UNDERSTANDING THE IMPORTANCE OF SCOPE 3 UPSTREAM EMISSIONS IN THE TEXTILE INDUSTRY VALUE CHAIN: A CASE STUDY OF A FINNISH TEXTILE COMPANY

Lappeenranta–Lahti University of Technology LUT

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ABSTRACT

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The significance of sustainability in business is constantly increasing and companies' accountability of sustainability extends more further to their supply chains. Therefore, in the changing business environment of the global textile and fashion industry, the greenhouse gas emissions along the activities of their supply chains are increasingly becoming a serious issue for textile companies. Practices of implementing different protocols and standards of scope 3 inventory are however fragmented and many companies are struggling on how to implement these standards and protocols in practice. The objective of this study is to examine how a Finnish textile company could implement scope 3 inventory. Results of this thesis indicates that the corporate carbon footprint is a controversial topic, as there are always emissions that are completely ignored in the carbon footprint calculations and reporting. Furthermore, the reporting company can report its carbon footprint in various ways, as it is allowed to choose what factors are the most beneficial to include to the scope 3 inventory from the reporting company's point of view. Thus, it is justified to claim that there is no unambiguous implementation method for scope 3 inventory. While different international standards and protocols provide a comprehensive basis and directional guidance for calculating and reporting carbon footprint, they can still be considered highly interpretive and complex.

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Scope 3 Upstream -päästöjen merkityksen ymmärtäminen tekstiiliteollisuuden arvoketjussa: Case-tutkimus suomalaisesta tekstiilialan yrityksestä

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Vastuullisuuden merkitys liiketoiminnassa kasvaa jatkuvasti ja yritysten vastuu kestävyydestä ulottuu yhä pidemmälle niiden toimitusketjuihin. Tämän takia globaalin tekstiili- ja muotiteollisuuden jatkuvasti muuttuvassa liiketoimintaympäristössä erilaisten toimitusketjujen kasvihuonekaasupäästöistä on tullut erityisen vakava ongelma tekstiilialan yrityksille. Erilaisten protokollien ja standardien mukainen yrityksen hiilijalanjäljen laskeminen ja erityisesti scope 3 -päästöjen raportoiminen on yleisesti koettu hyvin haastavaksi, minkä takia monet yritykset kamppailevat näiden kansainvälisten standardien ja protokollien käytännöntoteutuksen kanssa. Tämän kandidaatintutkielman tavoitteena on selvittää, miten suomalainen tekstiilialan yritys voisi toteuttaa scope 3 -päästöjen laskemisen ja raportoinnin. Tämän tutkimuksen tulokset osoittavat, että yritysten hiilijalanjälki ja sen laskeminen on erittäin kompleksinen aihe, sillä yrityksen hiilijalanjäljen laskemisessa ilmenee aina päästöjä, jotka jätetään kokonaan huomiotta hiilijalanjäljen laskelmissa ja raportoinnissa. Lisäksi on huomioitava, että raportoiva yritys voi raportoida hiilijalanjälkensä monella eri talla, koska yrityksen on mahdollista valita, mitkä tekijät ovat raportoitavan yrityksen näkökulmasta hyödyllisimpiä sisällyttää scope 3 -päästöjen laskentaan. Näin ollen on perusteltua väittää, että scope 3 -päästöjen laskentaan ja raportoimiseen ei ole olemassa yksiselitteistä toteutusmenetelmää. Vaikka erilaiset kansainväliset standardit ja protokollat luovat kattavan perustan ja suuntaa antavan ohjeistuksen hiilijalanjäljen laskemiseen ja raportoimiseen, voidaan niitä edelleen pitää hyvin tulkinnanvaraisina ja kompleksisina.

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1. Introduction

The textile industry is the second largest industrial polluter after aviation. For example, the industry produces up to 10 percent of global carbon dioxide emissions. (Niinimäki, Peters, Dahlbo, Perry, Rissanen & Gwilt 2020, p. 189) Traditionally organisations' primary goal has always been to maximize their profit from a business point of view. However, now a days the current social pressure and different regulations create a need for the companies to account different sustainable practices. (Ghosh, Jha & Sharma 2021, p. 136) Carbon neutrality has increasingly been highlighted in the modern discussions about sustainability of different companies (Virta and Räisänen 2021, p. 2). Therefore, in the changing business environment of the global textile and fashion industry, awareness of rising environmental impact can be attributed to the substantial increase in textile production. Hence, greenhouse gas emissions derived from different corporate activities are increasingly becoming a serious concern for textile companies.

There are differences in implementation methods of how organizations report their carbon footprints. Many of the companies only report scope 1 and scope 2 emissions, because the scope 3 emission reporting is generally seen optional and overall challenging. However, a wider carbon footprint calculation (including scope 3 emissions) has been constantly rising trend in business strategies. Climate change has led companies think their environmental impact more broadly, because organizations have realized that their responsibility for climate change is beyond their legally owned property and own business actions. (Eggert & Hartmann 2021, p. 1) Because the scope 3 emission calculations provide a strong starting point for companies to accelerate the actions of building climate resilient supply chains (Li, Wiedmann & Habjikakou 2020, p. 409), it would be highly important to have more research available about how companies should carry out scope 3 emission calculations.

This bachelor's thesis focuses on finding a comprehensive approach to calculate and report a carbon footprint for one Finnish textile company. The driving objective of this bachelor's thesis is to find out a simple version to define target company's carbon footprint and outline organisational boundaries for its scope 3 upstream emissions in carbon footprint calculations. There is no unambiguous answer as to how a company should determine and

report its scope 3 emissions. Therefore, it is found interesting to study theoretical literature and find the most convenient reporting method for the target company. The inclusion of scope 3 emissions allows the company to expand its understanding of sustainability issues along its value chain and to identify all relevant greenhouse gas emissions. On the other hand, these calculations only provide a broad overview of one part of the carbon footprint of this target company. Calculating the total carbon footprint of the entire company is perceived as a too broad topic to for a bachelor's thesis.

1.1 Previous studies

Carbon footprint accounting and reporting is currently a popular research subject. The carbon footprint calculations are complex and always consider selected aspects leaving some other factors unobserved. As presented later in this chapter, many studies have investigated the complexity of companies' carbon footprint calculation and have found that there are alternative ways to calculate scope 3 emissions.

During the past decades the developing importance of indirect greenhouse gas impacts in global supply chains has encouraged researchers to develop new tools to collect data and manage the issue (Schaltegger & Csutora 2012, p. 12). To keep the topic relevant, Eggert et al. (2021, p. 10) demonstrates that secondary data can be effectively used in scientific research of companies' carbon footprint calculations, as companies' global reporting is constantly increasing. Although the topic has been extensively researched and new methods are constantly developed, there are still multiple gaps in this field of research. This creates mistrust in corporate sustainability reporting. In their study Goncalves & Silvia (2021, p. 28) found that "green washing" and the lack of transparency will continue exist in the absence of an appropriate scientific method covering all aspect of sustainable development throughout the entire supply chain.

A previous studies have highlighted that there are multiple gaps in this field of study, especially in the calculation and reporting of a company's indirect greenhouse gas emissions. Hertwich and Wood (2018, p. 1) demonstrates in their study that carbon reporting is increasingly focusing on scope 3 emissions that occur in different supply chains of organizations. However, scope 3 emissions are debatable topic, because there are multiple

standards, protocols, and regulations to control and guide carbon footprint calculations and reporting. Multiple studies shows that the Greenhouse Gas (GHG) Protocol can be assumed to be a base reference for carbon footprint calculating but science-derived future emission targets are increasingly determined by policies at different jurisdictions. For example, in their research paper Li et al. (2020, p. 408) justify the imperfection especially of the current GHG Protocol Corporate Value Chain (Scope 3) with the claim that "organizations have long been seeking science-driven metrics to measure, scale and benchmark the environmental outcomes including greenhouse gas emissions". It follows that, in their study Li et al. (2020) claim that their "absolute targets provide more certainty on environmental outcomes by defining the future level of allowable indirect emissions and complement than the current GHG Protocol Corporate Value Chain (Scope 3)". Overall, in their research Klaaßen and Stoll (2021, p. 4) found that only a third of the suppliers report their own scope 3 emissions. Hence, most organizations are not able to quantify their scope 3 emissions along their supply chains with primary data. This leads to incompleteness of the emission reporting if the gaps are not filled with secondary data. (Klaaßen et al. 2021, p. 4.)

