METHODS FOR CALCULATING AND REPORTING OF CARBON DIOXIDE EMISSIONS IN FINNISH LOGISTICS COMPANIES

Lappeenranta–Lahti University of Technology LUT
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Examiners: Professor Jukka Hallikas
Professor Katrina Lintukangas

ABSTRACT

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Methods for Calculating and Reporting of Carbon Dioxide Emissions in Finnish Logistics Companies

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Keywords: carbon dioxide emissions, carbon management, logistics sector, calculation of carbon emissions, reporting of carbon emissions, carbon management drivers

Managing carbon dioxide emissions is increasingly important for forwarding and logistics companies. Companies in the industry are under pressure to calculate their carbon emissions and report them comprehensively to meet the needs of stakeholders. A problem is the large number of emission calculation and reporting methods. This study focuses on investigating the methods of Finnish freight forwarding and logistics companies to calculate and report their carbon dioxide emissions, as well as the companies' drivers of carbon management.

In the study, an article search and a selection was made based on that elements of research. The literature review laid the foundation for the empirical part of the study. The study was conducted as a qualitative multiple-case study and the data was collected through seven semi-structured interviews. In addition, the sustainability reports of the case companies were used.

The results of the study showed that companies' emission calculations and reporting are still largely incomplete, but they are constantly being developed. The most used methods among companies are GHG protocol, EN16258 and GLEC. There is a great deal of will for case companies to calculate and report carbon emissions comprehensively in the near future. Based on the research, the most significant drivers for carbon management are concern about the current state of the world.

TIIVISTELMÄ

Lappeenrannan–Lahden teknillinen yliopisto LUT

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Kauppatieteet

Hanna Rotinen

Suomalaisten huolinta- ja logistiikka-alan yritysten metodit laskea ja raportoida hiilidioksidipäästöjä

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Avainsanat: hiilidioksidipäästöt, hiilijohtaminen, logistiikkasektori, hiilidioksidipäästöjen laskenta, hiilidioksidipäästöjen raportointi, hiilijohtamisen ajurit

Hiilidioksidipäästöjen hallinta on yhä tärkeämpää huolinta- ja logistiikkayrityksille. Alan yrityksillä on paineita laskea päästönsä ja raportoida ne kattavasti sidosryhmien tarpeiden mukaisesti. Ongelmana on päästöjen laskenta- ja raportointimenetelmien suuri määrä. Tämä tutkimus keskittyy suomalaisten huolinta- ja logistiikkayritysten hiilidioksidipäästöjen laskenta- ja raportointimenetelmiin sekä yritysten hiilijohtamiseen vaikuttaviin ajureihin.

Tutkimuksessa tehtiin artikkelihaku ja valinta näiden välillä tutkimukseen liittyvien elementtien perusteella. Kirjallisuuskatsaus loi pohjan tutkimuksen empiiriselle osalle. Tutkimus tehtiin kvalitatiivisena monitapaustutkimuksena ja aineisto kerättiin seitsemällä puolistrukturoidulla haastattelulla. Lisäksi hyödynnettiin tapausyritysten vastuullisuusraportteja.

Tutkimuksen tulokset osoittivat, että tapausyritysten päästölaskelmat ja raportointi ovat vielä suurelta osin puutteellisia, mutta niitä kehitetään jatkuvasti. Yritysten keskuudessa käytetyimmät menetelmät ovat GHG-protokolla, EN16258 ja GLEC. Tapausyrityksillä on paljon tahtoa laskea ja raportoida hiilidioksidipäästöt kattavasti lähitulevaisuudessa ja se koetaan tärkeänä. Tutkimuksen perusteella merkittävimpiä hiilinhallinnan ajureita ovat huoli maailman nykytilasta.

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I want to thank my family for their support over the years an especially beloved Risto and Laura, thank you for always believing in me. With you everything is possible.

Hanna Rotinen
Lappeenranta 25.7.2022

Abbreviations

CO2	Carbon Dioxide
GHG	Greenhouse Gas
GLP	Green Logistics Practices
GRI	Global Reporting Initiative
LSP	Logistics Service Provider

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1. INTRODUCTION

Global greenhouse gas (GHG) emissions continue rising at a time when they should be rapidly falling. United Nations Framework Convention on Climate Change (UNFCCC) together with Intergovernmental Panel on Climate Change (IPCC) published Nationally Determined Contributions report indicating a temperature rising to 2.7°C above pre-industrial levels by the end of 21st century without immediate actions. (Saier 2021) However, according to IPCC (2021) if the GHG emissions can be significantly reduced, the effects of global warming can be mitigated. The environmental impact of forwarding and logistics sector has become an increasingly significant issue as climate change and its effects, such as global warming, are internationally recognized. Thus, the whole sector has been compelled to consider those impacts and the sustainability of its operations. (Derbel et al. 2020) Forwarding and logistics companies need to comprise and derive their carbon dioxide (CO_2) emissions to fulfil reporting requirements, guarantee their competitive advantage, and strengthen their capabilities for future government policies on climate change. There are various methods for logistics companies to calculate and report their CO_2 emissions (Wild 2021; Lößer 2021; Davydenko et al. 2022), but global CO_2 emissions method is still not available (Wild 2021). The need for standardization of accurate, comparable, and transparent emissions assessment is applying to logistics. (Kellner 2016, 565) Several authors state that there are a wide scale of state-supported standards and standards developed by associations, recommendations, regional approaches, and standards for especially individual modes of transport (McKinnon, 2018; Davydenko et al., 2019; Kellner & Schneiderbauer, 2019; Lößer, 2021;Wild, 2021) and according to Wild (2021), this poses challenges to the comparability and accuracy of standards since the typical supply chain involves several modes of transport and often several steps regarding transhipping and warehousing. In addition, according to McKinnon (2018), with several non-comparable options available, it creates uncertainty for logistics managers.

Even though there has made much research related to logistics, its sustainability aspect and especially its environmental sustainability get nowadays increasingly attention, and more research is being done constantly. According to Andersson et al. (2015) there are literature

providing guidance on how Logistics Service Providers (LSPs) can reduce their environmental impact through certain approaches yet LSPs continue to face challenges in reducing emissions. According to Evangelista et al. (2017) green supply chain management is not adopted widely in logistics sector and the benefits of it have been limited. However, according to the same authors LSPs have faced pressure to adopt Green Logistics Practices (GLPs). The goal of many organizations, including LSPs, is to achieve net-zero emissions in the upcoming few years, so the comparability and transparency of their carbon management cannot be emphasized enough. There are many different options for calculating and reporting emissions, so it is necessary and topical to compare LSPs' practices in relation to them. It is important to understand which drivers affect LSPs' carbon management, so that it is easier for LSPs to improve their performance in this regard. Based on previous studies, this study uses the division of drivers into internal and external.

The aim of this thesis is to research methods of CO_2 emissions calculating and reporting, differences and similarities between them and their drivers in Finnish forwarding and logistics sector. To get a clear picture of the methods and of case companies, the methods for calculating and reporting CO_2 emissions with related drivers need to be studied comparing them with literature on carbon management. Seven companies from the forwarding and logistics industry are involved in this study. The subject is topical since sustainability, calculation, and reporting of CO_2 emissions of companies are in table in various conversations and logistics sector produces significant part of those CO_2 emissions.

The research comes as an assignment from the Finnish forwarding and logistics company called Beweship Oy Ab. Beweship offers services such as air freight, road freight, sea freight, train logistics, art logistics, project logistics, customs clearance and event logistics, and warehouse storing. It was founded in 1957. The company is currently one of the biggest privately-owned logistics and transportation companies in Finland. It employs 150 people globally and 70 people in Finland only. The company also operates globally, and it has offices in Finland, Estonia, Latvia, and Poland. Beweship's headquarter located in Vantaa. Beweship originally formatted its business strategy in 2003 includes its mission and vision. In addition, sustainable development has been in the spotlight from 2015 and onwards.

Beweship's mission is to offer and develop reliable freight forwarding and logistics services globally. It also aims to be its clients' preferred choice in any transportation related matter. (Beweship interview 2022)

1.1. Literature review

The aim of this chapter is to find main elements on what CO_2 emissions calculations and reporting in forwarding and logistics sector consists of as well as investigate the related drivers. Literature review first introduces article search and defines the concepts that are important for the thesis and after that the relevant literature is presented and discussed. Then research questions and conceptual framework are presented. Finally, structure of the thesis is introduced.

1.1.1. Article search

Relevant articles were found by utilizing LUT Primo database. Both CO_2 emissions calculations and reporting are evolving rapidly and as the aim was to get an extensive picture of the current state of CO_2 emissions calculations, an article search required a comparison of the newest possible articles. Keyword search was made in February 2022 and keywords were "sustainable logistics", "environmental management", "environmental management practices", "logistics", "sustainable reporting", "emissions management ", "green logistics", and "carbon management".

A research process for relevant articles and books search is presented in Figure 1. It starts with search criteria to the Journal's search, which follows article search by presented keywords. After that evaluation is conducted whether article is used and if yes, it leads to analysis. Five journals were chosen to be searched based on that they have the most environmental management and carbon management related articles. The following journals were chosen: *The International Journal of Logistics Management, International Journal of*

Physical Distribution & Logistics Management, Journal of Environmental Management, and *Journal of Cleaner Production.*

Figure 1. Research process for relevant literature (Quarshie et al. 2016)

The results of the keyword search and distribution between the publications are pictured in Table 1. Open access and the years 2012-2022 were used as filters. Bolded numbers 1264 (environmental management), 807 (environmental management practices), 208 (logistics), 71 (sustainable reporting), and 182 (emissions management) under *International Journal of Physical Distribution & Logistics Management* and 18 (environmental management) under *Journal of Environmental Management* mean appeared cases where more than 1,500 articles were found. Since the amount of appeared was too wide, for these, the filters were limited to the years 2020-2022 to get the result which is seen in Table 1.

Table 1. Distribution of keywords

	The International Journal of Logistics Management	*International Journal of Physical Distribution & Logistics Management*	*Journal of Environmental Management*	*Journal of Cleaner Production*
Sustainable logistics	46	16	67	11
Environmental management	56	**1264**	**18**	56
Environmental management practices	53	**807**	321	53
Logistics	100	**208**	43	12
Sustainable reporting	15	**71**	14	40
Emissions management	27	**182**	309	21
Green logistics	29	**77**	17	5
Carbon management	23	**180**	424	42

A total of 4607 articles were found, most of which were found from *The International Journal of Physical Distribution & Logistics Management* with 2648 articles. *Journal*

of Environmental Management 1213 articles, *The International Journal of Logistics Management* was found below 349 articles, and finally, *Journal of Cleaner Production* 240 articles. After the search, the review was continued by looking at the titles, from which the most relevant to the themes of the thesis were searched, after which the selection was made by reading the abstracts.

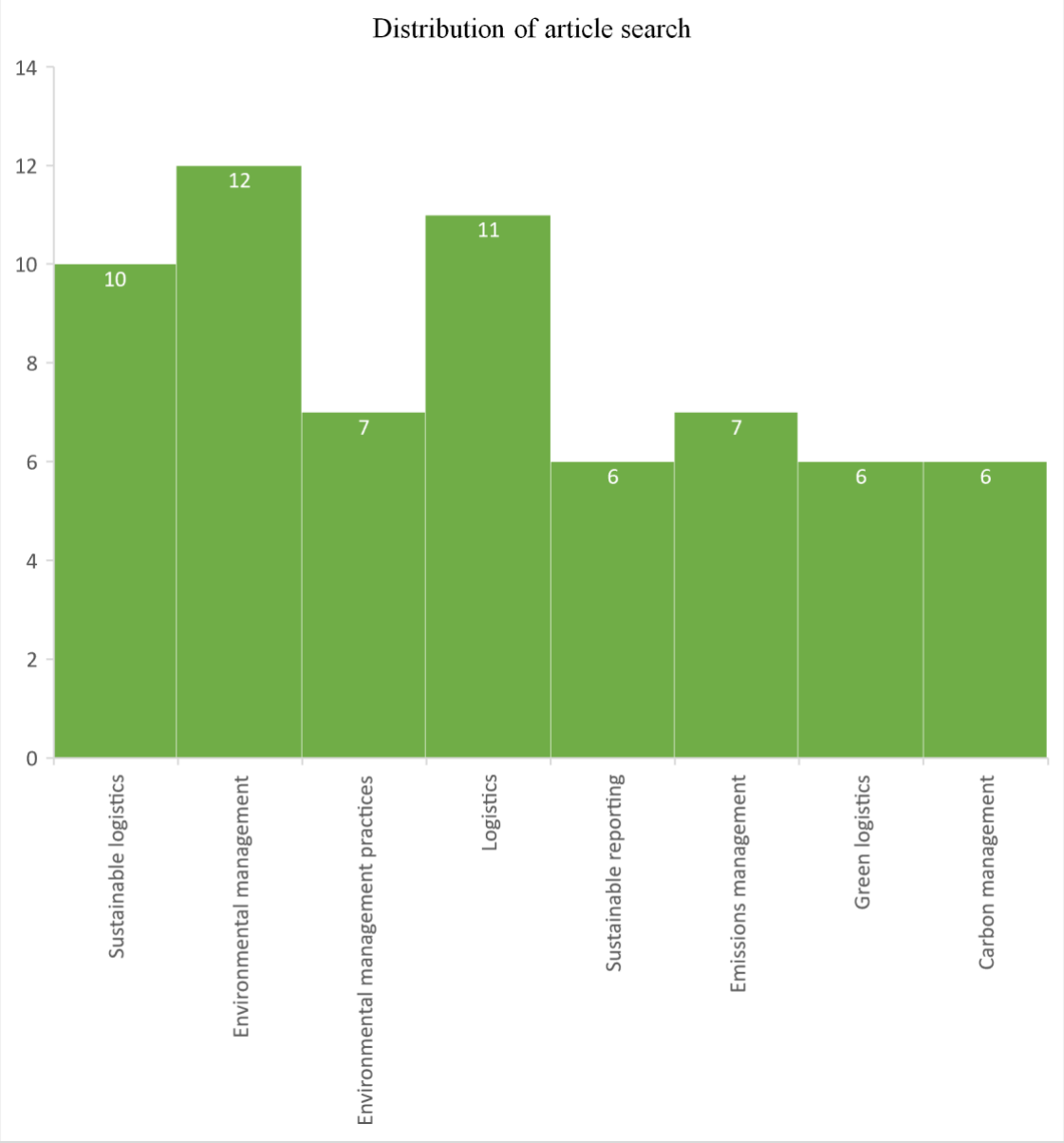

Figure 2. Distribution of main articles

As shown in Figure 2, from environmental management, logistics and sustainable logistics were found the most relevant articles and the least were found from sustainable reporting, green logistics and carbon management. Thesis also used articles, journals, and other relevant publications from outside the search.

