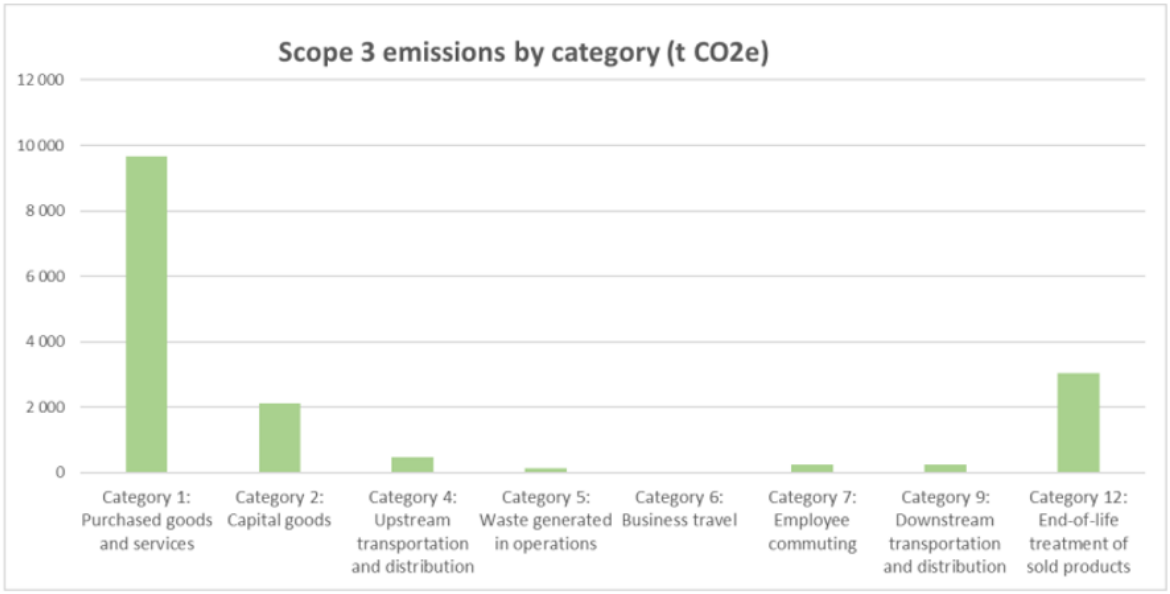


Figure 7. Prevex scope 3 emission in 2020. The production of raw materials (category 1) and end-of-life treatment of sold products (category 12) generated most of the emission. (Ecobio, 2020).

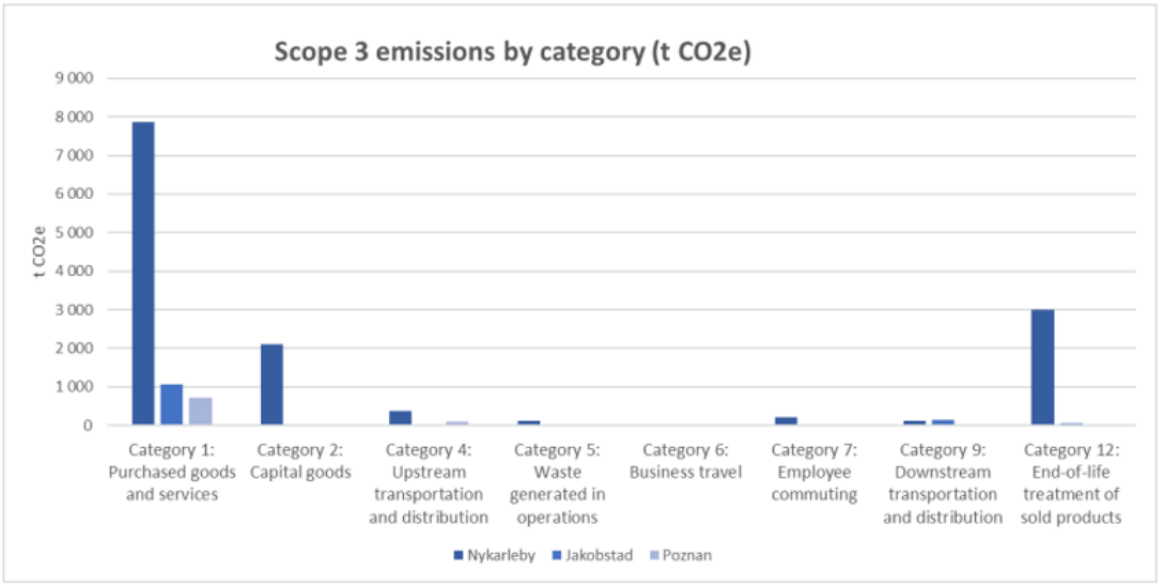


Figure 8. Scope 3 emissions between sites. Most emissions were generated in Nykarleby as the largest production site is located there.(Ecobio, 2020).

5.4 Uncertainties

When interpreting the results, it is important to understand the potential uncertainties, especially regarding scope 3. Data in scopes 1 and 2 is site and supplier specific and therefore the emissions represent the most accurate quality. However, it is typical that in and information regarding emissions. (Seo, M-S., T. Kim, G. Hong & H. Kim (2016). On-site measurements of CO2 emissions during the construction phase of a building complex. Energies 9:599).

It is important to define the data for the most important emission sources whenever possible and set less emphasis on less important categories. The biggest uncertainties regarding the calculation lie in scope 3 categories 2, 4, 9, and 12 even though estimations and generalizations were made in other categories, as well. The highest emissions in category 2 were related to building a new office in Nykarleby. The calculation was done based on the building costs and with an emission factor taken from a case study in which typical building emissions are proportioned to monetary value7.