The recent studies have suggested multiple approaches to improve this field of the study. Luján-Ornelas, Güereca, Franco-García and Heldeweg (2020, p. 1) recommend that future studies could have an in-depth diagnosis of the textile industry at a global and regional level because a lack of training and skills were found along the different life cycle stages. Further on, in their study Luján-Ornelas et. al. (2020, p. 1) indicates the need to generate strategies and tools to especially support SMEs (small- and medium-sized companies) with traceability and transparency along the entire supply chain. To support this approach, Pattara, Raggi and Cichelli (2012, p. 1256) suggest that future studies could continue research by broadening the research boundaries and diversifying the characteristics of different kind of companies in the carbon footprint calculations. Almost a decay later Eggert et al. (2021, p. 10) also suggest that future research could extend studies to also include different characteristics of supply chain structure to understand how supply chain specific (for example shorter supply chains) affect scope 3 emissions. With reference to a previous study, it can be noticed that there are significant gaps in corporate carbon footprint calculations and especially in defining the organisational boundaries in those calculations.

Overall, the main contributions of different research of carbon footprint should highlight the importance of its limitations and imperfection because there are multiple definitions and

suggestions as to how the carbon footprint could be calculated. Especially the scope 3 upstream emissions for a textile company can be difficult to define because each production step of the textile supply chain has an environmental impact due to material, water, energy and chemical use (Niinimäki et al. 2020, p. 190). The use of scope 3 calculations in the textile industry appears to be rare, and the topic will need closer examination.

1.2 Research objectives

Different studies indicate that even the textile industry has far-reaching effects, as different efforts to reverse unsustainable course seem to rely comparatively strongly on the efforts of individual companies or producers (Virta et al. 2021, p. 1). Therefore, it should be in company's interest to keep abreast of changes in the operating environment, identify impacts on its operations and take advantage of new opportunities. In other words, companies should constantly aim to achieve carbon neutrality to be part of a business strategy. Overall, companies must understand comprehensively the climate impact of their operations, products, and services. Before a company can become more sustainable and begins to pursue carbon neutrality it requires the company to calculate and report its carbon footprint. In other words, the first step towards a corporate carbon neutrality is to quantify the current level of emissions accurately (Klaaßen et al. 2021, p. 2). As defined in the previous paragraphs, there is no unambiguous way to calculate a company's carbon footprint. Therefore, this bachelor's thesis focuses on finding a comprehensive approach to calculate and report indirect emissions of corporate carbon footprint of one Finnish textile company.

The study focuses specially to examine the complexity of corporate carbon footprint calculations and reporting. The main aim of the thesis is to understand better how it is profitable for a company to report indirect emissions that result of activities from not owned or controlled by the reporting company. This approach must also consider different challenges that might occur in carbon footprint calculations. The approach and especially the results of carbon footprint calculations need to be clearly defined to avoid potential misunderstanding when interpreting the results and to avoid "greenwashing" (Kral, Huisenga & Lockwood 2009, p. 19). Thus, the process of searching answer for this issue will be based on one main research question:

RQ1: How to determine and calculate scope 3 upstream emissions for a Finnish textile company?

Thesis aim also study question raised from previous study of how shared responsibility among producers and suppliers in supply chains could be determined to prevent double counting of carbon emissions (Schaltegger et al. 2012, p. 13). Thus, the first sub-question is formed to gain further understanding of how the target company should define its operational boundaries in carbon footprint calculations and reporting. The aim of the third sub-question is to examine why the target company should include scope 3 emissions in its carbon footprint calculations if the scope 3 emission reporting is generally seen optional. It depends on the selection criteria such as the relevance of the emission sources or the interest of stakeholders whether the scope 3 emissions are beneficial to evaluate for the target company (Seixas & Ferreira 2021, p. 23). Given the above, a better understanding of the phenomenon of this research can be achieved by examine the main research question with the following sub-questions through theoretical and empirical research:

SQ1: How to define operational boundaries in corporate carbon footprint calculations in textile industry?

SQ2: How developing a scope 3 inventory strengthens company's understanding of its value chain in textile industry context?

1.3 Research methodology

The research is carried out as a single case study. The target company was mostly chosen because of the personal interest towards Finnish textile industry. In addition, the author has extensive personal knowledge of the target company and its operations. Because of the mutual trust between the author and the target company, the author has an opportunity to access target company's archival records and documents. The choice of the target company can also be justified as relevant on the basis of previous research. As mentioned above, there is a lack of research of corporate carbon footprint related studies especially supporting small- and medium-sized companies and their supply chains. The target company is a medium-sized company with unique and short supply chains that have developed over the years and

even decades. The target company wants to remain anonymous, so any detailed information about the company will not be addressed in this study.

The research literature review was performed by studying mostly peer-reviewed studies that emphasis the topic of corporate carbon footprint and sustainable supply chain management. Due the wide nature of this certain topic, the literature review was performed by using key words such as “textile industry”, “corporate carbon footprint”, “sustainable supply chain management”, and “scope 3 emissions”. The range of the used articles was set from year 2008 to year 2021. Different standards and protocols were also studied to gain a better understanding of the topic. The data used in theoretical part of the thesis in only secondary data. The empirical part of the research uses multiple sources of information such as direct and participant observations, protocols, articles, archival records, and documents.

1.4 Definitions of key concepts

This thesis focuses on studying the complexity of scope 3 upstream emission calculations in corporate carbon footprint reporting. This chapter defines key concepts that facilitate understanding of the theoretical section of the thesis. The key concepts to be discussed are: supply chain management (SCM), sustainable supply chain management (SSCM), life cycle assessment (LCA), and corporate carbon footprint.

Supply chain management (SCM): Supply chain management is the centralized management of a network of the flow of goods and services and includes all the processes that transform from raw materials into final products to final customer with benefits of adding value and maximizing profitability. Supply chain management expands the procurement perspective across the supply chain consisting of material suppliers, production facilities, logistics, marketing, and related systems that facilitate the forward and reverse flow of materials, services, finances, and information. (Stock & Boyer 2009, p. 706.)

Sustainable supply chain management (SSCM): Sustainable supply chain management is defined as a specific management style that takes actions that are taken to make the supply chain more sustainable with a final goal of creating a truly sustainable supply chain (Pagell & Wu 2009, p. 38). SSCM approach observes different activities at all levels of lifecycles of goods and services including material, information, and capital flows. SSCM highlights the

importance of cooperation among other companies along the supply chain while taking all economic, environmental, and social dimensions into account which are conducted from customer and stakeholder requirements. (Seuring & Müller 2008, p. 1700.)

Life cycle assessment (LCA): Life cycle assessment is a method of assessing the environmental aspects during the life cycle of a product from raw material, through production, use and disposal (Klöpffer & Grahl 2014, p. 1). The LCA methodology is known as cradle-to-grave analysis and has generally been used as the method of choice for assessing the environmental sustainability of supply chains (Desclee, Sohinto & Padonou 2021, p. 10).

Corporate carbon footprint: Corporate carbon footprint is defined as the quantity of greenhouse gas expressed in terms of CO_2-equivalent that occur from company's activities or products. The carbon footprint of a company is a significant measure to examine company's or organization's impact on environment. (Seixas et. al. 2021, p. 20.)

1.5 Research limitations and thesis structure

In order to limit the wide topic of the thesis the research examines only a small aspect of the company's carbon footprint. The research tends to examine company's carbon footprint in supply chain context and only observe Scope 3 upstream emissions of the company's carbon footprint. Therefore, the results consider only the carbon footprint from supply management and value chain perspective. There are also geographical limitations in the research. The study only observes the target company's factory in Finland and its actions related to that unit. Therefore, the study will not examine activities related to the company's units abroad. In addition, the observation period is year 2020. The year can be seen as unrepresentative because of the Covid-19 pandemic. Therefore, the year 2020 is not the most convenient base year. The results may not be reliable to be compared to future results for upcoming years. It is also important to note that the study only examines one company from one industry. Hence, comparisons of the results to other similar studies should only be done if the intention, assumptions, and functional units included in the comparable results are similar to this research.

The thesis consists of six main parts. The first part of the thesis is the introduction, which introduces the topic of the study to the reader. Introduction discusses the background of the

study and explains why the topic was chosen for closer examination. After the introduction part has concluded with research problem, research questions, research methodology, definitions, and limitations, the second part of the thesis introduces the background information of textile industry. After the textile industry background -chapter, the third part of the thesis introduces the theoretical part of the research. The main purpose of the theoretical part of the thesis is to understand how corporate carbon footprint calculations are linked to supply chain management. The fourth part of the thesis briefly introduce the research methodology of the study. After that, the fifth part of the thesis is the empirical analysis where the empirical results are presented. Finally, the sixth part of the thesis presents the summary and conclusion of the research.