1.1.2. Relevant findings

LSPs have adopted increasingly different kinds of GLPs over past years (Centobelli et al., 2020; Lieb and Lieb, 2010), yet there is still a widely accepted need to increase and improve decarbonization efforts in transport and logistics in a verifiable and monitorable way. (Ghisolfi et al. (2022) Ramanathan et al. (2014) study revealed the impact of cooperation in supply chain in reducing CO_2 emissions in the logistics industry, however, Björklund et al. (2021) found that not all types of GLPs may require cooperation in the first place. Kumar and Anbanandam (2020) listed assessment of CO_2 emissions and annual sustainability report publication, environmental management system certification, promoting collaborative transport practices with other transport organisations competitive pressure from other freight transport firms' green practices, and environmental sustainability knowledge and awareness programs as GLPs. Wild (2021) argues in favour of standardizing the calculation of emissions to make comparability easier. Demir et al. (2015) have studied that incorporating GLPs are essential to solving the problem of sustainable development of transportation. Davydenko et al. (2019) state that carbon footprinting is one key instrument when logistics company wants to view its emissions and the actions causing them. According to Davydenko et al (2022) one of the most important goals of carbon footprinting is to determine and allocate of CO_2 emissions realized by the carriers proportionally to transport activity of the customers on whose behalf these activities and CO_2 emissions have been realized.

According to Sureeyatanapas et al. (2018) typical drivers for adoption of GLPs are government regulations and policies as well as the pressure which comes from competitors' GLPs. Nachiappan and Muhamman (2017) found in their research that lack of resources and lack of training in organizations may cause a major incapability to manage CO_2 emissions.

Liesen et al. (2015) research indicated that the LSPs' information regarding reports of their CO_2 emissions, as well as other environmental activities, could be beneficially shared with stakeholders. Lieb and Lieb (2010) reported that publication of sustainability reports can improve the green performance of the LSPs and in accordance with this, Taskforce on Climate-Related Financial Disclosure (2017) recommends that organizations should disclose the metrics and targets they are using to assess their corporate progress in managing climate-related risks.

1.2. Research questions and conceptual framework

Title of the thesis is

Methods for calculating and reporting carbon dioxide emissions in Finnish forwarding and logistics companies

Main research question is

How are carbon dioxide emissions calculated and reported in Finnish forwarding and logistics companies?

sub-research questions are

What are the similarities and differences in calculation and reporting between companies?

What drives to Finnish forwarding and logistics companies to calculate and report their carbon dioxide emissions?

How forwarding and logistics companies see the future of carbon management?

Conceptual framework is pictured below in Figure 3. It describes how LSPs' carbon management includes the calculation and reporting of CO_2 emissions, as well as the drivers affecting it.

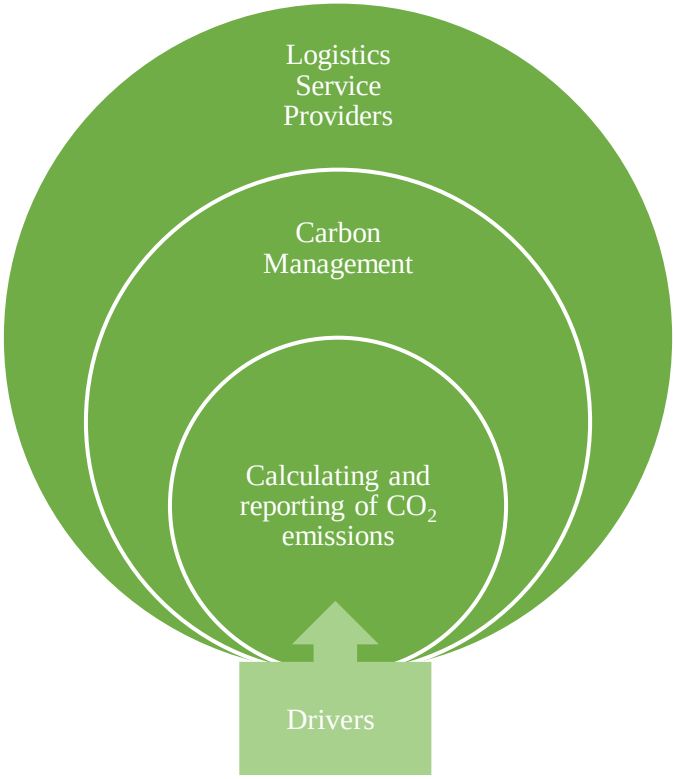

Figure 3. Conceptual framework

The purpose of the research is to discover LSPs' methods for calculating and reporting of CO_2 emissions and find the main drivers which make LSPs to apply them.

1.3. Definitions

This chapter introduces briefly the most important definitions used in this thesis. Carbon management, carbon emissions, carbon footprint, and carbon compensation are explained

Carbon emissions

CO_2 is the most significant GHG emitted caused human activities. The main human activity that emits CO_2 is the combustion of fossil fuel such as coal, natural gas, and oil for energy and transportation, although certain industrial processes and land-use changes also emit CO_2. The combustion of fossil fuels such as gasoline and diesel to transport people and goods was the most significant source of CO_2 emissions in 2019. This category includes transportation sources such as road transportation, air travel, marine transportation, and rail. (Environmental Protection Agency 2019)

Derbel et al. (2020) state that the increasing CO_2 emissions are significant issue which is one of the most globally recognized due to the negative impact on the environment and Churchill et al. (2019) follow this by saying CO_2 emissions being one of the main causes of global warming. According to Derbel et al. (2020) transportation is the main recognized contributor to the CO_2 concentration in the atmosphere, itself is the main factor of global warming.

Carbon management

Environmental management refers to the environment-orientated management of organization and as a part of it, carbon management can be seen as a function of factors that influence the implementation of environmental measures (Oberhofer and Dieplinger 2014). Carbon management is about how and where the organizations' operations cause GHG emissions to minimize them. Carbon management includes both calculating and reporting of CO_2 emissions. (Zhou 2020)

Carbon footprint

Carbon footprinting is an effective tool of carbon management (Oberhofer and Dieplinger 2014). The carbon footprint is a measure of the total amount of CO_2 and other GHGs that are directly and indirectly caused from an entity (Carbon Trust 2006). Conducting the carbon footprint of products across the supply chain is focal for business to take in the effort to reduce CO_2 emissions and mitigate climate change.

Carbon compensation

McKinnon (2018) defines carbon compensation as an event where an organization pays another to save GHG emissions on behalf of the paying organization. The event can also be called emission offsetting. Emissions can be compensated by receiving so called carbon credits outside of the operation area of the organization. One carbon credit equates to one ton of reduced CO_2-equivalents. The compensation projects can be based on, for example, renewable energy or forestation at homeland or abroad. There must be noted that before using emission compensation, the organization should avoid producing emissions and then decrease the mandatory emissions as much as possible. After this, emission compensation perchance used to compensate the remaining emissions. (British International Freight Association, 2017; Seppälä et al. 2019, 21)

1.4. Limitations

Thesis focuses on the topics shown in conceptual framework: LSPs' carbon management and drivers towards it. Also, as pictured in Figure 4 below, thesis centralizes on perspectives of Triple Bottom Line (TBL) and considers environmental, social, and financial perspectives when going through the drivers for carbon management with the focus on calculating and reporting of CO_2 emissions.

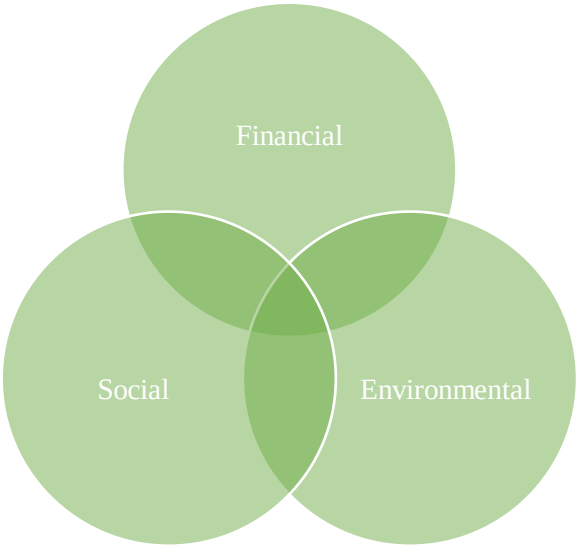

Figure 4. Focus on all sides of the TBL

According to McKinnon (2018) CO_2 accounts for 96 percent of GHG emissions from logistics sector, thus it is justified that thesis focuses on CO_2 emissions and exclusion of other GHG emissions. Limitations of thesis are geographical, since companies interviewed are from Finland. Finland offers optimal infrastructure for research as the country is an integral part of the EU, with its highly comparable legislation and the common market. The World Bank (2021) rates Finland as a high-income country and a logistic indicator of 3.56 also indicates a highly developed logistic infrastructure. However, all case companies operate globally. Thus, the war between Ukraine and Russia that began in late February in 2022 could affect the companies' operations with sanctions imposed on Russia and its impacts to the world economy.

When interpreting the results of the paper, the effects of the ongoing global pandemic on the interviews must also be considered. The global pandemic and increased fuel prices over the past year may have affected the operations of the companies interviewed recently. In addition, the interviews were conducted remotely via online meetings in Teams or Google Meets. Also, limited number of interviews will be conducted.

1.5. Structure of the thesis

The study consists of five main chapters which are introduction, theory part, methodology, empirical study and discussion and conclusions. In introduction there are literature review with article search and relevant findings as well as the background of the topic and research questions, definitions, limitations and structure. Theory chapter handles decarbonization of forwarding and logistic sector and it consists of the background of the sector and how it is polluting, calculation and reporting of CO_2 emissions, green logistics framework and carbon management and finally the drivers to carbon management. In methodology part there are information about research methodology, data analyzing and reliability and validity. Empirical study consists of general approaches towards environmental sustainability, stakeholders, calculation, and reporting of CO_2 emissions, and drivers. Finally, there are discussion and conclusions in which are answers to the research questions and suggestions for the future research.

2. DECARBONIZING FORWARDING AND LOGISTICS SECTOR

In this theory chapter is first discussed background of logistics sector and how it is polluting. Then calculation and reporting of CO_2 emissions, green logistics framework, and carbon management are presented. Finally, there are discussion on drivers which encourage companies to carbon management.

2.1. Background of logistics sector

Forwarding is the timely and cost-effective management of the movement of goods, information, money, and transport means and units in world trade between the buyer, seller, transport and storage companies, and authorities. It is crucial but often invisible part of a functioning foreign trade. Forwarding and logistics services form the basis of international trade. In addition, they are responsible for the smooth operation of industry and commerce, as well as the functionality of world trade between transport companies. Forwarding companies are companies operating in the logistics sector that offer and deliver forwarding and logistics services for the diverse needs of their customers. The core business of forwarders includes the logistics services that have traditionally been associated with forwarder operations, such as customs clearance services, organization and forwarding of international transport, and the related collection and delivery services. In Finland, the logistics and transport sector employ about 120,000 people in about 20,000 different companies (including all modes of transport in passenger and freight transport), which is about 6 percent of the number of people employed in Finland. In 2019, the total value of exports and imports of goods in Finland was approximately € 131 billion in which freight forwarders handle between € 68 billion and € 103 billion. The success of the Finnish forwarding and logistics industry largely depends on the development of Finland's foreign trade. If exports or imports of foreign trade (tonnes or value) decrease, the service orders of exporters and importers for forwarding and logistics companies decrease at the same time. Conversely, if foreign trade increase, forwarding and logistics companies also have a good chance of success. Finland's largest forwarding and logistics companies, which are also

members of the association of Finnish Forwarding and Logistics, include Schenker Oy, Nurminen Logistics Services Oy, Oy Kuehne + Nagel Ltd, and Oy Beweship Ab. (Suomen Huolinta- ja Logistiikkaliitto Ry 2022)

Forwarding and logistics sector enable economic growth, connects producers and consumers, determine trade competitiveness, support effective integration into global supply chains and promote social progress and inclusive development. At the same time, however, its operations also generate external costs that weaken the goals of sustainable development, such as economic efficiency, social inclusion, and environmental protection. Common external costs associated with freight transport, widely known as "externalities", include congestion, pollution, fossil fuel depletion, infrastructure degradation, accidents, emissions, and visual intrusion. Addressing these externalities requires that external costs from the forwarding and logistics sector be internalized and that the sector's ability to meet relevant sustainability objectives be improved. This entails a careful strategic decision making to strike the right balance between the varied economic, social, and environmental sustainability objectives. Maximizing benefits and minimizing side effects succeeds best when sustainability thinking is included right at the design stage and involved throughout the lifecycle. (Cadena & Magro 2015)

McKinnon et al. (2008) state in their paper that to mitigate the negative consequences for the environment deriving from freight transport and logistics functions, the management of LSPs need to incorporate GLPs in their decision-making process and strategy. Freight transport and logistics generate a negative impact on the environment by increasing fragmentation of supply chain and stretching of transport flows, increasing energy consumption and use of fossil fuels, increasing CO_2 emissions and pollution of the environment, and increasing fragmentation of supply chain and stretching of transport flows. Forwarding and logistics companies are requested to drastically reduce their externalities through effective green actions, incorporating environmental sustainability in their business model and providing more green services and solutions. (Deutsche Post DHL, 2010; Zailani et al., 2011) This may improve the competitiveness of LSPs, but it may impose challenges and concerns. McKinnon (2018) claim that transport and logistics is very difficult sector to

mitigate because there will be heavy increase in freight transport. In addition, EAA (2021) state that sector has proven difficult to decarbonize, and it has not shown the same decreases in GHG emissions since 1990 as other sectors. Forecasts say that there will be three times increase in freight ton-km between 2015 and 2050 (ITF, 2017). In addition, transport and logistics are heavily dependent on fossil fuels because of low level of alternative fuel adoption with limited commitment of governments and institutions to facilitate the transition from fossil fuels to more environmentally friendly fuels.