Therefore, the emissions are an estimation of the true emissions generated during the project. However, it is very typical that the exact building emissions are not known and only the building expenses can be used for the calculation. Calculation based on monetary value is an accepted and recommended method by the GHG Protocol when the reporting company is not able to get any other emission information. In the future, there will be more regulations for the building companies to measure and report their emissions, so Prevex may be able to get more accurate emission data of its building investments.

There are lots of estimations used in categories 4 and 9. The distances travelled between Prevex´s facilities and the import or export country were rough estimations, as was the transportation type. Most of the transports are calculated to be done by road, when in reality the transports are a mix of different transportation types. Transportation emissions could be calculated most accurately by the fuel usage in trucks, ships, trains, and airplanes, but as the fuel consumption was not known, emissions were calculated based on ton-kilometers (kilometers travelled x tons transported).

This is a good calculation method when the share of Prevex’s products in a transport equipment is not known. As the emissions in transportation categories are relatively low compared to other categories, such generalizations and assumptions do not affect the

calculation results significantly. Prevex may be able to get tailored emission reports straight from the transportation companies in the future. Category 12, the treatment methods of sold products in the end of their life were estimated based on the most common plastic recycling practices in Europe. Prevex´s products may be recycled, combusted and landfilled with different ratios depending on the country where the parts are disposed. Prevex uses plastics and other materials that are highly recyclable, but plastic recycling in many countries has not yet reached the level where all Prevex's materials could be recycled. (ECO bio report, Niclas Caldén Prevex, 2023)

6 Focus point for the Research

After I now have explained how Prevex have calculated their scopes. I have got the task in my thesis to look more into Category 4 upstream transportation and distribution that Prevex pays for.

Because this will have a big impact in the future how and in what way Prevex do their transportations. Regarding to the CO2 footprint, but also to the sustainability world trade. So, the research question is how and in what way are the best way in the further to do the transportation at Prevex for their product's. I will put focus on the following countries that Prevex delivered the longest and most to by CPT transportation, within the Nordics and Europe and the following countries:

- Sweden
- Austria
- Germany
- Belgium
- Poland

7 The route of transport today for Prevex

CPT- Deliveries (Carriage Paid To) to the Nordics from Prevex are carried out by road transport today. The goods is loaded in Jakobstad onto trucks and depending on the transporter, the transport runs via Vasa-Umeå or to Turku-Stockholm or Nådendal-Kapellskär. About 70-80% of the transports go via the ports in southern Finland, i.e., Turku or Helsinki.

If the goods are going to southern Denmark, the transport company usually runs either via Malmö and over the Öresund Bridge and then over the Great Belt Bridge or the Forsea Helsingborg-Helsingör ferry and the Great Belt Bridge. Sometimes the goods are taken via Gothenburg with Stena Line Gothenburg-Fredrikshavn, usually if the goods are going to Jutland.

Transports to Europe and the countries of Germany and Benelux departs from Jakobstad via Hanko, Helsinki or Turku and arrive in Lubeck in Germany.

To Austria, shipping can go two ways. Sometimes only the trailer is shipped, then it goes from Jakobstad to Hanko-Gdynia and in Poland it is brought down by road transport to Austria.

Another option is from Jakobstad - Helsinki - Tallinn and then it is driven down to Balticum, through Poland and the Czech Republic to Austria. The same applies to transport to Italy, France, and Spain. Within Finland the deliveries from Jakobsta or Nykarleby are handled by Itella and goes via the terminal in Seinäjoki. The local and nearby transportations from Jakobstad or Nykarleby are handled by Nykarlebud. And package deliveries are handled of TNT. Internal transportations between the sites are handled by Go Green Transport. (Martin Sundqvist Prevex, 2023).

Prevex has no influence today, which route the transport company chooses to run to their destinations. This could in the future have a major impact on the company's C02 footprint and costs introduced in 2027 for companies and road transport. The transportation manly goes with road transportation. As the GHG scope 3 also tells.

7.1 The transports route today for Prevex

I have chosen following countries Austria, Germany, Belgium, Poland and Sweden.
To show how the transportations looks today. To be able to explain this easier I have chosen to show you this in road maps.

7.1.1 Sweden and Jakobstad - Kolbäck

The trucks are loaded in Jakobstad and to 70-80% the truck departs from Jakobstad to Turku-Stockholm or Nådendal - Kapellskär. And then after arriving to Sweden drives drive

down to Kolbäck. (Figure 9). The distance is 809 km the trip takes 15h59min and the CO2 1089 kg/transport.

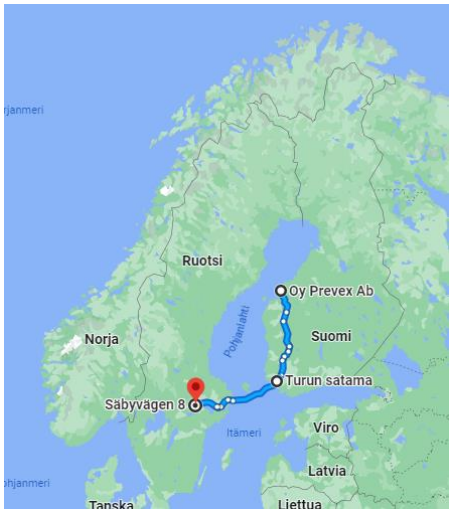


Figure 9. Jakobstad-Kolbäck truck, ship, truck. (Googel maps, 2023).