2. Textile industry background

During the recent decades improvement in standard of living has led to exponential increase in textile production and consumption (Gbolarumi, Wong & Olohunde 2021, p.1). Textile industry has grown enormously in the last decades and has become one of the largest, but also most polluting, global industries (Peters & Simaens 2020, p. 1). The turnover generated by the global textile and apparel market has been steadily increased in last decay. However, in 2020, the revenue has decreased because of the Covid-19 pandemic. In 2020, the revenue of the textile and apparel market was approximately 1.46 trillion U.S. dollars. Although the Covid-19 pandemic is reflected in the development of the textile industry's growth, it is projected to grow in the future. According to the research by Statista (2021), the revenue will increase to roughly 2.25 trillion Us. dollars by 2025. Figure 1 illustrates the estimated revenue of the global textile and apparel market from 2012 to 2025. The x-axis indicates the reference year and the y-axis indicates the revenue in billions of U.S dollars in the graph illustrated in the figure 1. (Statista 2021.)

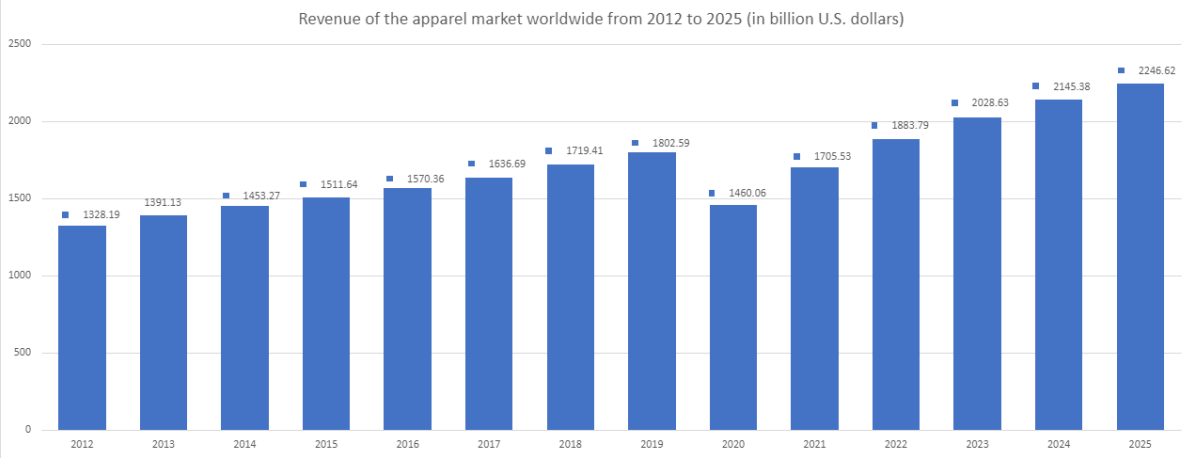

Figure 1. Revenue of the apparel market worldwide from 2012 to 2025. (Statista 2021)

The constantly growing textile industry has major environmental and social impacts due its wide field of its variety of processes and complex global value chains (Peters & Simaens 2020, p. 1). Despite the negative impact on the environment, the textile industry plays

globally a critical role in the economies of different nations because its employment and contribution to export (Gbolarumi et al. 2021, p. 2). On the other hand, the textile industry commonly receives negative attention because of different social issues related to employment such as low wages, poor working conditions, and exploitation of employees, especially in low-cost countries, where most of the textile production is outsourced (Peters et al. 2020, p. 1).

2.1 Textile supply chain and its environmental impact

Even sustainability is being practiced for years in textile industry, it is considered as ecologically one of the most polluting industries in the world (Muthu 2014, p. 1). The industry produces up to 10 percent of global carbon dioxide emissions (Niinimäki et al. 2020, p. 189) and is responsible for approximately 20 percent of the industrial water pollution (Koep, Morris, Dembski & Guenther 2021, p. 56). In order to increase sustainable transparency, it is necessary to identify and highlight how an in what respect a textile company is deviating from being sustainable (Schaltegger et al. 2012, p. 8). Every textile product begins its life cycle at the raw material extraction stage and passes through various other stages that all have impact on the environment (Muthu 2020, p. 1). The textile industry has long and complex supply chains, starting from agriculture to manufacturing, logistics and retail (Niinimäki et al. 2020, p. 189). The issues making the life cycles of textiles unsustainable are the use of harmful chemicals, high consumption of water and energy, generation of large quantities of solid and gaseous wastes, huge fuel consumption for transportations, and usage of huge amount of packing materials along the value chain (Muthu 2014, p. 1). Appendix 1 illustrates the complexity of a textile supply chain by demonstrating an example of value chain and its traceability from raw material industry to consumers by Kumar, Hallqvist, and Ekwall (2017, p. 16).

The complexity of the textile supply chains arises from multiple different reasons. Despite of countless environmental, social, and economic issues presented in previous paragraphs, other factors from the end of the value chain have to be also take into consideration. Now a days customers are supposed to have the ability to make informed decisions when it comes to purchasing textile products. Unfortunately, this is not always the case as the decisions made by the consumers are often geographically located far away from the sales market

(Zimon & Domingues 2018, p. 8). This leads to decreasing importance of social and environmental concerns in consumer behaviour and especially decision making. (Muñoz-Torres, Fernández-Izquierdo, Rivera-Lirio, Ferrero-Ferrero & Escrig-Olmendo 2020, p. 5) Therefore, the complexity of the textile supply chains arises from different reasons from different parts of the value chain of the textile product.

The long and complex supply chain of textile industry leads to increasing lack of transparency of multiple steps of the value chains and their potential environmental impacts (Peters et al. 2020, p. 14). The first element of the textile supply chain is fibre production, which is followed by yarn and fabric production. After the raw fabric is formed, other processes such as dyeing and finishing are carried out. After the product has been produced and distributed, it faces the consumption stage where the customer uses the product and maintains it by washing and drying. (Muthu 2020, pp. 66-67) Therefore, environmental consideration needs to be monitored and controlled throughout entire value chain of a product including all the stages introduced above. According to Muthu (2020) many studies illustrate that fabric production occupies a dominant part in the total life cycle greenhouse gas emissions of a textile product. However, the majority of studies have also concluded that the consumer use phase is the largest contributor of greenhouse gas emissions in a typical textile product's life cycle. (Muthu 2020, p. 67.)

2.2 Future requirements

The textile industry is constantly under a pressure to not only adapt the current requirements, but also to ensure that it reaches the future trends and scenarios of the global society. Due to the increasing awareness of the environmental issues, consumers and governments have urged producers to adopt more sustainable solutions (Pattara et al. 2012, p. 1249). Policymakers are constantly coming up with different regulations to set the industry into a sustainable direction. In 2020, the European Commission launched a new circular economy strategy for textiles, which included a strategy for stimulating innovation and boosting reuse within the industry. In 2021, the Parliament also demanded additional measures to achieve a carbon-neutral and fully circular economy by 2050. (European Union 2020) Carbon neutrality is linked with the circular economy, and a carbon-neutral circular economy is often referred to as the ultimate sustainability goal (Virta et al. 2021, p. 3). To achieve the carbon

neutral goal different demands have been established such as achieve high level of separate collection of textile waste, which European Union member states have to ensure by 2025 (European Union 2020). Overall, the upcoming European Union's textile waste directive will likely support the development of textile sorting, collecting, and recycling processes (Virta et al. 2021, p. 10).

Finland is considered to be a pioneer country, because it is aiming of become a carbon neural circular society already by 2035 (Ministry of Economic Affairs and Employment of Finland 2021). To support this goal carbon neutrality by 2035 has been announced also as an aim for the Finnish textile industry by Finnish Textile & Fashion -association (Heino, Markkula, Saario, Ylimäki, Kamaja, Mikkonen & Mäki 2020). The Finnish Textile & Fashion -association constantly requires its member companies develop their general sustainable business and improve on circular economy. On 12th of October in 2021 the Finnish Textile & Fashion -association launched a new Carbon Neutral Textile Industry 2035 -Commitment. As a part of this commitment the member companies are required to report their carbon footprints annually. (Suomen Tekstiili & Muoti 2021) Because the Finnish Textile & Fashion -association is highly encouraging its member companies to join the new agreement, the Finnish textile companies should start their carbon footprint calculations and reporting in the near future. As mentioned earlier in the previous study section especially the small- and medium-sized companies are lacking with the support of carbon footprint calculations and reporting tools. Therefore, the issue can be seen extremely relevant in the current nature of Finnish textile industry.