2.1.1. How logistics sector pollutes

Freight transportation is one of the largest sources of emissions around the world. (Derbel et al. 2020) According to European Commission (2021) in the last decades, transport emissions increased at a higher rate in comparison with other economic sectors such as manufacturing. Finland is committed to acting in a way that results in it will be carbon neutral in 2035 and carbon negative soon after. In addition, transport emissions are set by halve by 2030 compared to the emissions in 2005 (Council of State 2020). Similar emission reduction targets are being set at EU level. EU has set the goal of at least 40 percent cut in GHG emissions from 1990 levels (EU Commission 2020) and reaching 90 percent reduction in transport related GHG emissions by 2050 (EU Commission 2022).

According to Statista (2022) global CO_2 emissions were approximately 36 billion tons in 2020. As shown in Figure 5 of this total, the ‘power industry’ accounted for roughly 13 billion tons and thus 37 percent, making this sector the largest source of CO_2 emissions. It includes power and heat generation plants. ‘Other industrial combustion’ accounted for the second-largest share of global emissions in 2020, at 8 billion tons and 22 percent and, ‘transportation’ for the third-largest share of emissions at 7 billion tons and 21 percent. Transportation includes road, rail, ship, and aviation. (Statista 2022) According to BDL (2018) in 2015, the share of global emissions from logistics and transport were 24 percent (2018) Global freight transport contributing to a significant extent of transportation (Auvinen et al. 2014).

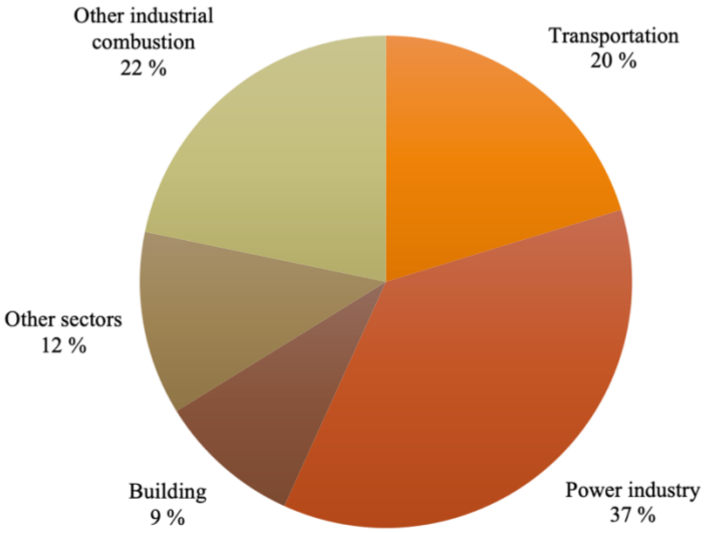

Figure 5. Distribution of global CO_2 emissions in 2020, by sector (Statista 2022)

'Other sectors' with 12 percent, which include industrial process emissions, agriculture, and waste, and 'building' with 9 percent, which include small scale non-industrial stationary combustion, are least polluting sectors (Statista 2022). The impact of global pandemic on transport should be noted and the fact, that there is passenger transport included in 20 percent.World Resources Institute (WRI) (2020) has done the similar kind of research about emission division from year 2016, and it is shown in Figure 6. The energy sector that causes most of the emissions is distributed to six main sectors and three greatest of them are 'energy use in industry' by 24 percent, 'energy use in buildings' by 18 percent, and 'transport' by 16 percent. Transport includes indirect emissions and direct emissions from burning fossil fuels to power transport activities. It does not include emissions from the manufacturing of motor vehicles or other transport equipment which are included in the previous point 'energy use in industry'. Transport is further distributed to road transport by 12 percent, aviation by 2 percent, shipping by 2 percent, rail by 0,4 percent and pipeline by 0,3 percent. (The World Resource Institute 2020)

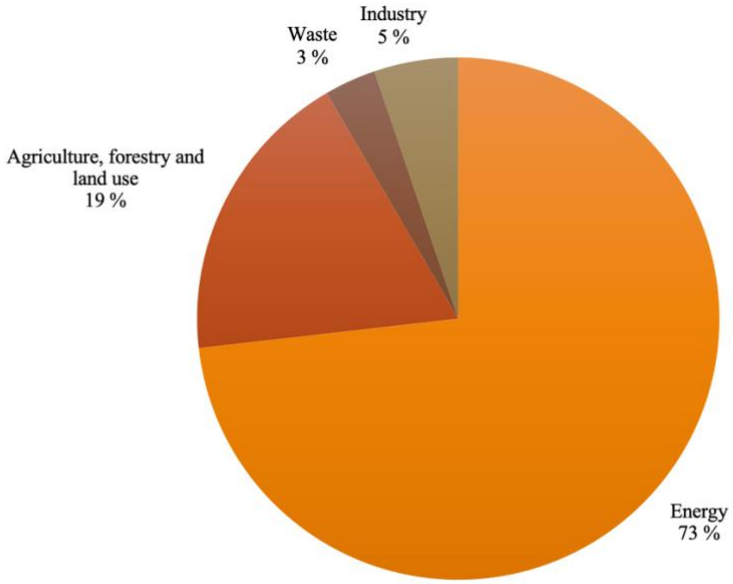

Figure 6. Distribution of global CO_2 emissions in 2016, by sector (The World Resource Institute 2020)

Road transport includes emissions from the burning of petrol and diesel from all forms of road transport which includes cars, trucks, lorries, motorcycles, and buses. According to IEA (2022) 60 percent of road transport emissions come from passenger travels by cars, motorcycles and buses and the remaining 40 percent from road freight such as lorries and trucks. Thus, if there could electrify the whole road transport sector, and transition to a fully decarbonized electricity mix, there could feasibly reduce global emissions by 12 percent. (Ritchie & Roser 2020)

Aviation emissions include emissions from passenger travel and freight, and domestic and international aviation. According to Graver, Rutherford, and Zhang (2019), 81 percent of aviation emissions come from passenger travel and 19 percent from freight. Shipping emissions come from the burning of petrol or diesel on boats, and it includes both passenger and freight maritime trips. Rail emissions come from passenger and freight rail travel. Fuels and commodities such as oil, gas, water, and steam often need to be transported, either within or between countries, via pipelines. This requires energy inputs, which results in emissions. (The World Resource Institute 2020) According to EEA (2021) focus of the

most planned policies and measures in the transport sector is on promoting low-carbon fuels as well as electric cars.

2.2. Calculation and reporting of CO_2 emissions

Emissions calculation and reporting is one important tool in reducing the carbon footprint. (Zhou 2020) It means calculating the emissions over the life cycle of a product or service using different methods, from raw materials and primary production to transport, use and recycling or disposal. The calculation allows the organization to identify its main sources of emissions and can target its reduction measures in such a way that the impact on the carbon footprint is as large as possible. The need for emissions calculation, also commonly referred to as carbon footprinting, is growing all the time. Methods, standards, and tools are giving more and more value to consumers and organizations when the accuracy of them is increasing. (McKinnon et al. 2015; Zhou 2020)

Lambrechts et al. (2019) have stated that increasing number of organizations attempt to develop their environmental, social, and economic indicators to measure, improve, and report their sustainability. Reports, which were initially called environmental reports, then social reports, are nowadays known as sustainability reports and they can include, among other things, CO_2 emissions from their business. According to Son-Turan et al. (2017) there are various studies that have established a link between financial performance and the organizations' reporting practices on their social, economic, and environmental performance, commonly referred to as Corporate Social Responsibility 'CSR' or Triple Bottom Line 'TBL' reporting. To what extent organizations communicate through their reports, indicates how committed they are to CSR (Wickert et al., 2016). Organizations are motivated to report on sustainability by the desire to improve their corporate image rather than the desire to be accountable to stakeholders and presenting a broader range of information. (Durden 2008) However, according to Hsu et al. (2013) increasing number of organizations are involved in stakeholder engagement and must exhibit responsibility through sustainability reporting. The stakeholder theory acknowledges that organizations

have obligations and responsibilities to various parties, both internal and external to the organization, who affect and are affected by the organization. (Sarkis et al. 2011)

International institutional groups, such as the Global Reporting Initiative (GRI), have gathered and collaborated to consider how and to what extent sustainability information should be reported. (Lambrechts et al. 2019) The GRI guidelines are widely accepted for the disclosure of environmental sustainability and are recognized as the most reliable and useful basis for sustainable disclosure. (Fernandez-Feijoo et al. 2014). The aim of the GRI framework is to find a consensus on the reporting of sustainable development impacts and to make it comparable and verifiable. It is a well-known framework that allows organizations to report on the level of social and environmental protection on a voluntary basis.

Liesen et al. (2015) argue that data users can compare the carbon dioxide emissions of different organizations if the data must be complete in scope, including both internal activity emissions and electricity procurement emissions, and type, including both carbon dioxide and other greenhouse gases, and third, the reporting limit, including emissions from group-wide operations. The industry is young and growing, and new metrics and methods are constantly being developed. Well-established standards, such as ISO 14069, and the GHG Protocol, are used to support emissions calculations and reporting. There are consulting and expert organizations of various sizes in the industry that do carbon footprinting. The use of partners is recommended. (Business Tampere 2021)

Adopting the CO_2 accounting methodologies, decision makers can establish a baseline for tracking CO_2 emission trends, developing mitigation strategies and policies. (Zhou 2020) In most cases, the method used to evaluate CO_2 emissions is based on the general equation: emissions = usage data × emission factor. Operational data is recommended to be collected at the location level, and the data collection should be described in detail when reporting the result. The emission factors related to each activity information are usually obtained from literature, such as IPCC guidelines or more detailed national manuals. An important consideration in the calculation is that if the analysis does not include Scope 3, the carbon footprint has not been correctly estimated, because the total amount of CO_2 emissions

indirectly caused by the organization is not captured. However, specific assumptions can be explained so that the analysis becomes valuable and representative. (Zhou, 2020; Wild 2021)

2.2.1. Current CO_2 calculation and reporting

Zhou (2020) listed international standards for carbon footprint calculation and reporting for different applications. Those are listed in Table 2. For organizations, author recommends the commonly used standards ISO 14064-1 and GHG Protocol. In addition to being widely used as a tool for reporting emissions, the GHG protocol has served as a basis for various other CO2 calculations and reporting programs. The most significant of these is ISO 14064-1: Specification with Guidance at the Organization Level for Quantification and Reporting of GHG Emissions and Removals, 2006. (Hickmann 2017)

ISO 14064 is a broad international standard that is divided into three different sections. The first section of ISO 14064-1:2006 defines organizational level requirements and principles for determining and reporting CO_2 emissions. ISO 14064-2:2006 provides steps for determining, monitoring, and reporting project-level reductions or removal improvements in CO2 emissions including advice to recognize and choose emissions sources and process the data up to the documentation and reporting stage. The third part of the ISO 14064-3:2006 standard contains requirements for management or control of how CO2 claims are certified and validated. (Zhou 2020)

Table 2. International standards for measurement of carbon footprint (Zhou 2020)

Application	International standards
Organization	ISO 14064-1 and GHG Protocol
Project	ISO 14064-2 and GHG Protocol
Services/products	ISO 14067, PAS 2050, LCA

WRI together with World Business Council for Sustainable Development (WBCSD) developed a partnership in the late 1990s to address the standardization of GHG emissions calculations. Environmental organizations and The Greenhouse Gas Protocol: A Corporate, developed in collaboration with industry The Accounting and Reporting Standard was published in 2001. It has since been updated with additional guidance and clarification to enable organizations to measure their electricity and other energy purchases, emissions and calculate emissions through their value chain. The GHG protocol forms globally an established model for calculating and controlling GHG emissions from private and public sector activities, value chains and mitigation. The GHG protocol has been developed also calculation tools to help organizations calculate their GHG emissions the effects of their climate change mitigation projects. (Greenhouse Gas Protocol 2021) The GHG protocol company standard classifies GHG emissions into three subsets. Scope 1 emissions are direct emissions from own or self-controlled sources. Scope 2 emissions are indirect emissions from purchased energy. Scope 3 emissions include all indirect emissions from a organization's value chain that are not considered in Scope 2. The largest organizations' emissions usually occur along their value chain. This means that the organization loses its greatest opportunity to develop its operations if it does not recognize these emissions. (Greenhouse Gas Protocol 2021)

According to Kellner (2016, 565-574) in 2012, the European Committee for Standardization (CEN) published EN 16258, a method for calculating and reporting the energy consumption and CO_2 emissions of transport services. According to the author, it is the only international and official supply chain transport standard for calculating emissions. Shipment level emissions calculations are solved in two steps. At first, the total amount of CO_2 emissions of the transport operation is calculated and secondly, this amount is allocated to individual shipments.