7.1.2 Austria Jakobstad - Winer Neudorf

The trucks are loaded in Jakobstad to Austria. The Trucks departs from Jakobstad - Helsinki - Tallinn and then it is driven down to Balticum, through Poland and the Czech Republic to Austria and Winer Neudorf. (Figure 10). The distance is 2215km 28h CO2 3798 kg/transport.

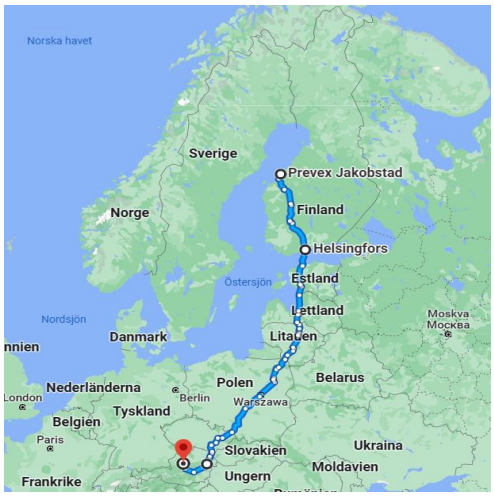


Figure 10. Jakobstad - Winer Neudorf truck, ship,truck. (Googel maps, 2023).

7.1.3 Germany and Jakobstad - Regen

The trucks are loaded in Jakobstad. The Trucks departs from Jakobstad to Hanko, Helsinki or Turku and arrive in Lubeck in Germany and down to Regen. (Figure 11). 2370 km 30h and CO2 4064 kg/transport.

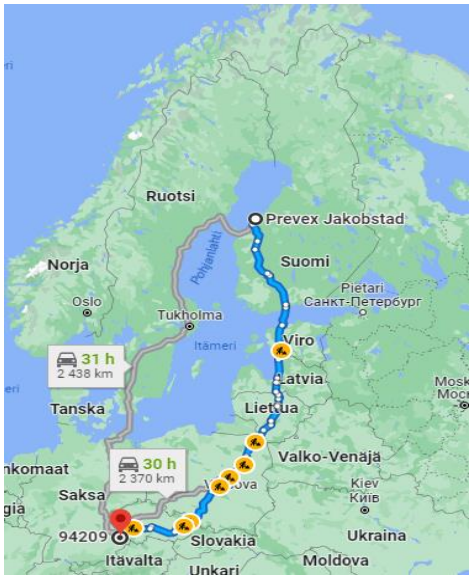


Figure 11. Jakobstad – Regen truck, ship, truck. (Googel maps, 2023).

7.1.4 Belgian and Jakobstad – Gingelom

The trucks are loaded in Jakobstad. The Trucks departs from Jakobstad to Hanko, Helsinki or Turku and arrive in Lubeck in Germany and down to Gingelmo. (Figure 12). 2792km 33h and CO2 4201kg/ transport.

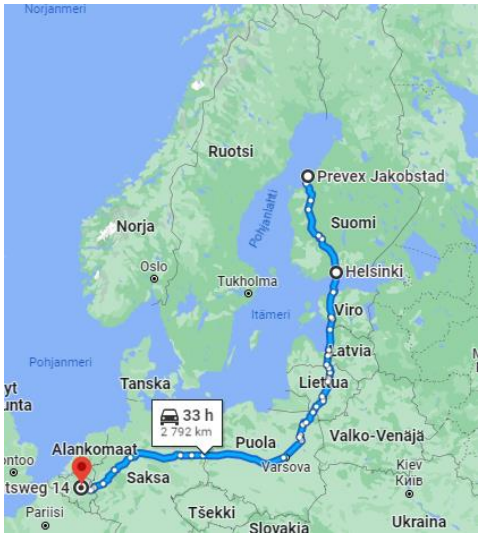


Figure 12. Jakobstad – Gingelmo truck, ship, truck. (Googel maps, 2023).

7.1.5 Poland and Jakobstad - Poznan

The trucks are loaded in Jakobstad. The Trucks departs from Jakobstad to Helsinki via Tallin and down to Poznan. (Figure 13.) 2112 km CO2 3622kg/transport and 3 days.

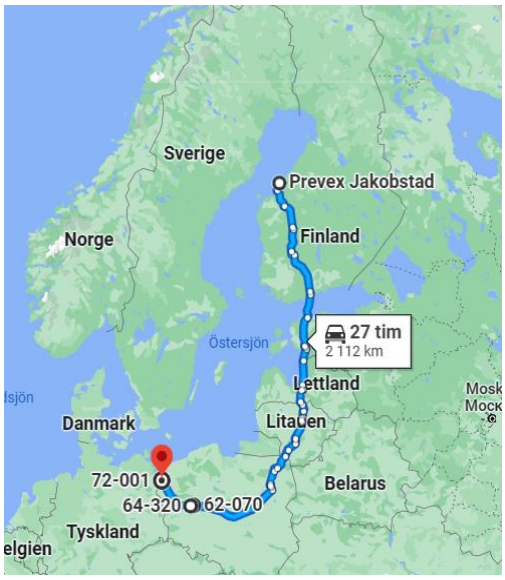


Figure 13. Jakobstad – Poznan truck, ship, truck. (Googel maps, 2023).

8 Methods of transportation in the further

The future solution for Prevex to be able to reduce their CO2 footprint could be to carry out their transports through intermodal or multimodal solutions. Intermodal transport is a transportation modality which uses standardized cargo units such as containers, swap bodies and semi-trailers that can be easily moved across different modes of transportation such as ships, trucks or trains, to be brought to the destination. Multimodal transport means combining different transport routes to get the most efficient flow of goods by train, ship and road transport. (Jonsson, Patrik & Mattson, Stig-Arne 2005, 97-98).