3. Theoretical framework

Theoretical framework of this thesis introduces the literature review of corporate carbon footprint calculations and especially scope 3 upstream emissions in sustainable supply chain management context. The literature review is based on previous literature of the topic and current standards and protocols. The theoretical framework of this thesis consists of sustainable supply chain management framework, corporate carbon footprint, and integration of GHG Protocol into supply chain management. This chapter aims to discuss the influence of sustainable supply chain management into corporate carbon footprint calculations and reporting. In the end of the chapter, a research framework has been introduced to gain better understanding concerning carbon footprint framework from this case study context.

3.1 Sustainable supply chain management (SSCM)

Stock and Boyer (2009, p. 706) have defined supply chain management (SCM) as "The management of a network of relationships within a firm and between interdependent organizations and business units consisting of material suppliers, purchasing, production facilities, logistics, marketing, and related systems that facilitate the forward and reverse flow of materials, services, finances and information from the original producer to final customer with the benefits of adding value, maximizing profitability through efficiencies, and achieving customer satisfaction". SCM in the textile industry requires extraordinary attention from entrepreneurs due two different aspect. First, customers have a decisive bargaining power (Zimon et al. 2018, p. 8) and second, the textile sector is characterised by a high degree of complexity in supply chain management due its global nature (Muñoz-Torres et al. 2020, p. 4). Over the years SCM has shared the stakeholder focus with the concept of business sustainability. Further, in the modern business environment, the nature of the competition has changed from individual company level to the entire supply chain level. (Yang & Zhang 2017, p. 114) Ongoing and growing effort to include different characteristic of sustainability into SCM have led to increasing research on sustainable supply management (SSCM). (Ahi & Searcy 2013, p. 330.)

From a sustainable supplier management perspective, it is highly significant to notice that suppliers are playing an increasingly important role in influencing company's long-term success. In their research Ahi et al. (2013, p. 339) have defined SSCM as:

"The creation of coordinated supply chains through the voluntary integration of economic, environmental, and social considerations with key inter-organizational business systems designed to efficiently and effectively manage the material, information, and capital flows associated with the procurement, production, and distribution of products or services in order to meet stakeholder requirements and improve the profitability, competitiveness, and resilience of the organization over the short- and long-term" (Ahi et al. 2013, p.339.)

This definition of SSCM highlights the supply chain as a key component for the sustainability development of the target company. In other words, SSCM can be seen as a component of balance that occurs between care for the environment and economic feasibility throughout the supply chain functions (Sánchez-Flores, Cruz-Sotelo, Ojeda-Benitez & Remírez-Barreto 2020, p. 5). Due to the increasing social and environmental issues associated with sourcing goods, many retailers have started adopting sustainable procurement practices instead of only thinking prices, delivery time or quality. SSCM practices have gained importance also throughout the increasing media attention of a lack of information transparency especially in textile industry. (Koep et al. 2021, pp. 55-57.)

For the most part SSCM is generally based on a life cycle thinking. In order to rely on a life cycle thinking and meet different challenges in integrating sustainable development issues in global supply chains a monitoring tool called "life cycle assessment (LCA)" have been developed (Muñoz-Torres et al. 2020, p. 2). LCA has been defined as "a methodology for assessing the environmental aspects and potential impacts throughout a product's life cycle from raw material through production, use and disposal. In other words, the methodology is known as a cradle-to-grave analysis". (Klöpffer et al. 2014, p. 1) The LCA has been normalised and generally used as a selected method to evaluate the environmental sustainability of the supply chains (Desclee et al. 2021, p. 10). On the other hand, due to the complexity of the supply chain involved in the textile industry, the study of LCA often requires the use of specialized datasets and procedures. (Jha, Soren & Mehta 2021, p. 28.)

3.2 Corporate carbon footprint

Different studies found that from 2010 onward, organisations have been more concerned about global warming and especially about carbon dioxide emissions. The amount of carbon dioxide and other greenhouse gasses emitted to the environment due to direct or indirect activities of the company are called the carbon footprint. (Ghosh et al. 2021, p. 126). Although carbon dioxide (CO_2) is the main greenhouse gas emission, other greenhouse gas emissions such as methane (CH_4) and nitrous oxide (N_2O) are also contributing to climate change. In order to properly measure the impact of these emissions, the relevant indicator used in carbon footprint calculations is CO_2-equivalents. (Schaltegger et el. 2012, p. 5) To summarize, according to Seixas et. al. (2021, p. 20) the carbon footprint can be defined as "the quantity of greenhouse gas expressed in terms of CO_2-equivalent, emitted into the atmosphere by an individual, organization, process, product or even from within a specific boundary".

In recent years the carbon footprint has been a relevant tool for different companies, but the carbon footprint calculations have also gained maturity throughout the time and different kind of applications (Seixas et al. 2021, p. 20). For this reason the corporate carbon footprint can be seen as a highly complex tool that especially smaller companies with smaller resources are afraid to use. There are multiple international standards and protocols to give guideline to calculate and report corporate carbon footprint. Despite the international standards and protocols, different studies show that the current carbon footprint accounting and reporting are seen unsystematic and not comparable, especially along the supply chains with scope 3 emissions (Klaaßen et al. 2021, p. 1). To summarise, the calculations are complex, because in absence of binding regulation, alliances of non-governmental organizations have shaped corporate carbon footprint practices (Klaaßen et al. 2021, p. 2).

Because of the challenges of calculating and reporting corporate carbon footprint, currently organizations are often integrating several standards by implementing different requirements from different standards. Implementing the requirements of standardized management systems is seen a commonly used way to improve SSCM. (Zimon, Madzik & Sroufe 2020, pp. 2-3) These standards are used for quantifying, monitoring, reporting, and validating greenhouse gas emissions to support low-carbon economy (ISO 14 067). In other words, carbon neutrality intentions are based on carbon footprint calculations that sum up the total

greenhouse gas emissions. Although there is no unambiguous calculation process for calculating scope 3 emissions, different international standards give guidelines for carbon footprint calculations, because without them the carbon footprint can be argued to be only a rhetoric illusion.

An international standard called ISO 14064 has been developed at the organisation level for quantifying and reporting greenhouse gas emissions. Seixas et al. (2021, p. 24) has summarize the two parts of the standard in a following way:

> *"ISO 14064-1:2018 includes all the requirements for the design, development, management, reporting and verification of an organization's greenhouse gas inventory, while ISO 14064-2:2019 specifies principles and requirements and provides guidance at the project level for the quantification, monitoring and reporting of activities intended to cause greenhouse gas emission reductions or removal enhancements. It also includes requirements for planning a GHG project, identifying and selecting GHG sources, sinks and reservoirs (SSRs) relevant to the project and baseline scenario, monitoring, quantifying, documenting and reporting GHG project performance and managing data quality."* (Seixas et al. 2021, p. 23.)

In other words, the ISO 14064 is commonly used as an assurance standard, which sets requirements on how the assurance process is performed in corporate carbon footprint accounting and reporting (World Resources Institute and World Business Council for Sustainable Development 2011, p. 117). Overall, the standard is an important reference for conducting a GHG inventory for a company.

Another commonly used standard in corporate carbon footprint calculations and reporting is the Greenhouse Gas Protocol (GHG Protocol). The GHG Protocol is a global standard that was formed from a cooperation between World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The GHG Protocol has been developed over the years and updated for different scopes that include direct and indirect emissions. (Seixas et al. 2021, p. 23) The GHG Protocol separates three categories of emissions: scope 1 refers to direct emissions from company's owned or controlled sources, scope 2 refers to indirect emissions from the productions of purchased energy, and scope 3 refers to all other indirect emissions along the company's value chain (World Resources Institute and World Business Council for Sustainable Development 2004, p. 25).