In the first step, the CO_2 emissions of the transport operation are calculated, which include all activities related to moving the shipment, also empty trips back. Next fuel consumption is converted to CO_2 emissions using the given conversion factors. The consumption models are vehicle-specific and consider all factors affecting fuel consumption except the utilization

of weight capacity. This includes vehicle design, driver behaviour, average road gradients, and congestion. In the second part, the calculated amount of CO_2 is allocated to shipments. EN 16258 allows different emission distribution units, such as volume, mass, or distance, which can cause ambiguities. According to Grönman (2018) EN 16258 follows the Well-to-Wheel (WTW) approach, which includes all indirect fuel emissions from raw material to distribution as well as direct emissions from vehicle operation

The GLEC framework is a framework prepared by the Global Emissions Council (GLEC) for calculating and reporting transportation emissions worldwide. The goal of this framework is to be accurate in distance measurement and to provide a valid approach when the subcontractor's exact distances are unknown. There are four general steps in GLEC: plan, data collection, emissions calculation, and definition of assumptions and reporting. In data collection instructions are reviewed and deficiencies are identified. Emissions calculations involve the selection of emission factor and calculations are made for the transport chain. (Hülemeyer 2019)

Wild (2021) states in his research that there are several widely used methods for calculating CO_2 emissions which are listen in the Table 3. According to Davydenko et al. (2019) BigMile collects and unites data from everyday operations of LSPs and shippers. It is commercial software implementation of a carbon footprinting methodology that is flexible with respect to input, allowing various types of data at different aggregation levels to be used, thus providing carbon footprinting implementation that is useful for different levels of data availability and valid globally with all transport modes. (Davydenko et al. 2019)

Clean Cargo Working Group (CCWG) is based on GHG protocol, EN16258, and IMO methodologies and it is relevant for shipping companies reporting their vessel emissions data, shippers calculating their emissions performance and comparing carrier performance, third parties including classification firms, as well as other modal initiatives and authorities working on emissions accounting in the global transportation industry. (CCWG 2015) According to Wild (2021) CarbonCare is commercial, globally used calculation tool for shippers, forwarders, and transport operators, with a focus on freight, however, few

customers use it only for offsetting. Calculations are carried out according EN16258, and it considers data from STREAM and CCWG.

CE Delft is a research and consultancy specializing in developing innovative solutions to environmental issues. CE Delft developed the “Study on Transport Emissions of All Modes (STREAM)” project which was used to assess various modes of transport on Europe with the database of STREAM. STREAM addresses all modes of transport excluding air transport. (STREAM 2020) EcoTransIT is commercial emission calculator which is based on the GLEC, EN16258, and GHG Protocol standards, however, it has implemented other standards for all modes of transport. It is suitable globally. (EcoTransIT 2022)

the GHG Protocol method is a multi-stakeholder partnership between several organizations and its mission is to develop internationally accepted GHG accounting and reporting methods for organizations, cities, and countries. (Wild 2021) the GHG Protocol’s focus is not especially on transport (Davydenko et al., 2014), and the ‘Corporate Accounting and Reporting Standard’ provides no specific calculation recommendations (GHG Reporting, 2014).

Table 3. Methods for calculating CO_2 emissions (Wild 2021)

Method/standard	Area	Transport mode	Legal basis
BigMile	Global	All	Commercial
CCWG	Global	Sea	Initiative
CarbonCare	Global	All	Commercial
CE Delft	Europe	Partly	Research
EcoTransIT	Global	All	Commercial
EN 16258	Global	All	Official
GHG Protocols	Global	-	Method
GLEC	Global	All	Framework
Green Efforts	Europe	All	Research
Green Freight Europe/Asia	Europe	All	Program
Green Logistics	Europe	All	Research
IATA	Global	Air	Association
ICAO	Global	Air	Official
IMO	Global	Sea	Official
ISO	Global	All	NGO
ITEC	Europe	All	Initiative
SmartWay	North America	All	Program

The focus in EU emission reduction projects seems to be the development of emission calculation tools. A detailed review of these calculation tools has been made and published in the Smart Freight Center (2019) as part of the LEARN project which lists seven calculation tools, LogEC, TK'Blue, VGP, BigMile, Green Router, Reff Assessment tool,

and EcoTransIT, for freight transportation, warehousing, and transshipment. LogEC, TK'Blue and VGP are available to members only whereas BigMile, Green Router, Reff Assessment tool and EcoTransIT are available to customers based on an agreement with the development company. However, there are only a simple version of EcoTransIT available on the open website (EcoTransIT world 2021), which limits usability.

After practicing GLPs including CO_2 calculations, attention should be paid to reporting. The same GHG reporting principles should concern to all aspects of the calculation of organization's carbon CO_2 emissions. The following principles are now generally adopted (WBCSD/WRI, 2004, ISO 14064-2, 2006; British Standards Institution, 2011):

1. Relevance: a GHG emission report should appropriately reflect the environmental impact of the organization, supply chain or product/service. It needs to contain all information that both internal and external users need for their decision making
2. Completeness: all GHG emission sources within the chosen reporting boundary should to be included in the carbon footprint calculations. Any exclusions should be adequately justified and clearly specified in the GHG report
3. Consistency: calculation policy aims to ensure that GHG emission data is comparable over time. If there are appears any changes in data that may affect GHG emission estimates, it should be explicitly documented and justified
4. Accuracy: GHG emissions estimation aims to ensure maximum accuracy and minimizes the risk of both over and under-reporting. Uncertainties should be reduced as much as possible to give internal and external users certainty in the honesty and reliability of the data
5. Transparency: data on GHG emissions should be reported in a factual, neutral, and cohesive appearance and it should be based on a clear audit trail. Any assumptions should be clearly disclosed and appropriate references to the reporting guidelines and data sources need to be included in the report

The GHG Protocol company standard classifies GHG emissions into three subsets, Scope 1, Scope 2, and Scope 3 as shown in Figure 7. In scope 1 there are direct GHG emissions which come from being owned or managed by the organization itself sources. For example, emissions from combustion from the organization's own vehicles, etc., as well as emissions from the production of chemicals with its own process equipment. Direct CO_2 emissions from biomass combustion are not included in scope 1 but are reported separately. GHG not mentioned in the Kyoto agreement are also not included Scope 1 but reported separately. (Corporate Standard 2004)

In Scope 2 there are indirect GHG emissions. The GHG protocol company standard requires organizations to calculate the emissions they incur supply and consumption of electricity, steam, heating, and cooling. These emissions are included in the Scope 2 calculation and are indirect emissions because they result from the activities of the reporting organization but are produced from sources owned and operated by another organization. Scope 2 represents one major source of emissions worldwide and energy consumers have a significant opportunity to reduce these emissions by reducing consumption and switching to alternative, low-carbon energy sources. (Corporate Standards 2004)

The calculation of Scope 2 emissions is recommended in the company standard to be calculated by multiplying the activity data (kWh of electricity consumption) with electricity-specific emission factors for electricity to find out the true amount of greenhouse gases. Only if this information is not available is the use of emission factors including local or national networks recommended. (GHG Protocol Scope 2 Guidance 2011) Indirect GHG emissions from the organization's value chain are included in Scope 3.

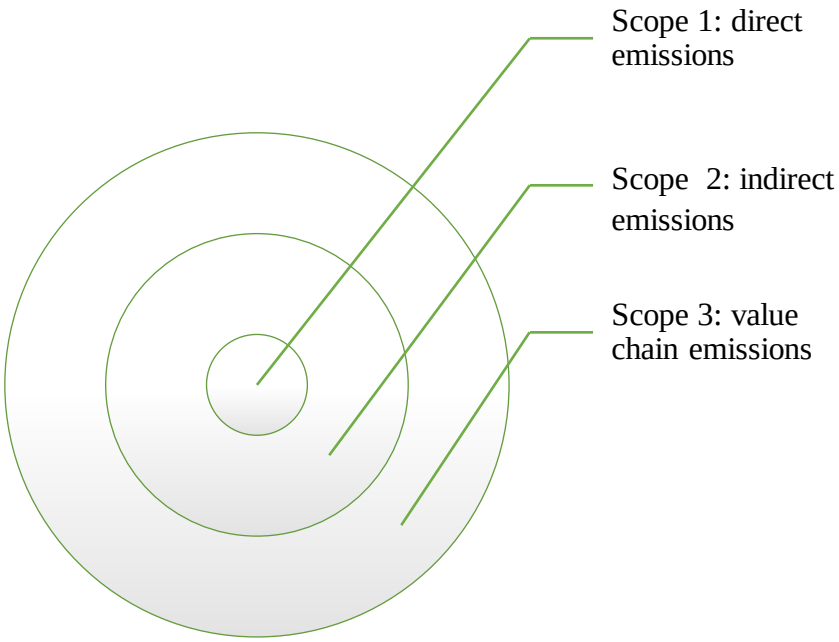

Figure 7. Scope 1, 2, and 3 according to GHG Protocol

The GHG Protocol the Corporate Value Chain (Scope 3) Accounting and Reporting standard was developed to create more consistency in the calculation of Scope 3 emissions by adding requirements and guidance to both calculating and reporting. The purpose of this standard is to enable comparisons within a organization GHG emissions over time. It is not designed to support a business-to-business comparison of Scope 3 emissions. Differences in reported emissions may be due to inventory methods or differences in the size or structure of the organization. The organization should have a consistent process, consolidation, to optimize and concentrate resources throughout the group, in all scope 1, 2 and 3 in inventories. Consolidation affects which functions in a organization's value chain are classified as direct emissions (Scope 1) and indirect emissions (Scope 2 and 3). (GHG Protocol Scope 3 Standard 2011)

Both Evangelista et al. (2017) and Piecyk and Björklund (2015) have found that the comparison of sustainability reporting is deficient in the logistics sector. The GRI released a pilot version of a sector supplement for logistics and transportation in 2006, however,

Piecyk and Björklund (2015) say that only a tenth of world's largest LSPs produce a formal CSR report. According to Piecyk and Björklund (2015) there is a contradiction here, as there is a mention on the websites of various organizations that they consider CSR issues. The EU has proposed a new Sustainability Reporting Directive. The Corporate Sustainability Reporting Directive (CSRD) is intended to replace the current Non-Financial Reporting Directive (NFRD). From 2023, the EU's Corporate Sustainability Reporting Directive (CSRD) requires all organizations with more than 250 employees, as well as all listed companies, to report on responsibility in accordance with the new EU responsibility reporting standard for the reporting year. (European Commission 2021) Cho et al. (2015) state that a significant gap persists between corporate sustainability talk and practice and Piecyk and Björklund (2015) attempt to explain this by arguing that the application of CSR within the logistics sector became known just recently, and thus CSR practices have not been widely adopted yet.

2.3. Green logistics framework

Several authors state that one of the main objectives of logistics is to co-ordinate activities in a way that meets customer requirements at minimum cost. (Rituraj, 2014; Ghoumrassi & Tigu, 2017). According to Derbel et al. (2020) green logistics aims at bringing the environmental perspective in traditional logistics. As concern for the environment rises, organizations must take more account of the external costs of logistics associated mainly with climate change, air pollution, noise, vibration, and accidents. Green logistics is a term which has been coined to bring together the various aspects of environmental sustainability in logistics. Green logistics aims to move and deliver raw materials and products at the lowest possible cost while maintaining the highest standards and minimizing environmental impact in the process. (McKinnon et al. 2010) According to Thiell et al. (2011), the framework for Green Logistics will comprises green transport such as green warehousing, green packaging, green procurement, and waste management, while according to Rogers and Tibben-Lembke (1998), the general character of the green logistics system is employing advanced technology and equipment to minimize environmental damage and increase the utilization of the resources. Green transport impacts sustainability throughout the

construction of transport network, the operations of transport vehicles and the disposal of transportation vehicles. Practices for removing the negative impacts could be modal choice, freight consolidation, clean vehicles, fuel efficiency, reuse of pallets and containers and standardization of truck sizes.

According to Thiell et al. (2011) green logistics activities include green warehousing, green packaging, green procurement, and waste management. Green logistics is considered equivalent to green transportation since green logistics often starts from reducing the environmental impacts of transportation which, as stated before, is the biggest sources of CO_2 emission in logistics decisions.

McKinnon et al. (2010) states that green logistics leans to

1. Strategic decisions regarding the number, location and capacity of factories, warehouses, stores, and terminals
2. Commercial decisions on product procurement, subcontracting of production processes and distribution of finished products. These create a model of business relationships between the company and its suppliers, distributors, and customers
3. Operational decisions on production and distribution scheduling and determining the stock turnover rate at the nodes of the supply chain
4. Functional decisions related to the management of logistical resources. Logistics managers still have discretion in the routing and loading of vehicles and the operating methods in the logistics facilities

Green warehousing impacts sustainability throughout layout, design, and capacity of the warehouse when practices for removing the negative impacts are, for example, process optimization and automatic warehousing systems. Green packaging impacts sustainability throughout size, shape and materials and practices removing the negative impacts are innovative packaging technologies and environmental certifications. Green procurement has impact to sustainability if there is lack in quality in raw materials purchased and practice for removing the negative impact is quality check monitoring tools. Waste management impacts

sustainability throughout different kind of waste generate during the logistics like waste from expired product or due to packaging. Practices for removing the negative impact are waste contractor and trade waste recycling. (Thiell et al. 2011)

2.4. Carbon management

In the larger scale of environmental management, there is a rapidly emerging literature that focuses specifically on carbon management (Boiral et al., 2012; Weinhofer & Busch, 2013). There has been attention to the development of typologies that aim to capture the firm-based emissions reduction activities of organizations. Different kind of classifications, such as product versus process oriented, internal versus external, direct versus indirect, radical versus incremental, and innovation versus compensation have been adopted (Kolk & Pinkse, 2012,). However, Okereke (2017) claims that to understand the carbon management activities, these classifications are arbitrary and contain several overlaps. Zhou (2020) argues that there are two different strategies to respond to climate change by reducing and managing the risks caused by it: mitigation and adaptation. Mitigation is the process of reducing emissions or enhancing sinks of greenhouse gases and adaptation means adjustment to actual or expected climate and its effects to either lessen or avoid harm or exploit beneficial opportunities.