8.1 Intermodala transport

This mode of transportation system dates to 18th-century Britain. The British used it to move coal stored in containers over their canal network. But it wasn't until the 1960s that intermodal become the preferred choice for sea transport. Logistics companies and international organizations made efforts to integrate the other modes of transport through intermodals. Later, containerization and standardizing

international container sizes made intermodal transport even more lucrative by enabling easy handling between modal systems. Currently, intermodal transport is the dominant mode for the global supply chain and logistics. By using intermodal transport, a company can reduce delivery times. The business can use the fastest mode of transport for long distances. Using containers also allows an efficient transfer of goods from one mode of transport to another. Reduced loading and unloading times also contribute to faster delivery. (Vector, 2020).

8.1.1 Multimodal transport

Multimodal transport is the transportation of goods under a single contract but performed with at least two different modes of transport; the carrier is liable (in a legal sense) for the entire carriage, even though it is performed by several different modes of transport (by rail, sea and road, for example). The carrier does not have to possess all the means of transport, and in practice usually does not; the carriage is often performed by sub-carriers (referred to in legal language as "actual carriers"). The carrier responsible for the entire carriage is referred to as a multimodal transport operator, or MTO. (Vector, 2020).

8.1.2 What is the difference between multimodal and intermodal transport?

The terms “intermodal” and “multimodal” both imply the use of more than one mode of travel. However, the two forms of transportation, intermodal and multimodal, are distinct in a number of ways. With intermodal shipping, each leg of your journey is handled by a separate company. As a result, you have a plethora of shipping invoices and reports, one for each step in the chain.

Like multimodal transportation, intermodal transport involves using more than one mode of transportation to convey goods (in this case, FEU and TEU containers) from point A to point B. In contrast to multimodal transportation, in which all modes are operated by the same company, in this scenario, the carriers are separate. As opposed to multimodal transportation, which just needs a single contract, this approach necessitates separate agreements for each leg of the trip. (Navata Rooad Transport 2023).

Intermodal transport may include more than one method of transportation, such as train, ship, and truck. While the cost of intermodal transport is lower than that of multimodal

transport, significant time is required for carrier negotiations. Safer, less time-consuming, and more efficient transport is possible with intermodal transportation. (Figure 14).

When businesses choose multimodal shipping, they just have to deal with one source for all of their shipping needs, eliminating the hassle of juggling many contacts. Timely deliveries are only one of the many benefits of multimodal transport, with sophisticated tracking capabilities. (Navata Rooad Transport, 2023).

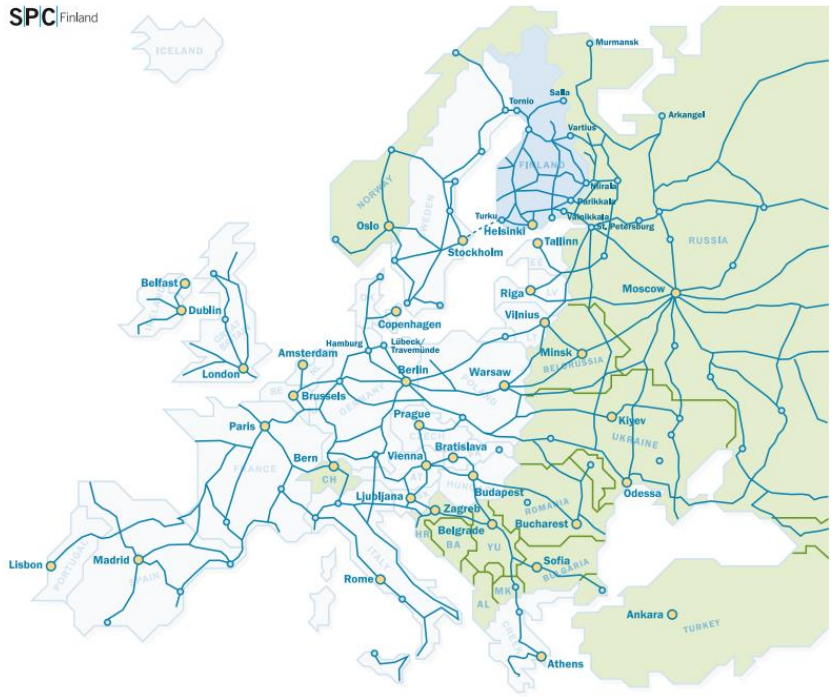


Figure 14. The European railway map. (SPC,2008).

Today, this is a good solution that Prevex does not use. I have found during the research there are two protentional company's for Prevex that offer intermodala or multimodala transportation solutions nearby. These are Green Cargo which is located in Sweden Holmsund and the other company is First Row Shipping also located in Sweden Lund. It may come more local transportations companies that will offer this service in near future. But that is too early to tell.

These two companies tailor door-to-door transportation for their customers. Below I will present how Prevex transportations could look like if they used this mode of transport and what it concretely reduces in CO2 emissions. But first a short introduction of these companies.

8.1.3 Green Cargo

Green Cargo is the largest train operator in Sweden. (Figure 15). They offer customized and climate smart logistics solutions to business customers. They ensure that the goods are delivered to the right place, at the right time, in the right condition. With their extensive national and international rail network, they provide:

- rail freight from A to B.
- door-to-door solutions, by combining rail with other modes of transport to reach beyond the railway track. (Anders Ohlsén Green Cargo, 2023).