The scope 3 greenhouse gas emissions include all upstream and downstream processes that are not owned by the company but that would not appear without the company's actions. (Radonjic & Tompa 2018, pp. 356-366) Commonly the scope 3 emissions are the largest proportion of company's carbon footprint. However, these emissions are also the ones that the company have the least control off. Therefore, the scope 3 emissions are also the most difficult to determine and quantify. Indirect emissions from sources outside the company's direct control are for example business travel, outsourced transportation, and waste disposal. Figure 2 provides an overview of the three GHG Protocol scopes and categories of scope 3 emissions. (World Resources Institute and World Business Council for Sustainable Development 2011, p. 5)

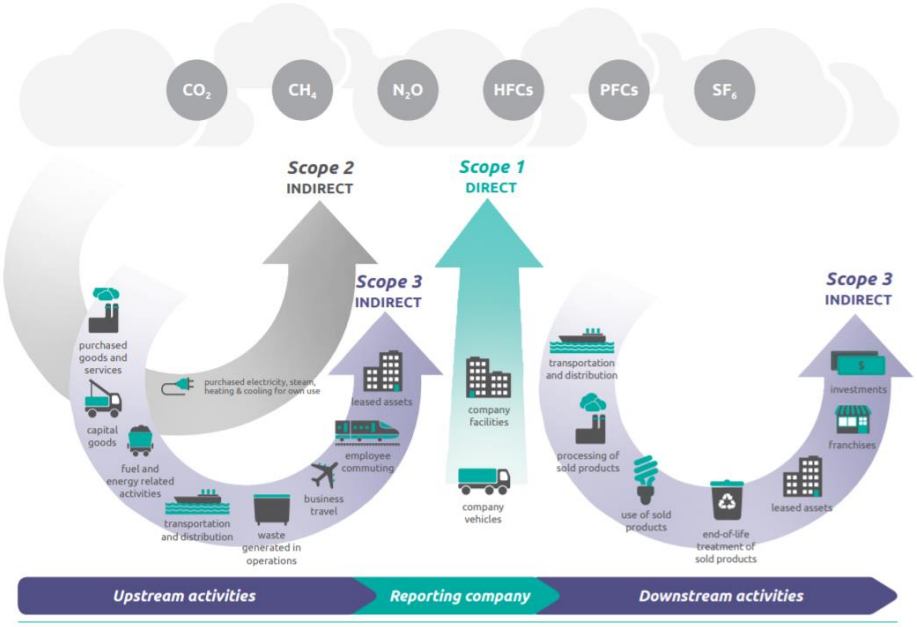

Figure 2. Overview of GHG Protocol scopes and emissions across the value chain (World Resources Institute and World Business Council for Sustainable Development 2011, p. 5.)

The scope 3 emissions are the most challenging ones from three scopes because of their broadness and complexity (Seixas et al. 2021, p. 23). Most greenhouse gas emissions of the entire value chain occur in the upstream supply chains that especially involve long and complex networks. (Eggert et. al. 2021, p. 1) Because the scope 3 includes the indirect greenhouse gas emissions that occur from all activities that are not owned by the reporting company, the upstream activities are purchased from other companies (Pattara et al. 2012,

p. 1250). Therefore, it is justified to examine upstream activities and the emissions occurring from these activities in sustainable supply chain management approach.

According to Greenhouse Gas (GHG)-protocol standards there are two options reporting corporate-level GHG emissions. The first reporting option relies on to report in conformance with the GHG Protocol Corporate Standard where scope 3 is an optional category. In this scenario the company may report any scope 3 emissions the company chooses. (World Resources Institute and World Business Council for Sustainable Development 2004) The second reporting option is to report in conformance with both the GHG Protocol Corporate Standard and the GHG Protocol Scope 3 Standard. In this reporting option the company is required to report scope 3 emissions following the requirements of the Scope 3 Standard. (World Resources Institute and World Business Council for Sustainable Development 2011, p. 6) The Corporate Value Chain Accounting Reporting Standard is organized according to the steps a company should follow when developing a scope 3 inventory. Figure 3 provides an overview of the steps in scope 3 accounting and reporting by the standard.

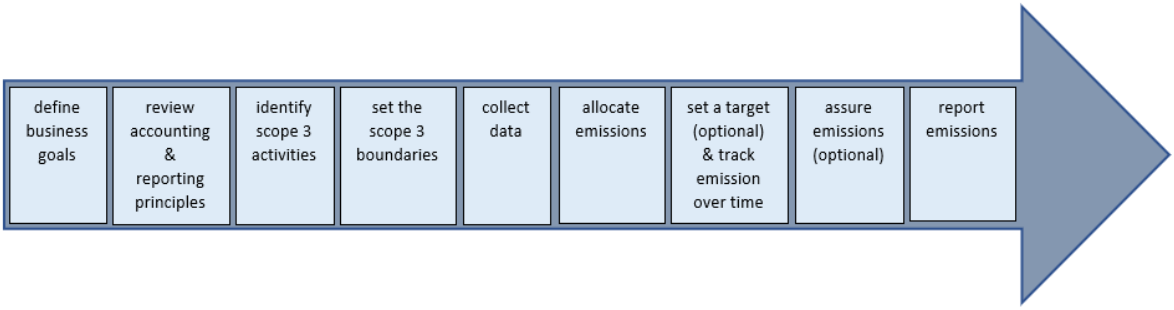

Figure 3. Overview of the steps in scope 3 accounting and reporting (World Resources Institute and World Business Council for Sustainable Development 2011, p. 19.)

3.3 Integrating GHG Protocol into supply chain management

Past years multiple studies on sustainable supply chain's carbon footprint have proven the growing importance of environmental costs in the supply chain strategy (Ghosh et al. 2021, p. 124). Generally, the brand owners contract suppliers either directly or indirectly, through different agents. Brand owners commonly generates the product developing process, including for instance design, and material purchasing. Therefore, brand owners are generally hold responsible for a change in the production of textiles though their choices of

suppliers, the design, and the control they can have exert over the use of energy, harmful substances, and other elements in the production process. (Muthu 2014, p. 2) Therefore, it is important that the brand owners have clearly identified the different parts and actions of their supply chains. Further on, it is highly important that the brand owners are familiar with the entire supply chain and its environmental impacts of each phase of the value chain.

By integrating GHG Protocol into supply chain management the company can create more value by increasing knowledge of its value chains. In other words, the GHG Protocol provides a useful framework for identifying different activities along the supply chain of the company. Overall, integrating different sustainability actions into corporate strategy creates value and competitive advantage to the reporting company and responds to stakeholder's current demands concerning environmental issues. (Murthy 2012, pp. 9-10) Therefore, the GHG Protocol is most widely used framework for corporate carbon accounting (Klaaßen et al. 2021, p. 2).

To conclude the theoretical part of the thesis a reporting framework is introduced to provide a better understanding of the structure of this research. The reporting framework of this study will follow the GHG Protocol because it reflects to be the most widely used framework for corporate carbon accounting (Klaaßen et al. 2021, p. 2). However, calculating the total carbon footprint of the entire company is perceived as a too broad topic to for a bachelor's thesis. Therefore, this research follows partly the steps illustrated in Figure 3 that the Corporate Value Chain Accounting Reporting Standard has organized. Figure 4 provides an overview of the five steps that are applied in this research.

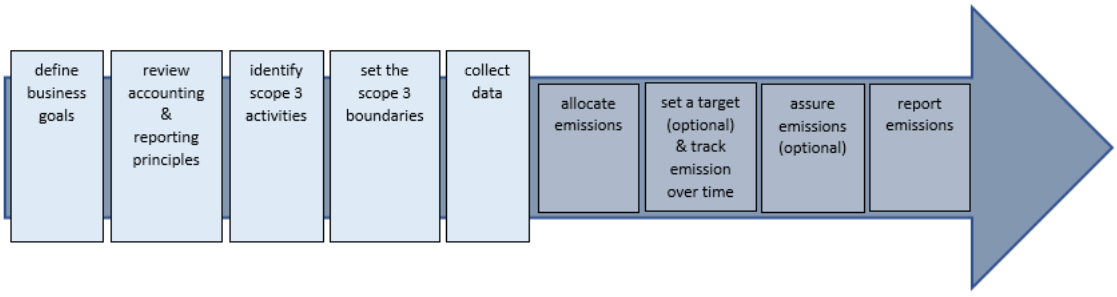

Figure 4. Overview of the steps of the research

This study will only examine upstream emissions of scope 3 category. In other words, the research boundary is set around the factory and the suppliers to so called “gate-to-gate” analysis, where the fundamental concept of LCA in not fully completed. These limitations do not consider neither the early stages of supply chains nor the use and disposal phases. (Klöpffer et al. 2014, p. 5) Therefore, the five steps illustrated in Figure 3 are followed in the research when developing a scope 3 upstream inventory.

The GHG Protocol framework, however, does not specify which types of GHG emission to report and remains silent on scope 3 emissions (Klaaßen et al. 2021, p. 2). Therefore, the scope 3 upstream emission calculations may partly face incompleteness and only achieve the minimum boundaries set by the GHG Protocol. To enable consistent and transparent reporting of scope 3 emissions, the GHG Protocol specific eight distinct categories upstream in the value chain of the reporting company as listed in Appendix 2. The eight categories are also shown in Figure 2 to illustrate, how these upstream emissions are only one part of the entire corporate footprint. For each category, the GHG Protocol provides a minimum boundary in order to standardize which activities should be included. (World Resources Institute and World Business Council for Sustainable Development 2011, p. 32) Appendix 2 provides an overview of the scope 3 categories and their minimum boundaries as stated in the GHG Protocol.