According to Gouldson and Sullivan (2012), several organizations set long-term emission reduction targets on their own initiative. Authors findings indicate that in addition of being line with national policies and may even exceeding these, they are probable and realistic. However, according to the authors, they also recognize that depending only to these voluntary commitments for decreasing emissions might not be adequate, since they might focus only to direct emissions and ignore the indirect emissions which may even exceed the direct emissions. Same authors also find that along with most of the organizations, the emissions will rise without major changes made to the practices, and that they are lacking indirect emission management practices that are the major causes of such. (Gouldson & Sullivan 2013, 733)

2.4.1. Carbon management process

Zhou (2020) suggests taking four steps when starting carbon management. The steps are pictured in Figure 8. At first, there must be the commitment from top management of organization. The role regarding to carbon management is to develop and approve carbon/sustainability policy as a statement of commitment; to provide resources and support during the process; and to regularly review the process to ensure its continuing suitability, adequacy, and effectiveness.

Secondly, the organization should establish the working group to develop the carbon management system which consists of people from different organizational levels. Roles, responsibilities, authorities, and resources shall be defined. When gathering the group members, the author urges to think, what are the organization's emission sources and who are the data owners of emission data, what is the business nature and how many business functions, operations, or units there are within the organization, who are the business operation heads and are property management, facility management and finance team engaged in team with the purpose to assign accountability.

Zhou (2020) found that calculation of emissions is one the most important part of carbon management. It is crucial to understand the current situation, starting point, before decisions how to mitigate CO_2 emissions. The third step is to understand current situation regarding to emissions of the organization. To identify the organization's baseline with emissions this step includes, CSR or carbon emission check, baseline carbon emissions measurement and carbon audit.

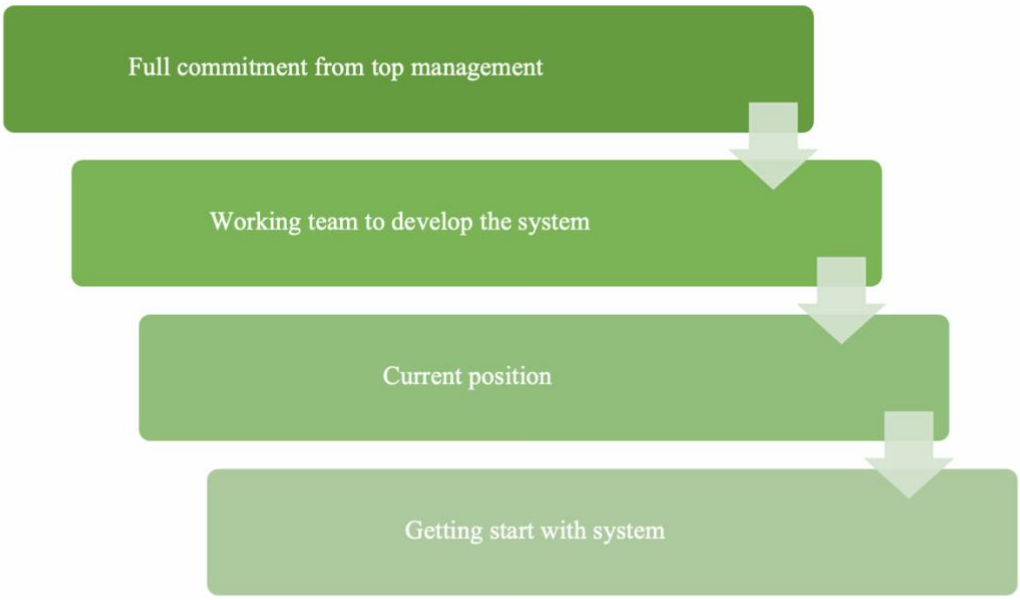

Figure 8. Four steps to start carbon management (according to Zhou 2020)

In addition of producing carbon footprint data, carbon footprint calculations help organizations to identify pain points in their functions where and how to reduce the CO_2 emissions. Finally, the carbon management system is ready to start.

2.5. Drivers

Drivers of sustainable supply chain management are pressures that encourage organizations on the implementation of specific sustainability practices and initiatives (Caniato et al. 2012). Köksal et al. (2017) have studied that drivers are prompting factors when applying sustainable supply chain management practices to organizations. The previous literature has found several drivers of doing sustainable supply chain management (Saeed and Kersten 2019) and drivers of doing sustainable supply chain management is closely related to the drivers of implementation of sustainable supply chain management, which is also researched topic. Tay et al. (2015) found that there are various reasons organizations engage with sustainable supply chain management. There are reasons such as top managements'

willingness, and external influences like customers' requirements or stakeholders' pressure. Liesen et al. (2015) claim that several studies found that specific stakeholder groups appear to influence organizations' environmental disclosure.

There are various points driving organizations to act including increases in direct energy costs, the energy costs of suppliers, existing and future regulation which penalizes high energy consumption and rewards emissions reductions, changing consumer attitudes to climate change, presenting forward-thinking organizations with an opportunity to develop and market low-carbon products, report CO_2 emissions to third party, consumers, supply chain partners, or regulatory bodies, and provide data for carbon management action and strategy. Wong et al. (2016) found in their research that the drivers of GLPs can be classified into customer pressures, economic incentives, and regulatory requirements. Lai et al. (2012) study with Chinese export manufacturers revealed customer pressure is remarkably and positively associated with the extent of organizations implementation of GLPs. However, according to the study, environmental regulations is less likely to affect the organizations' pursuit of GLPs. Same authors claim environmental regulatory pressure have a positive effect of customers' pressure. Economic incentives and regulatory requirements were seen to be effective through government subsidies and material cost savings.

Zhou (2020) shared carbon management business drivers to eight parts which are pictured in Figure 9: cost savings, reduction of risks, reputation, stakeholders, competitive advantage, employee morale, innovation, and revenue contribution. Carbon management has been studied to offer organizations a way to find out about the generation of emissions and thus the opportunity to reduce emissions from the operations that produce them, which can lead to cost savings.

With carbon management, an organization can identify and manage risks better, because the carbon footprint is at least related to compliance or regulatory risk, financial risk, operational risk, and reputational risk. It is likely that in the future, legislation and regulations include changes in government climate policy, local energy targets, the establishment of carbon trading schemes, and carbon taxes. With early adoption of carbon management, it is possible

for organizations to evaluate their capability at an early stage to avoid these future climate-related risks, protect their brand reputation and begin to take advantage of carbon management-related business opportunities. (Zhou 2020)

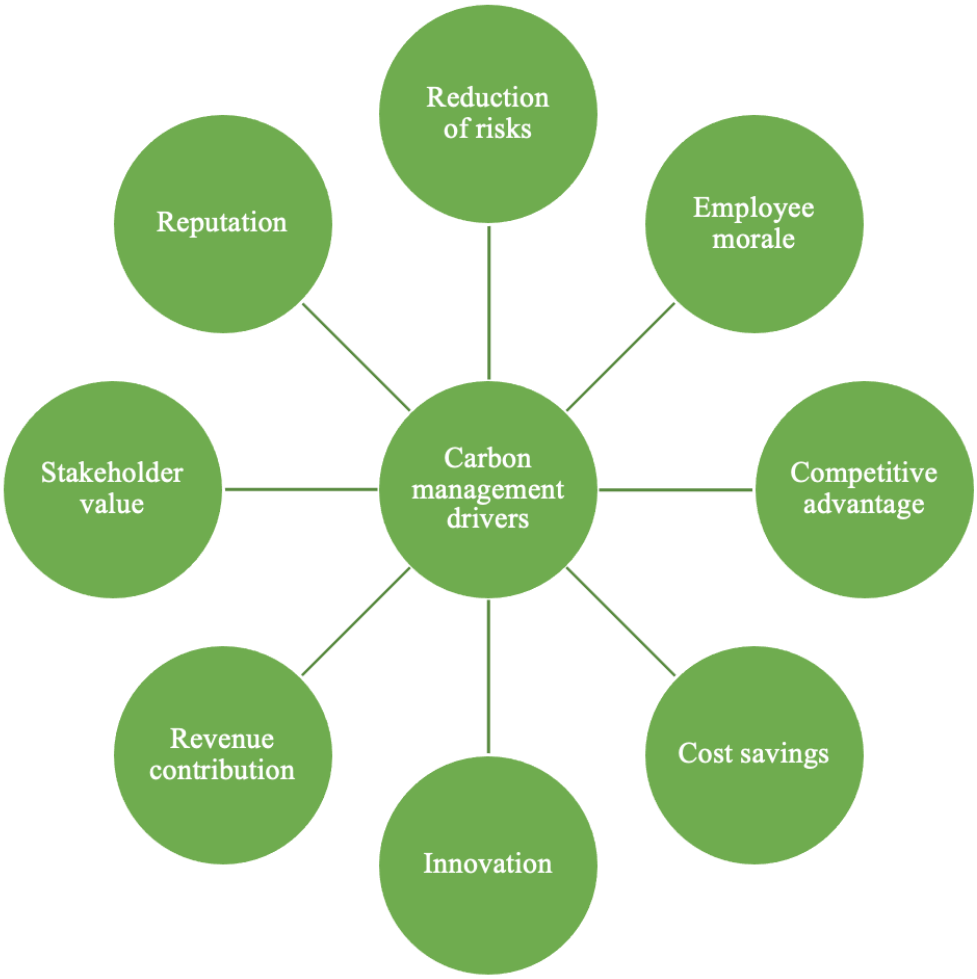

Figure 9. Key business drivers for carbon management (Zhou 2020)

CO_2 calculations and reporting are also stakeholders' demand. According to Wiengarten et al. (2013), stakeholders evaluate critically the success of a organization not only based on the financial and social performance, but also regarding to environmental performance. Investors, employees, customers, government, and non-governmental organizations require organizations to constantly make more efforts in terms of improving low-carbon products

and services. According to the study of Aminabhavi et al. (2020) bioenergy, which is a substitute to CO2, as it is renewable, eco-friendly, and can also create better brand image. Thus, gaining competitive advantage through carbon management is possible for the companies when customers are willing to consume lower carbon products and services and potential employees seek opportunities to find employer who matches their values. As the employees are crucial to the organizations, engagement of them should be done properly. One part of succeeded employer engagement is proper sustainability performance and related communication. Once the organization handles carbon management, related reporting, and communication to its employees correctly, employees are morale boosted, and performing tasks in more sustainable way, thus increasing sustainable performance and organization's reputation even more. In addition, when striving for lower emissions and developing their processes, organizations can end up innovating completely new ways to work, products, and services. (Zhou 2020; Wiengarten et al. 2013) Padilla-Lozano and Collazzo (2020) argue that green innovations have a major impact on the competitiveness of organizations' operations in an emerging economy.

2.5.1. Internal drivers

According to the study of Saeed and Kersten (2019), identification of drivers for practicing carbon management is a beneficial tool for organizations to understand sustainability related issues. One traditional way to view drivers is to categorize them to internal and external drivers. (Tay et al. 2015; Saeed & Kersten 2019) However, Saeed and Kersten (2019) studied that not all internal and external drivers have an equal level of access to the organizational knowledge and value contribution.

There have been various ways in literature how to classify internal drivers and some of those are being viewed in this chapter. Saeed and Kersten (2019) identified that internal drivers include organizational-related elements that are supported by efficiency targets, corporate values, and corporate responsibility objectives. According to the authors internal drivers can be divided into four sections: corporate strategy, organizational culture, organizational resources, and organizational characteristics. Corporate strategy includes four drivers: top

management's commitment, organizations' strategy, cost-related pressure, and operational performance. Organizational culture includes five drivers: sosio-cultural responsibility, innovativeness, code of business conduct, information diffemination, and health and safety. Sosio-cultural responsibility means company's moral obligations to act correctly in society and code of business conduct refers standardized and common systems that fulfil the needs of its stakeholders. There are six drivers in organizational resources: adequate organizational resources, resource depletion, human capital, employees' pressure, physical capital, and training and development.

Organizational characteristics include six drivers as well: company's size, industrial sector, position in supply chain, geographical location, degree of internationalization, and current level of sustainability practices. The size of the company is driver since larger companies can feel more internal pressure to implement sustainability practices, and the pressure comes from employees, as well as external pressures from regulatory, media, and social organizations. Smaller companies are under pressure from their competitors and customers. Different industrial sectors have different kind of stakeholder expectations, sustainability requirements, and performance assessments. The company's position in supply chain is important to consider: focal companies face pressures from supply chain and to achieve sustainability goals, they develop their relationships with suppliers.

In addition, downstream supply chain actors may face more pressure than upstream supply chain partners to adopt sustainability practices. Geographical location is important to consider due to different laws between countries. When compared to non-international, multinational organizations are under more pressure to adopt sustainable practices. Companies that already operate sustainable way, face less pressure from stakeholders to act sustainable, whereas stakeholder pressure is higher for companies that have not implemented any sustainable practices. (Saeed & Kersten 2019)

2.5.2. External drivers

According to Saeed and Kersten (2019) external drivers come from outside of the organization, however, they affect how the organization works internally. Mathiyazhagan et

al. (2015) state that organizations feel the most pressure from external stakeholders when making decisions about sustainable practices. In the same way as internal, external drivers have also been studied a lot in the literature and this section presents a few of them. Table 4 summarizes the internal and external drivers which are reviewed in this study.