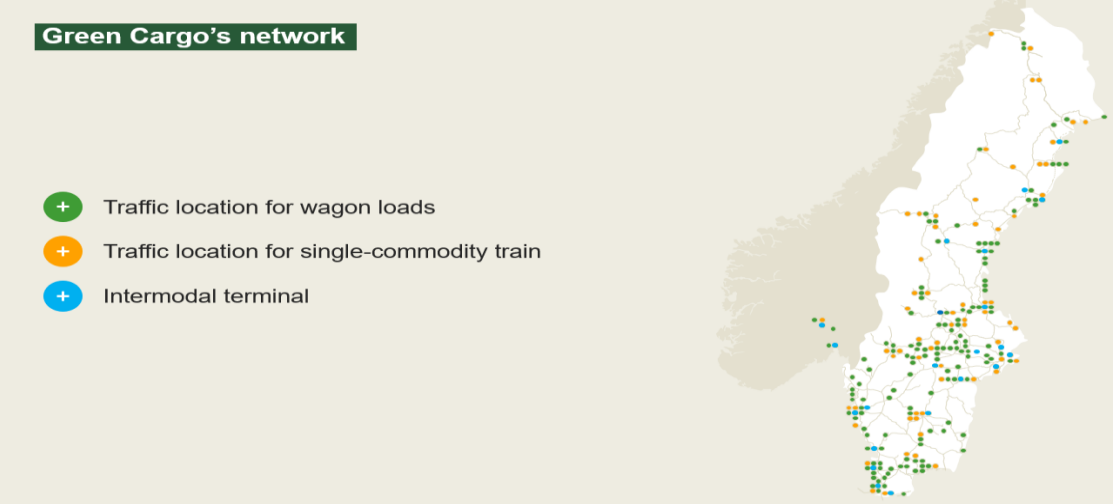


Figure 15. Green Cargo´s Network. (Green Cargo, 2023).

8.1.4 First Row Shipping

First Row Shipping is an independent intermodal freight forwarder and agency founded in 2018 and based in Lund, Sweden. First Row Shipping have wide experience of Break Bulk, RoRo, Container Shipping, multimodal o intermodal transport and freight forwarding. (Jens Schrevelius First Row Shipping, 2023).

9 Transportations ways in the future

I will describe below how the transportations could look like if Prevex chose an Intermodal or multimodal solution instead in the future. I will use the same countries and destinations so you can compare how Prevex do today and how it could look like in the future.

9.1. Sweden and Jakobstad - Kolbäck

The trailer or container is loaded in Jakobstad and to depart from Jakobstad to Vasa-Umeå - Eskilstuna. And then after arriving in Eskilstuna, the trailer or container is driven to Kolbäck. (Figure 16.) The distance 875,3 km CO2 238kg CO2/transport and 2 days.

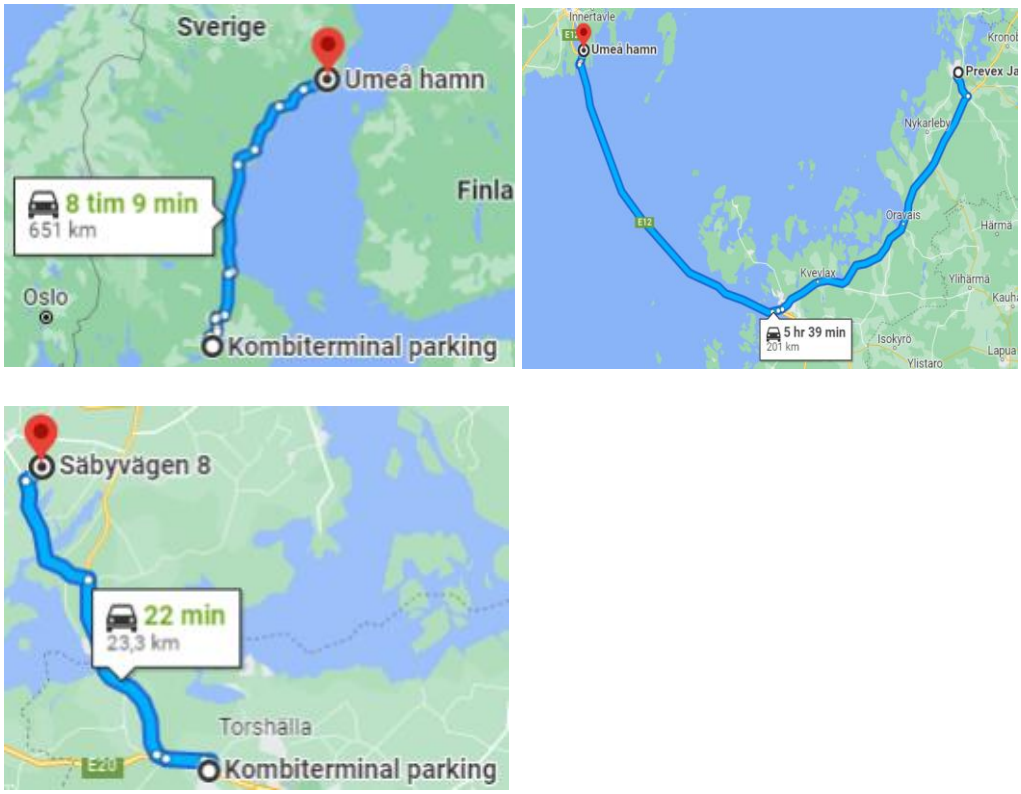


Figure 16. Jakobstad-Kolbäck with Green Cargo truck, ship, train truck. (Googel maps, 2023).