4. Methodology

This chapter of the thesis will define the research methodology, introduce the data used in this research, and illustrates the research process of the thesis. The purpose of the thesis is especially examining the complexity of corporate carbon footprint calculations and reporting. Moreover, the aim of the thesis is to understand better how it is profitable for a company to report indirect emissions that result of activities from not owned or controlled by the reporting company. Thus, the study is carried out as qualitative research. On the other hand, the results of this study will provide a framework for the case company to carry out a further study of the entire scope 3 upstream inventory which will require both qualitative and quantitative research methods.

4.1 Research methods

To develop a complete understanding of the issue introduced above, the research is carried out as a single case study. A single case study is justified, as this research aims to gain profound and deep knowledge concerning the theme. In his study Yin (2009) introduces variety of different application for case studies. A relevant application for this case study is to see this research “as part of a larger evaluation with the case study portion viewed as complementary and providing explanatory information”. (Yin 2009, p. 63) Calculating the total carbon footprint of the entire company is perceived as a too broad topic to for a bachelor’s thesis. Therefore, only upstream emissions are only taken under consideration which are just a part of the entire company’s carbon footprint. More specifically, in order to limit the wide topic of the thesis the research this thesis aims only to present a proposed framework for the scope 3 emission calculations. In other words, this research does not aim carry out the emission calculations. Therefore, the research is carried out as qualitative research although further supporting studies of this research will also need a quantitative method to successfully achieve the entire scope 3 upstream inventory.

4.2 Data

For both the theoretical part and the empirical part of the research, data was gathered with qualitative method. Therefore, the research question and sub-questions are answered throughout qualitative research by studying literature, protocols, and standards. Because of the mutual trust between the author and the target company, the author has an opportunity to access target company's archival records and documents. In-house documents and archival records of the reporting company are used to gather data for empirical part of the thesis. These documents are especially used in chapter 5.3 "Scope 3 upstream activities" where a proposed framework for data collection for carbon footprint calculations is presented. The observed company's archival records and documents are listed into table presented in Appendix 3. The table reflects the types of documents observed for each category, but due to the anonymity of the company, the data collected from these documents and the first calculations of the carbon footprint are not presented in this thesis. In addition to this, the calculation of the carbon footprint itself is limited to the outside of this thesis, so the data collected for computation is not relevant to this thesis. In other words, the data collected from company's internal documents is only used to gain better understanding of the different parts and functions of its supply chains and especially to gain understanding of what should be included to the scope 3 inventory from case company's perspective.

In category 1 "purchased goods & services", the main raw materials are selected, which are most used in the case company's factory, and which can be considered relevant for the scope 3 emission calculations. The number of materials used for production has been calculated from invoices sent by suppliers, of which there have been an estimated 63 invoices in total during 2020. Instead, the amount of packaging materials is obtained directly from one annual report of the external service producer. The category 4 "upstream transportation and distribution" counts as well as the amount to be transported in kilograms, as well as the distance travelled in kilometres. The quantities and routes of transport of materials and products have been obtained from invoices sent by different transportation service companies, as well as annual reports, of which there have been approximately 220 in total. Category 5 "waste generated in operations" contains the amount of waste generated by operations collected from invoices sent by the external service producer. The case company receives these invoices monthly. Consequently, the amount of waste generated in operations

has been collected from 12 invoices during the observation year. Categories 6 “business travel” and 7 “employee commuting” are both collected from internal travel reports, which are constantly replenished by company employees when they have done any business travel on their working time. Mileage transported by vehicle and purchased hotel nights have been collected from about 80 travel expenses bills. This category is clearly narrower than in earlier years, as the Covid-19 pandemic has caused a lot of exceptions from the so-called normal years. For example, there have been none of the long-haul flights during the year under review.

4.3 Research process

The research process of this thesis follows the five steps that are illustrated earlier in chapter 3.3 “Integrating GHG Protocol into supply chain management” in the Figure 4. The applied five steps are: define business goal, review accounting & reporting principles, identify scope 3 activities, set the scope 3 boundaries, and collect data. In other words, the research process was started by delimiting research objectives with the target company. Once the subject of this research and the objectives of the target company had been clarified, the GHG Protocol was studied through to gain a better understanding of the different accounting and reporting principles. In order to implement the last three stages of the research process, the target company’s supply chain was mapped in scope 3 upstream activities perspective. Furthermore, in order to gain further understanding of the different parts and functions of the case company’s supply chain multiple internal documents were reviewed. After the proposed scope 3 activities and the proposed scope 3 boundaries were defined, the recommended framework for data collection was presented. In accordance with the proposed framework for the data collection, data was collected from various archived documents inside the company. Furthermore, data was requested from various stakeholders and suppliers.

5. Research results

In this section the research questions are answered by examining the research results extensively from the point of view of the case company. The research questions are answered by following the GHG Protocol, which is seen as justified from the perspective of this thesis. The GHG Protocol requires that the corporate carbon footprint accounting and reporting must base on the following principles: relevance, completeness, consistency, transparency, and accuracy (World Resources Institute and World Business Council for Sustainable Development (2011, p. 21). Complying as closely as possible these principles the five steps in scope 3 accounting and reporting by the GHG Protocol standard are applied in this chapter of the thesis. Throughout these five steps the research questions are answered and discussed. First in this section of the thesis the business goal of the reporting company is defined. Because this thesis follows the GHG Protocol accounting and reporting principles which are under examination at different parts of this study, the second step "reporting principles" is only reviewed briefly in this section. After the reporting principles has been outlined, the proposed scope 3 upstream activities and the proposed scope 3 boundaries for the inventory are introduced. Finally, this section presents the data needed for the scope 3 upstream emissions calculations and the proposed method of processing data is introduced.

5.1 Step 1: business goal

According to GHG Protocol the first step in counting the corporate carbon footprint is to define business goal. In other words, the company should consider which business goals it is intending to achieve. (World Resources Institute and World Business Council for Sustainable Development (2011, p. 11). According to the research's observations, the object as the main business goal of the scope 3 inventory is to gain and maintain corporate reputation through public sustainable reporting and meet need of stakeholders, especially with the customers. The case company recognizes that its customers are increasingly demanding more sustainable and ethical actions by the company. Therefore, it is highly important to maintain the customer's trust towards the quality and transparency of sustainable reporting. In addition, the reporting company's business goal in scope 3

inventory is also to identify and understand different risks and opportunities associated with the supply chain emissions. With the future in mind, the target company also aims to set reduction targets to quantify and report carbon footprint performance over time.

Overall, these business goals are justified, because as stated in the chapter 2 the case company will face different sustainable related requirements in the future. By including the scope 3 inventory into its business strategy and business goals, the company remains involved in modern transformation of business strategies and is able to maintain its position in the market competition. Furthermore, developing a scope 3 inventory helps the company to identify its value chain greenhouse gas emissions and develop a strategy to minimize its carbon footprint. The company is increasingly practising sustainable supply management and its supply chains are certified with different certificates. To improve the sustainability of its value chain the company needs to have an understanding of the carbon footprint of its entire supply chain. This is assumed to be highly important in the future if the company will be required to start making emission compensations. The reporting company can also benefit from a voluntary scope 3 inventory, because throughout a transparent sustainable reporting the company strengthens and maintains credibility in the eyes of consumers. Similarly, the company may gain more competitive advantage by differentiating itself from its competitors if the reporting company manages to be the so-called pioneer in scope 3 emission reporting.

5.2 Step 2: reporting principles

According to the GHG Protocol the second step in counting the corporate carbon footprint is to review reporting principles. The protocol requires all GHG accounting and reporting of scope 3 inventory to be based on the following five principles: relevance, completeness, consistency, transparency, and accuracy. From the case company's perspective this mean that it must carry out the appropriate scope 3 inventory both internally and externally. In other words, the reporting company should be careful with decision making and use the principle of relevance when selecting data sources or when determining which activities to include or exclude from the inventory. The company should also implement complete accounting, meaning that all GHG emissions sources need to be reported and any exclusions need to be justified transparently. Correspondingly, consistency is highly important to follow in a long-term tracking performance of corporate carbon footprint over the time. For this

reason, the reporting company should use consistent methodologies and take any changes into account if for example any factors change over the time. Overall, the scope 3 inventory process should aim to achieve sufficient accuracy to ensure that the relevant assumptions and appropriate references are used effectively and transparently. (World Resources Institute and World Business Council for Sustainable Development (2011, p.23.)