Table 4. Summary of internal and external drivers

Internal drivers	•Code of conduct •Culture •Competitive advantage •Competitiveness •Cost reduction •Customers' awareness •Degree of internationalization •Employees' pressure •Geographical location •Green supply chain management capabilities •Health and safety •Human capital •Industrial sector •Infomation dissemination •Level of environmental commitment •Level of sustainability practices •Operational performance •Size •Physical capital •Position in supply chain •Resources •Strategy •Top management support •Training and development
External drivers	•Certifications •Competitive advantage •Competitors' pressure •Consumer organizations •Customers' pressure •Financial benefits •Financial resources •Globalization •Government regulations •Institutional pressure •Media •NGOs •Professional associations •Public pressure •Regional pressure •International pressure •Regulations •Reputation •Shareholders' pressure •Investors' pressure •Social well-being •Stakeholders pressure •Suppliers •Value-based networks

Tay et al. (2015) argue that external drivers can be divided into six groups: government, which includes policies and regulation, competitors, customers, suppliers which involves co-operation with suppliers, investors which includes pressures from investors, and influence of NGOs. Abdul-Rashid et al. (2017) in turn recognized in their study three external drivers: regulation, public awareness, and suppliers. According to their study, regulation means compliance with local market regulations, legislation, and standards and public awareness could be considered as pressure from the local or international public and environmental advocacy groups. Suppliers implies their pressure of choosing green initiatives.

Saeed and Kersten (2019) argue that external drivers can be divided into regulatory pressures, societal pressures, and market pressures. First one includes five drivers: government legislation, regional or international regulator, professional associations, financial benefits, and certifications. According to authors, environmental sustainability practices are more likely to occur in organizations that have certificates compared to organizations that do not and they have more concerns about environmental sustainability. Also, Azedevo et al. (2014) found that organizations with ISO 14001 certification further had more positive impact on the environmental of suppliers than organizations without certificate.

Societal pressure includes non-governmental organizations' pressure, media, value-based networks, public pressure, consumer organizations, and social wellbeing. All of these can be influential drivers that makes organizations adopt sustainable practices, since consumers are aware of sustainability issues and demand organizations to act in sustainable way, networks are willing to build their own sustainability and thus demand same kind of actions from their partners, and media have a power to inform people about the lack of sustainable practices. (Saeed & Kersten 2019)

Social wellbeing means a driver to act sustainably towards the local communities' expectations. Market pressures can be further divided to competitive advantage, competitor's pressure, shareholders' and investors' pressure, institutional pressure, suppliers' pressure, customers' pressure, reputation, and globalization. Institutional pressure can be, for example, pressure from banks in connection with financing and bank loans. Competitive advantage is a significant driver, as organizations strive to create a competitive advantage with the help of green technologies that promote environmental sustainability. In connection with this, also pressure from competitors, as organizations are also pressured by the sustainable performance of competitors and reaching the same level.

In addition, shareholders and investors may demand a certain level of sustainability. Institutional pressure comes usually from banks and stakeholders. Organizations value their customers' demands since they want to achieve high level of customer satisfaction. High customer satisfaction is correlated with adoption of environmental sustainability practices. Globalization is an important driver since it gives accessibility to review global competitors' environmental sustainability practices. (Saeed & Kersten 2019)

3. METHODOLOGY

After the theoretical discussion of decarbonizing forwarding and logistics sector and regarding drivers, the empirical section is reviewed. This chapter introduces the methods used to make the thesis. First, used research methodology and data collection are presented. Second, the chapter will discuss the conducted interviews as well as the interviewees. Finally, there is discussion about reliability and validity.

3.1. Research methodology

Examined concept and research questions lead this thesis to choose qualitative approach, which suited the goal of examining which suited the goal of examining the phenomenon comprehensively. Qualitative research can be defined as a process of understanding based on distinct methodological traditions of research that investigate a social or human problem. The researcher builds a complex, comprehensive picture, analyzes words, reports detailed views of informants, and conducts research in a natural environment. (Creswell, 1998, 15) Qualitative research is especially important when previous views on the phenomenon under review are modest (Eriksson & Kovalainen 2008, 5). The thesis was done with a case study. A case study is the production of detailed and comprehensive information. The analysis consists of several empirical sources rich in context. (Eriksson & Kovalainen 2008, 27, 117) Case studies are used in different situations to increase our knowledge of a group, individual, organization, social, political, and other related phenomenon. If research questions focus on "what" questions, two possibilities arise. Some of these questions are exploratory, so an exploratory survey, experiment or case study can be used. (Yin 2003, 5-6)

The research process of this study is pictured in Figure 10. It follows the traditional research process model, elaborated for example, Hirsjärvi and Hurme (2001, 14).

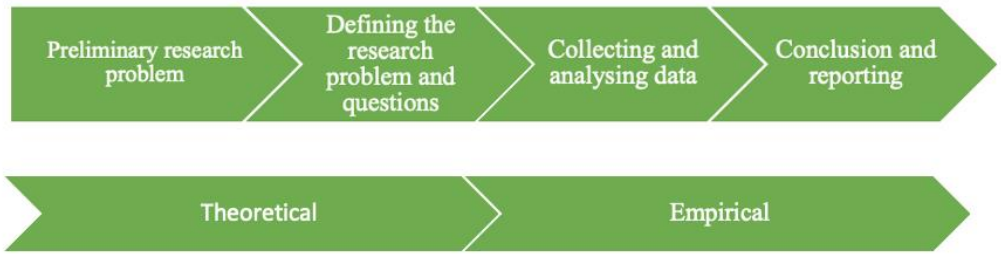

Figure 10. The research process of the study (Hirsjärvi & Hurme, 2001)

At first, the process model defines the research problem. Second, research problem will be dealt with at a more detailed level. The third stage of the model includes collecting and analyzing the data. Finally, the process model includes conclusion and reporting.

3.2. Data collection

Primary data were collected through a semi-structured interview. Semi-structured interviews contain outlines of topics, subjects, or themes, but vary in wording and order. The main advantage of semi-structured interviews is that the materials are somewhat comprehensive and systematic, and the tone of the interview is conversational and free form. (Eriksson & Kovalainen 2008, 82)

There were seven different companies from forwarding and logistics industry which were interviewed via online meetings. The duration of one meeting was approximately an hour, and the discussed themes and interview questions were sent to the interviewee in advance. As shown in Table 5. below, most of the interviewee's were CEOs. However, there were also Head of ICT & development, Director of development, Sustainability & Development

manager, Head of climate and environment, and Quality manager that were interviewed. There were two interviews in which were two interviewees and otherwise there were one of them.

Table 5. List of interviews

Case company	Interviewee's position	Number of interviewee's	Duration
Company 1	CEO, Head of ICT & development	2	58 min
Company 2	CEO	1	1 hour
Company 3	CEO	1	42 min
Company 4	CEO	1	55 min
Company 5	Director of development, Sustainability & Development manager	2	1 hour
Company 6	Head of climate and environment	1	1 hour
Company 7	Quality manager	1	1 hour

In addition, secondary data was also utilized, and it was collected from interviewed companies' corporate reports. Relevant articles and literature were searched in the LUT Primo database by keywords "sustainable logistics", "environmental management", "environmental management practices", "logistics", "sustainable reporting", "emissions management ", "green logistics", and "carbon management".

3.3. Data analysing

According to Creswell (2009) and Klenke et al. (2016) there are multiple options for analysing data. In addition to the sustainability reports, empirical data was collected with seven semi-structured interviews from Finnish freight forwarding and logistics companies. The interviews were recorded so that they could be listened to later and write transcripts to computer. The text was read through and then moved to a detailed coding process, which means that the different themes of the data are classified and given a code. The process makes it easier to divide the themes into parts so that they can be handled more easily. (Eriksson & Kovalainen, 2008; Creswell 2009) The last step in the analysis process is interpretation the meaning of data themes. which can be helped by, for example, literature related to the topic. (Creswell 2009)

3.4. Reliability and liability

Reliability and validity are common measures that affect the quality of the study. (Klenke et al. 2016) According to Rose and Johnson (2020) reliability is understood through repetitiveness. This means that if the study can be repeated several times and the results support each other, the study can be considered reliable. Reliability means the consistency of the research, which results from the choice of method and analytical depth. Validity refers to the research methodology and its place in the research. That means it measures the subject research intends to study. (Rose & Johnson 2020) Trustworthiness must be considered on all studies' results. Creswell and Creswell (2018) argue that the nature of qualitative studies can lead to low reliability and validity, as these studies can be unreliable, subjective and have limited generalizability. Qualitative studies have less strict guidelines than quantitative studies and studies can be hard to replicate. The authors state that the reliability may suffer if the researcher takes a stand only on the discussed results, which give the participants a good light. The aim of this study is to be as reliable and valid as possible. To achieve higher data reliability and liability, thesis was based on multiple data sources by combining primary interview data and secondary data, such as companies' corporate reports and information about sustainable strategies from case companies' websites. The process of this study is documented systematically and explained.

4. EMPIRICAL ANALYSIS

The analysis handles the interviews made for seven case companies. In addition, secondary data is used from case companies' corporate reports. First, the study finds out how sustainability is generally seen in companies. Second, companies' most important stakeholders and their role in companies is analyzed. After this the CO_2 calculations and reporting are discussed. Finally, drivers promoting the carbon management are examined.

4.1. General approach towards environmental sustainability

Interviews disclosed that sustainability is considered important in all case companies. All of nine interviewees see sustainability 'very important' or 'crucial' both in the company they represent and logistics and forwarding industry. Interviews revealed that not all companies have a sustainability strategy, however, there are some clauses related to sustainability, or they are currently being drafted in a near future. Gaining a cost savings with sustainable activities was also seen as variable. However, most of the case companies stated that they have been able to gain cost savings with environmental sustainability activities. The results of attitudes, achieved cost savings, and sustainability strategy are gathered in Table 6 below.

Company 1 stated sustainability is considered very important in the company. Environmental sustainability and its practices are seen in as a chance to be a pioneer in the forwarding and logistics industry, and it has been much discussed topic for five years. According to the interviewees it brings a competitive advantage to them. The interviewees strongly believe that the discussion around the topic will not decrease, but on the contrary, especially issues related to reducing emissions are more and more prominent throughout the logistics industry. The company does not have a separate sustainability strategy, but the interview reveals that sustainability is mentioned as part of the strategy. According to company 2 the term 'environmental sustainability' has been in their company always as an endogenous role, but interviewee recognized that the general attitudes related to it have changed within the company and it is considered more seriously now as there is widespread

awareness about forwarding and logistics sector influences climate change and global warming. Gaining cost savings through sustainability activities are not identified. The interviewee stated that they have a narrow sustainability strategy now, but its improvement is ongoing process. Company 3's interviewee revealed that environmental sustainability has been significant topic in recent years, and it is seen, especially nowadays, as a vital part of all activities and must be considered, however, according to the interviewee, it has not brought cost savings to the company. They don't have separate sustainability strategy but according to the interviewee sustainability is considered in their strategy.

Table 6. General approach towards sustainability

Case company	Attitudes towards environmental sustainability	Cost savings achieved	Environmental sustainability strategy
Company 1	Very important	No	Integrated into the strategy
Company 2	Very important	No	Narrow. Wider version is forthcoming
Company 3	Very important	No	Integrated into the strategy
Company 4	Crucial	Yes	Yes
Company 5	Very important	Yes	Narrow. Wider version is forthcoming
Company 6	Very important	Yes	Integrated to the strategy
Company 7	Very important	Yes	Yes

The interviewee of company 4 highlighted that sustainability is crucial to the company. Environmentally sustainable activities have brought a cost savings to the company with the savings related to the heating of property and High-Capacity Transport (HCT) combinations. Company 4 has a separate sustainability strategy. Company 5 describes sustainability as *'a very important and essential part of the existence of this company'*. According to the interviewees, sustainability principles have launched a couple of years ago, and the launch of the sustainability program has been planned during 2022. The company recognizes that it has achieved cost savings with environmentally sustainable activities. Interviewees mention that they have noticed decreasing energy consumption.

Company 6's interviewee revealed that from all the triple bottom line aspects environmental aspect is the most important to them because of the polluting nature of the logistics and forwarding industry. Interviewee feels like there is a chance to influence to the future of sector by being at the forefront and leading by the example. According to the company, there are not separate environmental strategy, but sustainability is integrated to strategy. Although cost savings are recognized through environmental sustainability activities, they have also become costs. The interviewee could not say whether more savings or costs had been generated. The interviewee of company 7 described their attitude towards environmental sustainability as *'we feel it is very important and see it as a new potential mode of action'.* They have a sustainability strategy, and it comes from the mother company. Cost savings are gained through energy savings, for example, redesigning the lighting in the properties.

4.2. Stakeholders

Interviews revealed that stakeholders' carbon management do not affect the selection criteria of stakeholders. Except in company 6, in all case companies, stakeholders CO_2 emissions is not recognized to one of the factors affecting the stakeholder selection. However, things that may have effect environmental sustainability performance, such as quality certificates, physical location, and mutual values are mentioned as main criteria. Some case companies revealed that sufficiently low stakeholders' CO_2 emissions will be one of the criteria when selecting stakeholders and partners in the future. When considering factors that are affecting

to the relationship, it must be considered that some authorities such as customs, are given and not chosen by the company itself like the suppliers and subcontractors. Findings from the stakeholders are listed in Table 7.