9.1.1 Austria and Jakobstad - Winer Neudorf

The trailer or container is loaded in Jakobstad and depart from Jakobstad to Vasa-Umeå-Göteborg-Malmö port - Lübeck-Lübeck-Wien-Wien-Customer. (Figure 17). The distance is 2514 Km 875kg CO2/transport and 8 days.

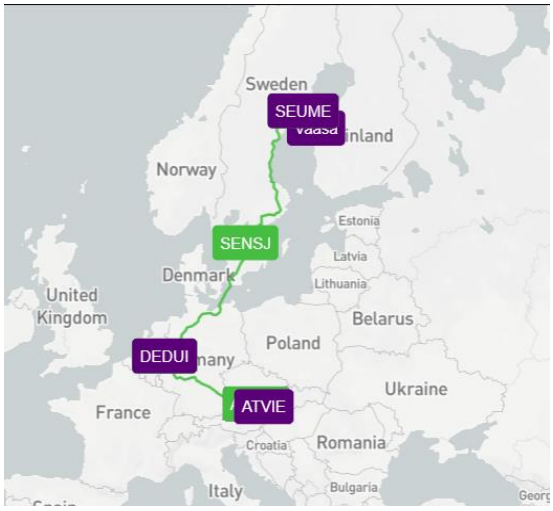


Figure 17. Jakobstad - Winer Neudorf with First Row Shipping truck, ship, train, truck. (Googel maps, 2023).

9.1.2 Austria and Jakobstad - Winer Neudorf

The trailer or container is loaded in Jakobstad and depart from Jakobstad to Vasa – Umeå – Malmö- Lübeck-Wien-Customer. (Figure 18).The distance 2244km 679kg CO2/ transport and 8 days.

Figure 18. Austria Jakobstad - Winer Neudorf Green Cargo truck, ship, train, truck. (Googel maps, 2023).

9.1.3 Germany and Jakobstad - Regen

The trailer or container is loaded in Jakobstad and to depart from Jakobstad to Kokkola-Lubeck-Nurnberg-Customer. (Figure 19).The distance is 2869 km 660kg CO2/transport and 7 days.

Figure 19. Jakobstad - Regen with Route Scanner truck, ship, train truck. (Googel maps, 2023).

9.1.4 Belgian and Jakobstad - Gingelom

The trailer or container is loaded in Jakobstad and to depart from Jakobstad to Vasa-Göteborg-Gent-Customer. (Figure 20). The distance is 2361km 759kg CO2/ transport and 4-5 days.

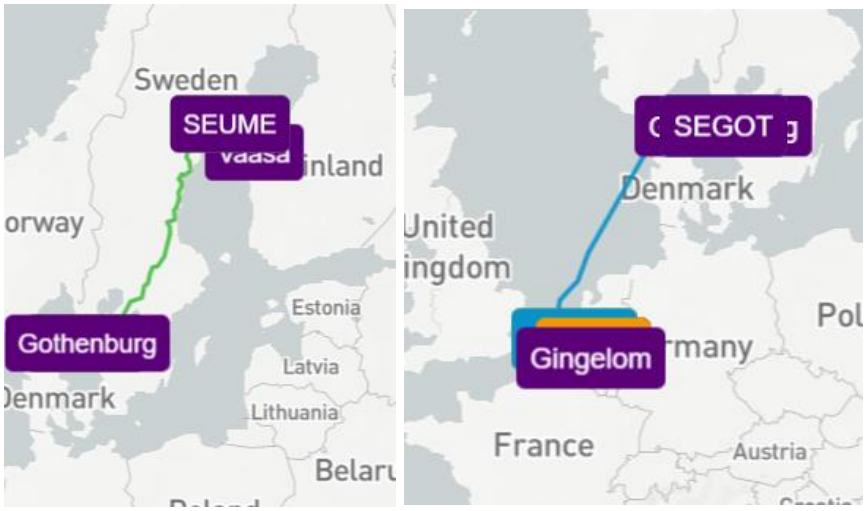


Figure 20. Jakobstad – Gingelmo with First Row Shipping truck, ship, train, ship, truck. (Googel maps, 2023).

9.1.5 Poland and Jakobstad – Poznan

The trailer or container is loaded in Jakobstad and to depart from Jakobstad to Vasa-Umeå-Göteborg-Malmö-Malmö hamn- Lubeck- Poznan- Customer. (Figure 21). The distance is 2197km 798kg CO2/ transport and 3-4 days.