5.3 Step 3: scope 3 upstream activities

This section provides a proposed scope 3 upstream activities that the case company could include in its scope 3 inventory, including the list of proposed scope 3 categories and descriptions of these chosen categories. Appendix 2 provides a list of all the eight scope 3 upstream categories of the GHG Protocol. However, the target company is noticeably initiating with carbon footprint calculations, therefore, based on the findings of the researcher, it would be useful for the company to start with the observation listing of the most relevant categories for it. The most relevant categories for the case company from an emission reporting perspective are proposed to be the following categories: category 1: purchased goods and services, category 4: upstream transportation and distribution, category 5: waste generated in operations, category 6: business travel, and category 7: employee commuting.

Category 1 includes all upstream emissions from the purchased good by the reporting company in the reporting year (World Resources Institute and World Business Council for Sustainable Development (2011, p. 38). Compared to other companies, the target company has clear supply chains, since the target company is a product manufacturer and not only a brand owner like many other Finnish textile companies. Accordingly, the materials of the products under consideration come directly to the target company, from which finished products are sent directly to customers. Therefore, from the perspective of the reporting company, this category observes production-related procurements. In other words, this category observes materials used in production. This category is proposed to be further divided into two main categories: materials for products and packing materials. Only the main materials are included in this observation which are listed in the Figure 5. It is justified to consider only the most used materials, since less used materials do not produce

significantly high emissions that would affect the corporate carbon footprint in a large picture.

Category 4 includes emissions from the transportation and distribution of products purchased or acquired by the reporting company in the reporting year in vehicles and facilities not owned or operated by the reporting company (World Resources Institute and World Business Council for Sustainable Development (2011, p. 44). From the perspective of the reporting company, this category observes emissions raised from the following transportation activities throughout the value chain: air, rail, road, and marine transports. These four transportation types are used by the case company to transport materials and products from its suppliers to its warehouse.

Category 5 includes emissions from third-party disposal and treatment of waste that is generated in the reporting company's owned or controlled operations in the reporting year. (World Resources Institute and World Business Council for Sustainable Development (2011, p. 45) From the perspective of the reporting company, this category observes emissions raised from the mixed waste and cardboard waste, because they are the largest types of waste that arise from the operations of the company. It is justified to exclude other waste types, since the amounts accumulated from the operations of the company do not produce significantly high emissions that would affect the corporate carbon footprint in a large picture.

Category 6 includes emissions from the transportation of employees for business-related activities in vehicles that are nor owned by the reporting company (World Resources Institute and World Business Council for Sustainable Development (2011, p. 46). From the perspective of the reporting company, this category observes emissions from business travel that arise from: rail, marine, air, and road (automobile) travels. According to GHG Protocol reporting company may optionally also include emissions from business-related hotel nights. (World Resources Institute and World Business Council for Sustainable Development (2011, p. 46). Before the data collection, it can be assumed that this category is most affected by the Covid-19 pandemic, as business traveling abroad has not been allowed during the chosen base year. Therefore, the results of this category will significantly reduce the carbon footprint of the company. This should be taken under consideration in the future when corrections are made to the carbon footprint calculations and its reporting.

Category 7 includes emissions from the transportation of employees between their homes and their worksites. (World Resources Institute and World Business Council for Sustainable Development (2011, p. 47). From the perspective of the reporting company, this category observes emissions from employee commuting that arise from: use of own car, taxi, or train. The Figure 5 illustrates the summary of proposed scope 3 upstream activities to be included in scope 3 inventory and lists the factors that should be considered in data collection.

Scope 3 upstream category:			
1. Purchased goods & services:			
	Materials for products:		
		Cotton fabric	kg
		Filling material	kg
	Packing materials:		
		Plastic	kg
		Cardboard	kg
		Wood	kg
4. Upstream transportation and distribution			
	Transport to the warehouse:		
		Rail	kg & km
		Marine	kg & km
		Air	kg & km
		Road	kg & km
5. Waste generated in operations			
		Mixed waste	kg
		Cardboard	kg
6. Business travel			
		Rail	km
		Marine	km
		Air	km
		Road (Automobile)	km
		Hotel nights	qty
7. Employee commuting			
		Use of own car	km
		Taxi	km
		Train	km

Figure 5. Proposed framework for Scope 3 activities and data collection.

5.4 Step 4: scope 3 boundaries

According to the GHG Protocol it is highly important to notice that determination of which scope 3 upstream emissions to include in the inventory is a critical decision in the inventory process. As stated in the theoretical part of the thesis and in the previous section of the thesis, the GHG Protocol allows companies to choose which scope 3 activities to include in the GHG inventory when the company defines its operational boundaries. On the other hand, according the GHG Protocol the scope 3 emissions are optional to include to GHG inventory. If the company chooses to include scope 3 activities in the GHG inventory, the reporting company should disclose and justify any exclusions of the minimum boundaries listed in Appendix 2. Therefore, it is highly important that the case company has a clear description of what categories are excluded from the inventory. For example, the company may choose to exclude some categories and begin to include those categories to inventory, as the needed data becomes available. (World Resources Institute and World Business Council for Sustainable Development 2011, pp. 59-60.) The proposed categories have been presented in the previous section 5.2 “scope 3 upstream activities”. According to the writer’s own observations and findings, the proposed framework provides an excellent basis for the initiation of the case company’s scope 3 upstream inventory, because it contains all the most relevant sources of scope 3 upstream emissions of the company. On the other hand, an incomplete framework leads to inconsistency of results and to the imperfectness of carbon footprint calculation and reporting.

Among multiple other factors, the incompleteness of boundary defining is one reason that leads to the imperfectness of carbon footprint calculation and reporting. The Figure 6 illustrates how different factors in carbon footprint calculation might lead to a large number of emissions that are ignored in carbon footprint calculations and especially in corporate sustainable reporting. The Figure 6 is also intended to highlight how scope 3 upstream emissions are only a very small part of the entire corporate carbon footprint.

Figure 6. Visualization of the framework of the Scope 3 upstream emissions vs the total carbon footprint of the organization.

The corporate carbon footprint is a controversial topic, as there are always emissions that are completely ignored in the carbon footprint calculations and reporting. Furthermore, the reporting company can report its carbon footprint in various ways, as it is allowed to choose what factors are the most beneficial to include to the scope 3 inventory. Thus, it is justified to claim that there in no unambiguous answer for the research question (RQ1): "How to determine and calculate scope 3 upstream emissions for a Finnish textile company?". This is because there is no unequivocal way that all companies should report their carbon footprint. Therefore, there are multiple different ways to report a corporate carbon footprint. If the reporting company justifies the boundaries of its carbon footprint calculation well enough and reports the choices made in the calculation process transparently enough, it is possible for the reporting company to calculate and report the corporate carbon footprint extremely freely.

5.5 Step 5: data collection

After the reporting company has identified the activities to include in its scope 3 upstream inventory and have identified its operational boundaries, the next step is to collect the necessary data in order to calculate the corporate carbon footprint. The data collection process can be divided into four main parts, which are: prioritize data collection efforts,

select data, collect data and fill data gaps, and improve data quality over time. (World Resources Institute and World Business Council for Sustainable Development (2011, p. 65.)

According to the GHG Protocol there are two main methods to quantify emissions: direct measurements and calculation. The proposed method for the target company to quantify scope 3 upstream emissions is the calculation method. The calculation method requires two types of data: activity data and emission factors. Quantification of GHG emissions is carried out by multiplying activity data by an emission factor:

$$GHG = \text{Activity Data} \times \text{Emission Factor} \times GWP$$

Activity data is a quantitative measure of a level of activity that results in GHG emissions. An example of activity data is "kilometres of distance travelled". An emission factor is a factor that converts activity data into GHG emissions data. An example of emission factor is "t CO_2 emitted per kilometres travelled". "GWP" in the formula above indicates "Global warming potential". According to GHG Protocol the GWP values describe "the degree of harm to the atmosphere of one unit of given GHG relative to one unit of carbon dioxide". GWP values convert GHG emissions data for non-CO_2 gases into units of carbon dioxide equivalent (CO_2e). Reporting company should use GWP values provided by the Intergovernmental Panel on Climate Change (IPCC). The reporting company is required to disclose the source of GWP values and maintain consistency in the source of GWP values used to calculate the inventory over time. (World Resources Institute and World Business Council for Sustainable Development (2011, pp. 68-70.) The proposed framework for the data collection has been presented earlier in this study in Figure 5.