In case of company 1, interviewee sees customers, subcontractors, ports, suppliers, and authorities as the most important stakeholders. Interviewee describes that communication between stakeholders is frequent and they appreciate close relationships with the stakeholders. The service must be able to produce as agreed in right place and the price and quality must be in balance. Sometimes, due to limited supply, some factors must be emphasized over others. Although the sustainability aspect is included in the tendering, the company does not yet recognize the impact of CO_2 emissions on the selection. However, they see that in the future it will be one criterion.

Company 2 describes customers, partners, and authorities as its most important stakeholders. Long-term cooperative relationships are appreciated and when selecting partners need and functionality are the most critical factors. Communication and its succession are described as crucial as it is expected to be effective. Interviewee states that *'at the moment, unfortunately, sustainability or ecological issues does not affect when selecting stakeholders.'* Company 3 emphasizes investor relationships but mentions media, financiers, and customers as most important stakeholders as well. Communication between those is describes as regular as necessary and always depends on the current situation of the company. For example, the media are more closely connected on a quarterly basis due to the obligations of the listed company. Company 3 does not recognize either that sustainability affects the choice of stakeholders.

Table 7. Companies' relations with stakeholders

Case company	Most important stakeholders	Main stakeholder selection criteria	Whether stakeholders' CO_2 emissions affect the choice
Company 1	Customers, subcontractors, ports, suppliers, authorities	Quality, price, physical location	No
Company 2	Customers, partners, authorities	Need and functionality	No
Company 3	Investors, media, financiers, customers	Assurance, quality certificates	No
Company 4	Subcontractors, associations, customers	Perseverance, going in the same direction, moving the industry forward	No
Company 5	Subcontractors, customers, shipping companies	Cost effectiveness	No
Company 6	Customers, owner-employees	Communication, emission performance	Yes
Company 7	Customers, subcontractors, employees	Reliability, security of supply, credibility	No

In case of company 4, subcontractors, associations and customers are the most important stakeholders. However, chambers of commerce, municipal agencies and employers' associations are mentioned as well. Communication between them is described as vary as varies between different forums, once every two or three months. The same issues can be addressed multiple times when going through various forums. Long term and honest communication are considered valuable, and perseverance and working together to achieve common goals is seen as one of the primary criteria when selecting stakeholders. Company 5 mentions subcontractors, customers and shipping

companies as the most important stakeholders and emphasizes that the network of subcontractors is wide with about 260 subcontractors, which makes too little attention to communication at time to times. In addition to cost efficiency, the company emphasizes the effectiveness of cooperation. Interviewees state that *'we have a certified quality system in place since 93, based on which we commit our subcontractors to act as we do'.*

Interviewee of company 6 describes their communication between the most important stakeholders, customers, and owner-employees, as a critical dialogue, where it becomes clear that company can provide the service and information they need. According to the interviewee, for various employees, environmental sustainability is a motivating factor, thus successful communication and emission performance are critical if company wants to practice decent employee engagement. Interviewee describes the situation that *'it is like a continuum because we are looking for people who value these things, and these people put our values into practice in their daily work'*. Interviewee recognizes the CO_2 emissions of stakeholders being affective factor when selecting stakeholders. In company 7 they see customers, subcontractors and employees as the most important stakeholders and interviewee tells that communication with them is continuous and planned at some parts, for example, the company has group-wide projects aimed at influencing employees. They aim to increase employee information by sharing information via trainings and encouraging sustainability. According to the interviewee, communication is affected by general awakening and the fact that CO_2 emissions have begun to be talked about in the news. Interviewee says that customers ask how company 7 can ease their pressure regarding CO_2 emissions calculation and reporting. Reliability, security of supply and credibility are seen as the most important criteria while selecting stakeholders. The interview shows that co2 emissions of stakeholders are not affected to the selection of them in case of company 7.

4.3. Calculation of CO_2 emissions

When comparing calculation in case companies, it is evident that larger-sized and group-based companies have more clear ways how to calculate their CO_2 emissions. CO_2 emissions calculation methods and the major emitters of the case companies are listed in Table 8. The scale of calculations varies between companies as case companies 5, 6, and 7 have

calculation methods which produces the results of emissions for a certain period or route, and in case of case companies 2 and 3 calculation is to some extent handled manually, and the CO_2 emissions will be calculated and delivered to the customer in case if they ask it.

Due to the nature of company 1's business, the CO_2 emissions are largely consisting of property and the transport side is minor, so CO_2 emissions from transportation, which is bought from subcontractors, are not calculated separately for customers. Scope 1 and 2, in line with GHG protocol, are known about own business activities. According to interviewees, scope 3 calculations will be calculated in the future. Emissions calculations from scope 1 and 2 from 2020 have been made in 2021, and emissions from 2021 are currently being calculated. Company 1 classifies its emissions to electricity emissions, property heating and transport of own vehicles. Property creates the most CO_2 emissions. Factors that affect CO_2 emissions are solutions that affect heating, such as what kind of oil is used. Things about the motive power of own vehicles is also mentioned. As part of the group, company 1 can pursue this issue. Electric cars are preferred as vehicles change quickly, faster than average. Plug-in hybrids or electric vehicles are planned to take in use during 2023. If that does not work, for example because of delivery difficulties, diesel will be replaced with renewable energies.

Company 2 states that CO_2 calculations are done for the customers who request those. The calculations are handled manually by one or two employees, and they are based on the EcoTransIT method. CO_2 emissions are not classified except when requested and when calculating the report to be delivered to the customer. The interviewee describes that the event is customer-oriented, i.e., everything that is done comes as an order from the customer. Air cargo has been identified as the biggest source of emissions. Since they have no own air fleet, air cargo is bought as a subcontract. Company 3 calculates its emissions partly and it is based on EN 16258. For rail transport the emissions are fully known. Interviewee states, that emissions from other sources are not recognized as the biggest emissions are identified from future value chains and not direct emissions of the company. Emissions from buildings are identified to the extent that can be seen on the electricity and water bills, but the emissions are not classified.

Table 8. CO_2 emissions calculation methods and major emitters

Case company	Calculating CO_2 emissions	Calculation method	Major emitters
Company 1	Partly	GHG Protocol	Property
Company 2	Partly	EcoTransIT based	Value chain emissions (Air Freight)
Company 3	Partly	EN 16258	Value chain emissions
Company 4	Partly	EcoTransIT (GLEC, EN 16258 and GHG Protocol)	Air freight, road transport
Company 5	Yes	ENSIO (Based on GHG Protocol)	Handling of goods
Company 6	Yes	GHG Protocol	Value chain emissions
Company 7	Yes	EcoTransIT (GLEC, EN 16258 and GHG Protocol)	Air freight

Company 4 calculates its CO_2 emissions with EcoTransIT since it is the group's selected method and attachment comes directly from the mother company. Road transportation, air freight and container transportation emissions are known but there are issues with emissions calculations with ferries and storage, however, their emissions are intended to be resolved as soon as possible. After EcoTransIT results, no further classification of emissions is done in the company 4 because they consider that the classification of EcoTransIT is sufficient. The group reports that the major sources of emissions are air freight, road transport, and property. Company 5 calculates its CO_2 emissions by using the software they developed

together with their partner. Calculation method is based on GHG Protocol, and it is called ENSIO. CO_2 emissions are based monthly. According to the interviewee, the entire machine base of company is in ENSIO, so the emissions of an individual machine can be viewed precisely. Machinery and heating of property create the most CO_2 emissions. The amount of material handling affects the generated emissions, the goal is not to reduce emissions by an absolute number but by a ratio. Company 6 calculates its emissions with GHG Protocol's standards and instructions. The goal is to halve by 2030 total emissions (scope 1, 2 & 3) for 2020 level. This includes all own emissions (scope 1 & 2) printing to zero and fossil-free road transport also in terms of subcontracting. Value chain emissions are recognized as the largest source of emissions. Company 6 has calculated that 80 percent of all emissions are generated in value chains. The company has further divided these into subcontracted transport and distribution (50 percent), purchased products and services and fixed assets (35 percent), production of fuel ideas and transmission losses (6 percent), business travel and traveling to work (9 percent). The remaining 20 percent is caused by company's own emissions (scope 1 & 2) and it is divided into own vehicles and fuel with 80 percent and property with 20 percent. (Company 6, 2021) According to company 7, there has been an instruction from the group level to use EcoTransIT. Emissions from scope 1 and 2 are known, and fully compensated from 2020, but emissions from scope 3 is in clearance. They get information about scope 3 emissions comes from the chain of suppliers, e.g., from large shipping companies, but there is so much data that the process is slow. The goal is to achieve carbon neutrality of the footprint of company's transport service suppliers and customers (scope 3) by 2030 (Company 7, 2021) Company 7 recognizes air freight as the biggest source of CO_2 emissions.

4.4. Reporting of CO_2 emissions

Interviews reveal that there are various ways how case companies manage CO_2 reporting. Findings from reporting are in the Table 9. In case of company 1 the emissions of 2020 are internally reported. There is no external reporting, however, interviewees state that having active external reporting would be the ideal situation for them. Information of internal reports include electricity and oil consumption, water transportation and heating methods. These have been monitored for a long time, for example by monitoring the refuelling of the

company's vehicles, thus, there are plenty of the data. Company 1 have NESTE as a partner, and from there the company receives information about refuelling of company vehicles in automatic reporting. The reports contain the emission factors used in the CO_2 calculations. In 2021, cooperation with consulting firm called BearingPoint has been started, and through that the 2020 emissions have been and reported internally.

Table 9. CO_2 emissions reporting methods

Case company	Internal/External reporting	Reporting method	Reporting entity
Company 1	Internal	EN16258	Consulting company
Company 2	Internal	Under development	In-house
Company 3	Both	EN 16258	Consulting company
Company 4	Both	GRI	In-house, verified by third party
Company 5	Both	GHG Protocol	In-house
Company 6	Both	GRI	In-house, verified by third party
Company 7	Both	GLEC, EN 1658, GHG Protocol	EcoTransIT

According to the interviewees of company 1 the issue related to reporting is new and thus the company does not know whether the reporting complies with the standards or whether it is verified with a third party. According to the website, BearingPoint follows EN16258 in its reports (BearingPoint 2022). When discussing about advantages of reporting of CO_2 emissions, it turns out that customer demands, brand image and employer image are

perceived as advantages. According to the interviewees, all these topics can be answered by decent CO_2 emissions reporting. On the other hand, the question about how to make CO_2 emissions a reasonable part of reporting is perceived as a shortcoming. Tenders have already asked for CO_2 emissions reports, but they have not yet been a decisive factor. The related questions have mainly concerned whether a calculation is made and whether there are reports. However, company 1 recognizes that in the near future it will already be a decisive factor. The interviewees believe that when scope 3 emissions measurement is reached, the emission reporting of partners will have a greater impact on their own reporting than it does now. In terms of improving CO_2 emissions reporting, the company's plan is to calculate CO_2 emissions once a year with the help of a partner. They want to make the process a smooth part of normal reporting, for example quarterly. In the future, they aim to do the reporting themselves and build in their own reporting systems so that real-time is the key factor. The company wants to get scope 3 involved as soon as possible, when scope 1 and scope 2 are properly under control.

In case of company 2, CO_2 emissions reports from transportations are delivered externally to customers who ask for them. Reports are also processed internally, when necessary, from example, in case of educating personnel. There exists a lot of data on electricity and water consumption, waste treatment and fuel use, but they have not been combined in the form of CO_2 emissions report. According to the interviewee, there is not a specific protocol for CO_2 emissions reporting, however, a system is being developed for this and it will hopefully be completed in 2022. Company 2 has established the working group, which involves consultants and company’s employees from officers to directors, to develop the system. Now the reports which are delivered to the customers include the emission factors, transported goods, and kilometres in addition to emissions from transportation. If compensations have been used, they are in the reports as well.

The advantages of CO_2 emissions reporting are identified as the personnel's access to information and the building of the employer's image, while the shortcoming is the incompleteness of the process. The interviewee finds it interesting that emissions reports are asked more in Finland than in Eastern European countries. At the time of the interview, the

situation is that in Finland emissions reports have been requested several times by customers, while in Eastern Europe not once. What makes the situation interesting for the interviewer is that there are various Western companies in those countries as well. However, the interviewee believes that CO_2 emissions reports will be rapidly requested from everywhere. Company 2's partners' CO_2 emissions reports is not yet seen to affect their own reporting, however, this is also believed to change a lot in the near future. When company 2's own reporting is clarified, the interviewee will see that it affects their own reports a lot in terms of scope 3. A plan for improving CO_2 emissions reporting has been considered and is being worked on. For these customers, who are being tested on a pilot reporting, and the situation is mapped out and company 2 continue according to the results. The goal is to make the process as automated as possible.

In case of company 3, at the end of 2021, emission reporting calculated in accordance with the EN 16258 standard was introduced for all vehicles between Europe and Asia to the main traffic routes. The emission calculation is based on an external consulting company specializing in sustainable business development to implement the calculation model and is reported individually for every transportation. The report has been verified by a third party. (Company 3, 2021)

The interviewee of company 4 states that both internal and external CO_2 emissions reporting are done and under constantly improving. The company reports in accordance with GRI and the report is verified by a third party. This year's goal to be able to report CO_2 emissions at the country level in Finland in a monthly report. Externally, the group takes care of the reporting, and it is built from country level so that the countries initially report to the group and the group compiles the reports together. The advantages of CO_2 emissions reporting are traceability and the fact that a shipment-specific report can be produced for the customer. It is seen as shortcoming that the process is yet too manual and the associated uncertainty. According to the interviewee, customers who buy transportations request emission reports, but other stakeholders do not. The company would like emissions to be one of the competitive criteria in the market. Partners' emission reporting is not perceived to affect their own reporting.