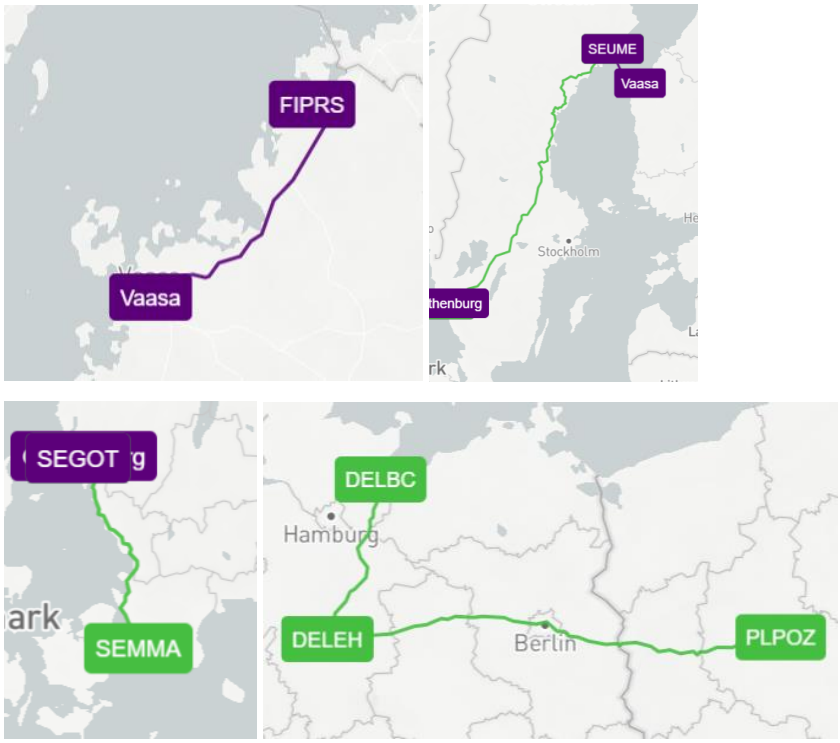


Figure 21. Jakobstad – Poznan with First Row Shipping truck, ship, train, truck. (Googel maps, 2023).

9.1.6 Poland and Jakobstad – Poznan

The trailer or container is loaded in Jakobstad and to depart from Jakobstad to Rauma-Lubeck- Poznan- Customer. (Figure 22). The distance is 1540 km 505 kg CO2/ transport and 4 days.

Figure 22. Jakobstad – Poznan with Rout scanner truck, ship, train, truck. (Googel maps, 2023).

10 Empirical study

In this chapter, I will tell you how I conducted this survey in order to answer the research questions.

1. Can Prevex choose an environmentally friendly way to transport their products in the future and reduce their CO2 footprint?

2. If so, in what way can this be accomplished?

By analyzing Prevex's current GHG emissions and the company's current analysis.

I got information about this by talking to the focus group and asking them questions such as why? How? And what? The focus group consisted of the following participants:

Niclas Caldén is the Senior Advisor at Prevex and works actively with sustainability issues within Prevex and GHG calculations and reporting.

Mikael Gäddnäs is the COO at Prevex is responsible for the operational part of Prevex. Have extensive knowledge within production and the transport flow in Prevex.

Martin Sundvist is the Warehouse Manager at Prevex and has extensive knowledge of internal and external logistics at Prevex.

Anders Ohlsén is the Sales Manager at Green Cargo. He has extensive knowledge in intermodal transport within rail transport in Sweden.

Jens Scherevelius is the Sales Manager at First Row Shipping and has extensive knowledge in intermodal and multimodal transport within and outside Europe.

Prevex's wish was for me to focus my research on category 4 upstream transports. The countries I focused on were Sweden, Austria, Germany, Belgium, and Poland. Prevex transports the largest quantities of its products to these countries, where Prevex also covers the delivery costs to the customer.

After having received the exact addresses for the customers to the above countries, as well as discussing with Martin Sundqvist the Warehouse manager at Prevex about which different routes the goods are transported today from the warehouse in Jakobstad.

I used Google Maps to make a map of how the goods are transported today, and how far the distance is from the Prevex warehouse in Jakobstad to each customer in the above countries. Based on the numbers of kilometers, I calculated the current CO2 footprints. As shown in Chapter 7.

After mapping the current mode of transport, I researched to see if there were other alternative transport solutions that could reduce the CO2 footprint of transport to destinations in the above countries. After doing some research, I came across two companies that offer Intermodal and Multimodal solutions. The companies are Green Cargo and First Row shipping, both located in Sweden. I contacted these companies and discussed with Anders Ohlsén at Green Cargo and Jens Sherevelius at First Row Shipping about intermodal and multiomdal solutions.

They were able to tell me that they offer transport solutions already today for the destinations and countries above through intermodal and multimodal solutions.
Based on the discussion and the facts I got from these companies, I was able to map the same destinations, but with a different route as shown in Chapter 9. After mapping the new route, I calculated the kilometers, CO2 and travel time of the new alternative route. I could conclude that today there is a more environmentally friendly way to transport Prevex products and the way to do this is by intermodal or through multimodal transports.

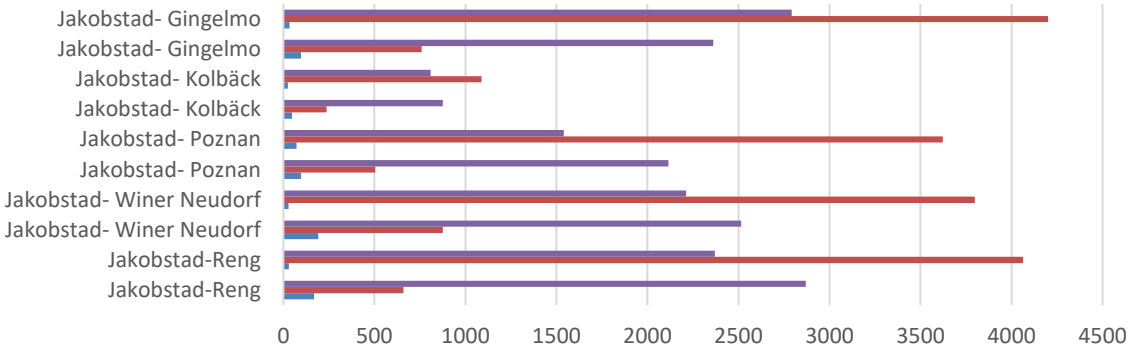
11 Discussion

I will present my personal opinions in this chapter. There is a lot of information on the subject, and I am happy to see that there are people who have a great interest and a lot of knowledge in the field of sustainable world trade. It is quite clear that there are already better and more environmentally friendly ways to transport products from companies to customers by using intermodal or multimodal transport solutions to reduce the road transport that currently handles large parts of the transport for industrial companies. I can also see in my research that not everyone is fully aware of the various possibilities that already exist today. I personally think that there will be big changes in methods of transportation in the near future. To reduce C02 emissions, the fuel or mode of transport needs to be changed. Otherwise, it will be difficult to reduce the CO2 footprint by 2030 and

to reach the climate goals. What is interesting and gives hope for the future, is that there are industrial companies like Prevex that work actively with sustainability and are driven and have set climate goals and work actively to reduce the CO2 footprint in their operations. This is just the beginning.