Company 5 reports CO_2 emissions both externally and internally using ENSIO. Customers are asking the most questions about emissions, and they receive several emissions reports from the company 5. The interviewee states that the company has internal monthly monitoring for scope 1 and 2. Regarding Scope 3, to be reported once a year. Information on the basics of ENSIO can be found in detail: fuel consumption, technical data on work machines, average consumption, and driving hours. Subcontractors are asked for their respective information. Electricity consumption and heating come from electricity companies. CO_2 emissions from the purchase of office supplies, lumber and similar products, and business travel are the most random, but they are also reported separately. The reporting protocol is always the same, once a month the data is collected in ENSIO, and the result is considered. Third-party verification has not been considered necessary because there is no separate sustainability report. The advantages are perceived as knowing where the company is going in terms of emissions and knowing the effects, customers get what they ask for and thus are satisfied. Shortcomings are not seen in emissions reporting since ENSIO has been so efficient.

Company 6's external reporting covers the annual sustainability report and internal reporting includes reports with the sustainability team and management. Interviewee says that there is no specific reporting protocol, just company's own guidelines. It includes no specific rules but just general best practices and is based on GRI. The sustainability report is verified every two years and random inspections are also carried out. The advantages of reporting are data collection and credibility. On the other hand, data is also perceived as a shortcoming, because its quantity is massive. Emissions reporting is not yet seen as a finished process but is constantly evolving. The interviewee says that customers demand CO_2 emission reports. Many do their own calculations and reporting, so they request information to complete their own processes. There are new requests every day, so it is mandatory for company 6 to keep data updated. Company 6 want to achieve continuous improvement in terms of data since it helps improving their own reporting and when the standards develop and the requirements become clearer, a more detailed plan will be built.

Company 7 reports its emissions both internally and externally in accordance with EcoTransIT, but the interviewee states that external reporting is more important for the company because it has a greater impact to the stakeholders. Each emissions report is not verified separately with a third party, but how the emissions are calculated is verified with verification criteria ISO 14064-2:2006 and conducted by using ISO 14064-3:2006. The interviewee sees raising awareness among customers and improving employer image as advantages of emissions reporting. As shortcomings, there is such a large amount of data and there can be problems with it. Stakeholders ask if there are reports available, but do not require it. Mostly they ask if reporting is possible if it is needed at some point. The interviewee sees that it is not yet the case that no one is demanding but that it will be the situation in the future. The reporting of the CO_2 emissions of the partners affects the reporting of company 7, because the operation is so critical and dependent on the CO_2 emissions that come from the subcontractors. When discussing about improving the reporting of CO_2 emissions, the interviewee states that there is a plan to improve the data. There can be errors in the data, so internal working groups focused on data quality have been established. These include the company's employees, from the CEO to officers.

4.5. Drivers

The interviews revealed that most of the case companies felt that the main driver for calculating and measuring emissions was concern about the current state of the world. Company 1 interviewees said that concern for the current state is the most significant driver for all environmental management at the moment. However, pressure from employees, government regulation, employer image and recognition of competitiveness were also mentioned. The interviewee from company 2 also felt that concern for the current state of the world was the biggest driver for managing and promoting CO_2 emissions. Networks and customers were also mentioned as influencing. While the last two are not currently compelling drivers, they were seen as the biggest drivers in the near future. List of main drivers to manage CO_2 emissions are seen in Table 10. In the case of company 3, concern about the current state of the world was the most significant driver. In a publicly listed company, pressure from financiers and government regulations were also significant drivers for carbon management.

Table 10. The main driver to manage CO_2 emissions

Case company	**Drivers that encourage to manage CO_2 emissions**
Company 1	Concern about the current state of the world
Company 2	Concern about the current state of the world
Company 3	Concern about the current state of the world
Company 4	Employer image
Company 5	Concern about the current state of the world
Company 6	Regulations
Company 7	Concern about the current state of the world

The interviewee from company 4 mentioned the employer's image as the most important driver. According to the interviewee, it is impossible for a company that handles carbon management poorly to seek good employees, because sustainability is increasingly important value when looking for an employer. Greenwashing is not considered in a good way, and by compensating emissions, for example, it is impossible to win over environmentally conscious employees. Since the company 4 is part of the group, the resources brought by the group were also identified as a driver. According to the interviewee, without sufficient resources it would be very difficult to promote carbon management in the logistics sector. The interviewees from company 5 identified concern about the current state of the world as the most significant driver. Since company 5's business is mostly based on the port operator and warehousing, subcontractors, and relationships with them were also perceived as a driver.

Company 6 stated that state regulation affects carbon management as the biggest driver. As a state-owned company, it is a significant factor for the company, although other drivers,

such as cost savings and competitiveness, have also been identified. In the case of Company 7, concern about the current state of the world was cited as the biggest factor. It was felt to be important that the company's management is committed to supporting the carbon management process and that there are enough resources to support it. The company is part of an international group, and according to the interviewee, the necessary support has been sufficient and a lot has been achieved with it, even though the development work is still ongoing and ongoing.

5. DISCUSSION AND CONCLUSIONS

In this chapter, the results of the research will be discussed and reviewed, mirroring them in the theory section. The main research question and sub-research questions are answered. Finally, future research proposals are reviewed.

5.1. Answers to research questions

How are carbon dioxide emissions calculated and reported in forwarding and logistics companies?

There is a potential in forwarding and logistics companies to cut unnecessary emissions. Several authors have investigated that there are various ways to logistics companies to calculate and report their CO_2 emissions (Davydenko et al., 2019; Lößer, 2021; Wild, 2021) Interviews revealed that the calculation and reporting methods used were GHG protocol, EN 16258, and GLEC. When interpreting the results of the study, interesting found was that several case companies recognize the impact and importance of GLPs, but do not yet calculate or report their emissions properly. In several cases, however, it seems that the practices for them are being worked on and constantly being improved. The reasons for the current incompleteness seem to be the relatively small size of the companies, thus the lack of resources and ready-made methods of practices, as well as a rather confusing field of different methods for calculating emissions and reporting. However, case companies also felt that their culture includes a sustainable attitude and environmental sustainability is seen as a matter of course.

Reducing the carbon footprint is successful when companies are ready to invest in work and monitor the effectiveness of the work. The starting point for planning climate work and setting goals is that the company identifies the most significant sources of emissions from

its own operations. Once the development targets have been determined, emission reduction targets and indicators can be set for the targets. Continuous and long-term measurement of emissions is needed to determine the effectiveness of emission reduction measures. (Zhou 2020) The largest emissions of case companies consisted of value chain emissions and air freight.

What are the similarities and differences in calculation and reporting between companies?

Emissions should be calculated regularly to keep track of whether emissions have increased or decreased (GHG Protocol 2022). In the interviews with the case companies, it became clear that the carbon management of several case companies is only at the beginning, and methods and practices for calculating and reporting emissions are still being developed. Therefore, it is likely that the comparison of emissions is not straightforward within companies or between different companies. The interviews revealed that the case companies vary in their methods of calculating and reporting CO_2 emissions.

Some of the companies did not calculate all their emissions in all three scopes while some did. There were calculations in scope 1, scopes 1 and 2, and all three scopes. The reports produced were different from each other. Reports were produced both internally by the companies and purchased from outside. In cases where the calculation and reporting were done in-house, the verification of the reports with a third party was variable, so that two case companies announced about the verification. Based on the results of the study, the larger and group-based companies measured and reported their emissions more accurately and had a clearer approach to the process.

What drives forwarding and logistics companies to calculate and report their carbon dioxide emissions?

Organizations are highly motivated to improve understanding of their CO_2 emissions since customers, suppliers and other stakeholders' interests are increasingly oriented to those (Demaria & Rigot 2021). The increasing importance of environmental values for stakeholders is supporting the competitiveness and importance of low emission forwarding and logistics companies in value chains. Tightening regulation and the increase in fossil fuel costs accelerate the transition to lower-emission transport. Several case companies are committed to reduce CO_2 emissions and aim to achieve net-zero carbon emissions so own commitment to carbon management goals is one driver.. In addition to drivers such as government regulations and institutional pressure, the main reason for that was found from the culture: LSPs' own willingness to reduce them because of they are worried about the current situation of the world.

Both Tay et al. (2015) and Saeed and Kersten (2019) recognize that one traditional way to classify drivers is to categorize them to internal and external drivers. This classification was used in this study. Internal drivers arise from the company itself, while external drivers affect and push the company from the outside. The most significant internal drivers, which repeated in interviews among case companies are culture, competitiveness, cost reduction, employees' pressure, level of environmental commitment, size of the company, strategy, and top managements' support. However, research also reveals that drivers such as geographical location, innovativeness and industrial sector are recognized in few cases. The last three are marked in italics in Table 11, which lists internal and external drivers founded.

Table 11. Internal and external drivers

Internal drivers	**External drivers**
Culture	Cost savings
Competitiveness	Government regulations
Cost reduction	Institutional pressure
Employees' pressure	Social wellbeing
Level of environmental commitment	Value-based networks
Size	*Customers*
Strategy	*Public pressure*
Top management support	
Geographical location	
Innovativeness	
Industrial sector	

As main external drivers there were identified certifications, government regulations, institutional pressure, social wellbeing, and value-based networks. Marked in italics in the Table 11, customers, and public pressure were recognized as drivers as well.

Dabija and Bejan (2018) investigated that adopting sustainability to the business strategy may give the company a competitive advantage. Based on the interviews, those companies do not feel that they have achieved a competitive advantage through long-term transactions, nor have they fully calculated their CO_2 emissions covering all three scopes. An interesting observation is that at the time of the interview, the case companies knew a little about the CO_2 emissions calculations and reporting of their competitors and the competitors were not perceived to be the driver.

How forwarding and logistics companies see the future of carbon management?

The economy is heavily reliant on the logistics sector to move large quantities of raw materials to point of manufacture and the finished goods to market (Derbel et al. 2020). The interviews revealed that the target companies believe that the industry will continue to play a significant role in the future, as the world is globalized and LSPs are an important part of supply chains. Based on the interviews, environmental management was seen as an important part of business in all case companies. Due to the nature of the logistics industry, carbon management was felt to be important, and it was seen to take on a bigger role in the near future. Carbon management was thought to bring new leadership roles to companies and their boards. This became evident, for example, in the establishment of sustainability working groups whose purpose is to develop carbon footprint calculation and reporting.

Carbon management was felt to be important in the future to preserve the diversity of the environment and minimize damage damages caused by emissions, but it was also felt to be important because all the case companies recognized that in the next few years their stakeholders, such as customers and partners, will demand CO_2 emissions reports from the services such as transports sold to the customers but from the total CO_2 emissions as well. Emissions are also seen as a potential criterion when putting out in tendering.

The data obtained from the calculations show the direction in which the companies' development work is going and whether the emissions have been cut in line with the targets. Getting good results tells companies the right direction to do, but it is just as important to know if their goals are not being met. Identifying a failure allows the company to self-examine why this happened and what is going to be done about it in the future. In every interview, it became clear that the companies are developing their own carbon management going forward. The problem was perceived to be the large amount of emission data and the uncertainty about which of the numerous existing methods for calculating and reporting emissions is the most effective. The general opinion expressed in the interviews was that

emissions calculations and reporting will be requested by stakeholders in the near future. They are also seen as a potential criterion when putting out in tendering.

5.2. Suggestions for future studies

The freight transportation is a potential source of environmental sustainability degradation and having negative impact of sustainable supply chain performance, thus the principles of a sustainable supply chain should be applicated and explore more. Case companies from the same supply chains could be taken to be interviewed and research the topic at the supply chain level. Also, further research on the topic could be done on other GHG emissions. For example, methane is 80 times more polluting than CO2. Similarly, all emissions caused by the logistics sector could also be studied without limiting CO2 to the only one.

Future research should also be done on the same subject since it is topical and carbon management is moving forward at a fast pace. For example, a study conducted on the same subject a year from this one will probably give different results than now. Research could also be done on carbon management among larger or correspondingly smaller companies in the logistics industry. In this study, it was revealed that larger, international group-based companies were somewhat ahead in carbon management than smaller ones, so a comparison between them would be interesting.

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Appendices

Appendix 1. Interview questions

General attitudes towards sustainability

1. What is your role in the company and how long have you worked there?
2. What kind of business model is in your company?
3. How important do you think sustainability is in the logistics and forwarding sector?
4. How important do you think sustainability is in your company?
5. Do you have a sustainability strategy? If not, has sustainability been considered in your strategy?
6. What methods does your company use to reduce emissions?
7. Has your company achieved cost savings through sustainable business activities?
8. What factors encourage your company to promote sustainability issues?

Stakeholders

9. Your company's most important stakeholders? How long have you been cooperating with them?
10. What affects your relationship with them?
11. What kind of communication you have with them?
12. What are the most important selection criteria for stakeholders?
13. Do the stakeholders' CO2 emissions affect their choice?

Calculation of CO2 emissions

14. Do you calculate CO2 emissions in your comoany? If so, how?
15. Do you classify CO2 emissions in your comoany? If so, how?
16. Which areas of your business generate the most CO2 emissions?
17. Which factors affect the CO2 emissions generated in your company?
18. What are the advantages and disadvantages of calculating CO2 emissions?
19. What advantages and disadvantages do you see in your current approach to CO2 emissions?

20. Do you have short- and long-term goals related to reducing CO2 emissions? If so, what kind of?
21. Do you know how your stakeholders and competing companies calculate CO2 emissions?

Reporting of CO emissions

22. Do you report CO2 emissions internally and/or externally? If yes, how?
23. What information and based on what they contain?
24. Do you have a person/group responsible for reporting?
25. Is there a protocol for reporting??
26. Has the report been verified with a third party? If yes/no, why??
27. What are the advantages and disadvantages of reporting CO2 emissions?
28. Do your stakeholders require your company to report on your carbon dioxide emissions?
29. Does the reporting of your stakeholders affect your own reporting?
30. Does your company have a plan to improve reporting?