12 Conclusion

I have concluded in my thesis that there are alternative and more environmentally friendly ways of transport for Prevex to export its products in the future and also be able to reduce its CO2 footprint. Prevex today uses road transport combined with ship transport. Road transport today has a relatively high C02 emission when compared to other alternative modes of transport. The alternative that I propose in my research is that Prevex could use intermodal and multimodal transport solutions in the future. These carriers are already on the market today and fully usable. However, these transports are most optimal from A-B destinations. What I can also state is that by using intermodal and multimodal transport solutions, Prevex could reduce its CO2 emissions quite a lot. (Tabell 2). And without the delivery time being affected so much based on today's delivery time. In the diagram below you can see the effect of using intermodal and multimodal transportation instead of only road transports.



	Jakobstad -Reng	Jakobstad -Reng	Jakobstad - Winer Neudorf	Jakobstad - Winer Neudorf	Jakobstad - Poznan	Jakobstad - Poznan	Jakobstad - Kolbäck	Jakobstad - Kolbäck	Jakobstad - Gingelmo	Jakobstad - Gingelmo
Km	2869	2370	2514	2212	2115	1540	875,3	809	2361	2792
CO2/Kg	660	4064	875	3798	505	3 622	238	1089	759	4201
h	168	30	192	28	96	72	48	24	96	33

Tabell 2. Today CO2 emissions compared to using intermodal, multimodal transportations in the future.

What is also needed in the future for Prevex if it were to decide to switch to this intermodal and multimodal mode of transport is to review the partners' current bookings for these transports, since none of the current transport companies offer these services. What I would recommend, based on my research, is that Prevex use road transport to the destinations for which they do not have full loads. But for those destinations where they have full loads, they would use intermodal and multimodal solutions. And there First Row Shipping is a good candidate. This means that Prevex needs to review bookings of transport and destinations to make this possible.

But to do that, Prevex needs to rethink its transport planning for the exports that Prevex pays for. The carriers that Prevex uses today do not offer intermodal or multimodal solutions. Prevex has many destinations to Sweden and there it would be a good to use Green Cargo solutions, they reach a lot of destinations in Sweden nearby Prevex customers. Prevex could consider that they also recommend customers that has paid for their own transportations from Prevex to also use intermodala and multimodala solutions to reduce their CO2 emissions.

12.1 Concluding remarks

I started this journey in April 2022, when agreeing with Oy Prevex Ab to do my thesis for them. And now one year later the work is completed. When I am looking back, it has been an interesting but challenging journey. The writing of the thesis took time and effort. The best part of this thesis was the good an interesting discussion with the focus groups. It is always inspiring to listen to people who are passionate about their jobs and have great knowledge.

There have been times during this writing period that I have not been able to write, wichs was sometimes frustrating when it feels like starting all over again. I have had a very short timeline for this thesis, and I was aware of that from the beginning.

So, my recommendation to others that also set a short timeline, you have to have a structured way of working and self-discipline. There have been many late nights and evenings. But if someone asks me if it was all wort it, I will always answer that question with a yes! I have learned a lot during this journey. And knowledge is not heavy to carry. I

hope that this work will be of interest and bring contribution to future research work to other.

13 Future research

Within this topic, there are many more interesting things to research future. It would be interesting to take a closer look at the upstream transport of purchased gods at Prevex, and how it could travel via intermodal and multimodal modes of transport. In this area Prevex has the largest CO2 figures today. But also, to take a closer look at transport companies in Finland. How they intend to act in the face of the new emissions regulations that will enter into force in 2027 for road transport. And if companies today take a closer look themselves or question how transport companies will act and what more environmentally friendly solutions, they will see that they need to offer their customers in the future. Transport companies in Finland are considering switching to intermodal and multimodal solutions. There is definitely more to research on this topic.

14 Summary

This thesis set out to give an overview of the current situation of Prevex´s GHG emissions and modes of transport and deliver their product to their customers. The research focus point was to look into Prevex´s Category 4 downstream transportation. If these transportations could be done in a more environmentally friendly way and if so, in what way can this be accomplished?

And as you can read in the thesis, there are actors today that offer good intermodal and multimodal solutions to companies today that can reduce the C02 emission or and will have a positive effect on the environment. I have put focus on five different destinations and compared how Prevex manly transport today with road transport and how the same destinations with intermodal and multimodal solution could look like. And the result is that it is almost the same distans, but the CO2 emission are much lower with intermodal and multimodal solutions. The time is almost the same.

The cost I have not compared in this thesis. But even if the cost with intermodal and multimodal transportations method should be a bit higher the companies have to consider that they have to pay for the emissions in the future. I think it will change a lot in how we

are thinking and act regarding the transportation methods in companies, transporters, ports, and shipping companies before 2030.

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