According to the GHG Protocol in the process of data collection and in the entire process of the scope 3 upstream inventory, it is highly important to consider the possibility of double counting (World Resources Institute and World Business Council for Sustainable Development 2011, p. 69). Double counting is a term that is commonly used to refer to the erroneous practice of counting some values more than once (Fu, Su, Wei, Willett, Lü & Liu 2010, p.1). In this context, according to the GHG Protocol, double counting refers to a situation where two or more companies claim ownership for the same carbon emission. For example, if two entities in the same chain account for the same scope 3 emissions, double counting within scope 3 emissions could occur. Scope 3 accounting is an integral part of accounting. It involves recognizing the varying impacts of various entities within a value

chain. In certain cases, an emission may be accounted for by multiple companies in a different scope 3 category. Couple examples of type of double counting within scope 3 could be in the category 6 or in the category 7. The category 6 includes a risk of double counting because a reporting company's scope 3 emissions from business travel include the scope 1 and scope 2 emissions of transportation companies. Similarly, in the category 7 the reporting company's scope 3 emissions from employee commuting includes the scope 1 and scope 2 emissions of employees and third-party transportation provides. (World Resources Institute and World Business Council for Sustainable Development 2011, pp. 46-47).

The quality of scope 3 upstream inventory logically depends on the quality of the data gathered to calculate upstream emissions. Therefore, the reporting company should use data that supports its business goal and data that bases on the relative significance of scope 3 activities. Correspondingly, the reporting company should only use data of sufficient quality to ensure that the inventory appropriately reflects the GHG emissions of the company. Overall, the data used for inventory should be most complete, most reliable, and most representative in terms of technology, time, and geography. (World Resources Institute and World Business Council for Sustainable Development (2011, pp. 74-78.)

6. Conclusions

This thesis examines the complexity of corporate carbon footprint calculations and reporting. A large number of different companies and organizations worldwide have voluntarily adopted carbon footprint calculation and reporting tools to measure their climate responsibility and manage emission reductions over the time. In a global context, it is highly important to measure and report the corporate sustainability impacts considering what is happening along company's entire supply chain. The global textile supply chains are highly complex. Therefore, the main aim of the thesis is to understand better how it is profitable for a textile company to report indirect emissions that result of activities from not owned or controlled by the reporting company. To avoid greenwashing and to ensure transparency, the reporting company should report a description of the data quality of reported emission data. Different standards provide a better understanding of way in which complex systems can be directed to reduce emissions and increase sustainability. On the other hand, while these different standards and protocols set the foundation for more comprehensive and consistent sustainability reporting, their approaches towards scope 3 disclosure remains inconclusive. Although the topic has been extensively researched in previous studies and new methods are constantly developed, there are still multiple gaps in this field of this research.

The corporate carbon footprint calculation and reporting is found challenging, and globally only a third of the suppliers report their own scope 3 emissions. Hence, most organizations are not able to quantify their scope 3 emissions along their supply chains with primary data. (Klaaßen et al. 2021, p. 4) This leads to incompleteness of the emission reporting and creates mistrust in corporate sustainability reporting. Therefore, green washing and the lack of transparency will continue exist in the absence of an appropriate scientific methodology that encompasses all aspect of sustainability, and that is applied throughout the entire supply chain (Goncalves et al. 2021, p. 28). The recent studies have suggested multiple approaches to improve this field of the study and especially a lack of training and skills have been found problematic along the different life cycle stages in textile industry (Luján-Ornelas et al. 2020, p. 1). In their study Luján-Ornelas et. al. (2020, p. 1) indicate the need to generate strategies and tools to especially support SMEs (small- and medium-sized companies) with traceability and transparency along the entire supply chain. Overall, previous studies and literature show

that the corporate carbon footprint calculation and reposting are seen highly complex. In their research Li et al. (2020, p. 408) specifically justify that this is due the imperfection of the current GHG Protocol Corporate Value Chain (Scope 3).

The empirical finding of this thesis supports previous studies with the idea that there is no unambiguous answer to how a company's carbon footprint should be implemented. This is because the GHG Protocol can be interpreted in multiple different ways. The protocol provides a significantly comprehensive and free way to implement scope 3 inventory. As the most significant empirical observation of the thesis is found to be that it is more convenient for the case company to use results of scopes 1 and scope 2 inventory only until proper and verified scope 3 inventory can be carried out. This is because the thesis only examines the cradle to gate phase of the greenhouse gas emission from LCA perspective. In other words, the thesis only examines the scope 3 upstream emissions and the so-called gate to grave phase has excluded completely and the LCA has not been applied completely. Furthermore, the scope 3 upstream emissions are only reviewed to some extent, because only the most relevant scope 3 upstream categories from the point of view of the business goal set for the GHG inventory by the case company have been selected under the observation. Therefore, the results of the thesis can be seen only as a relevant framework to start the scope 3 inventory with the most convenient scope 3 upstream categories. Overall, the thesis supports the complexity aspect of the scope 3 inventory, since despite the great settlement work it is not profitable for the case company to report emissions of the scope 3 inventory. This research shows first that it is not necessarily profitable for a company to report the scope 3 emissions even if the company would do a great amount of investigation on it, and second that the great ambiguity of the GHG Protocol makes it complicate to implement.

Considering previous research and the empirical findings of this thesis it is justified to claim that there is no unambiguous answer for the research question (RQ1): "How to determine and calculate scope 3 upstream emissions for a Finnish textile company?". This is because there is no unequivocal way that all companies should report their carbon footprint. Therefore, there are multiple different ways to report a corporate carbon footprint. If the reporting company justifies the boundaries of its carbon footprint calculation well enough and reports the choices made in the calculation process transparently enough, it is possible for the reporting company to calculate and report the corporate carbon footprint extremely freely. The second objective of the study was SQ1: "How to define operational boundaries

in corporate carbon footprint calculations in textile industry?". The GHG Protocol allows companies to choose which scope 3 activities to include in the GHG inventory when the company defines its operational boundaries. If the company chooses to include scope 3 activities in the GHG inventory, the reporting company should disclose and justify any exclusions of the minimum boundaries listed in the GHG Protocol. Furthermore, the company may choose to exclude some categories and begin to include those categories to inventory in the future, as the needed data becomes available. Therefore, the empirical findings can be concluded with the idea that there are multiple ways to define operational boundaries in scope 3 inventory, as the scope 3 emissions are optional to include to GHG inventory. Finally, the last objective of this thesis was SQ2: "How developing a scope 3 inventory strengthens company's understanding of its value chain in textile industry context?" Despite that the scope 3 emission calculation and reporting are optional; the results of this research show that the inclusion of scope 3 inventory helps the company to gain more understanding of the responsibility that it has for climate change beyond its legally owned property. By understanding its value chain its emissions better, the company attempt to force itself to think more broadly its environmental impact.

This thesis can be considered to be limited, which creates need for further study. Further study especially for the case company should investigate the entire scope 3 inventory possibilities. Scope 3 upstream inventory is seen highly challenging, because scope 3 emissions are emissions from activities that are not under the reporting company's ownership or control. The most challenging phase of inventory is to collect data and ensure the data quality for scope 3 emissions. Data quality is also important for minimizing uncertainties in scope 3 accounting and reporting. Generally, the empirical findings of this thesis indicates that any reporting company should not collect data that is not adequate to support its transparent emission reporting. In addition, according to this research, the reporting company should ensure that the data is relevant to its business goal, and to ensure that this is achieved the empirical findings of this thesis suggest that the reporting company should also use primary data collected from suppliers and other value chain partners for scope 3 upstream activities. Thus, the case company can achieve effective monitoring of its supply chain performance and produce quality calculations of corporate carbon footprint. Overall, the reporting company should strive to create reports that are as accurate and complete as possible. This should include a variety of factors that affect the report's content

and goals, as well as the company's strategy and goals for greenhouse gas emission reduction.

From the general perspective, and especially from the climate change perspective, the global total carbon footprint of different organizations is crucial. Without clear definitions, calculations instruction, and monitoring, corporate carbon footprint calculations and reporting could be claimed to be just a rhetoric illusion. For this reason, the future study of this research field could study a possibility of having a methodological tool that guides the company in measuring its corporate carbon footprint. Furthermore, this research shows how it is challenging for a medium-sized company to carry out scope 3 inventory due the lack of resources. Therefore, the future studies could continue research of how organizations can improve their sustainability strategies that could especially facilitate the transition of small- and medium-sized companies.

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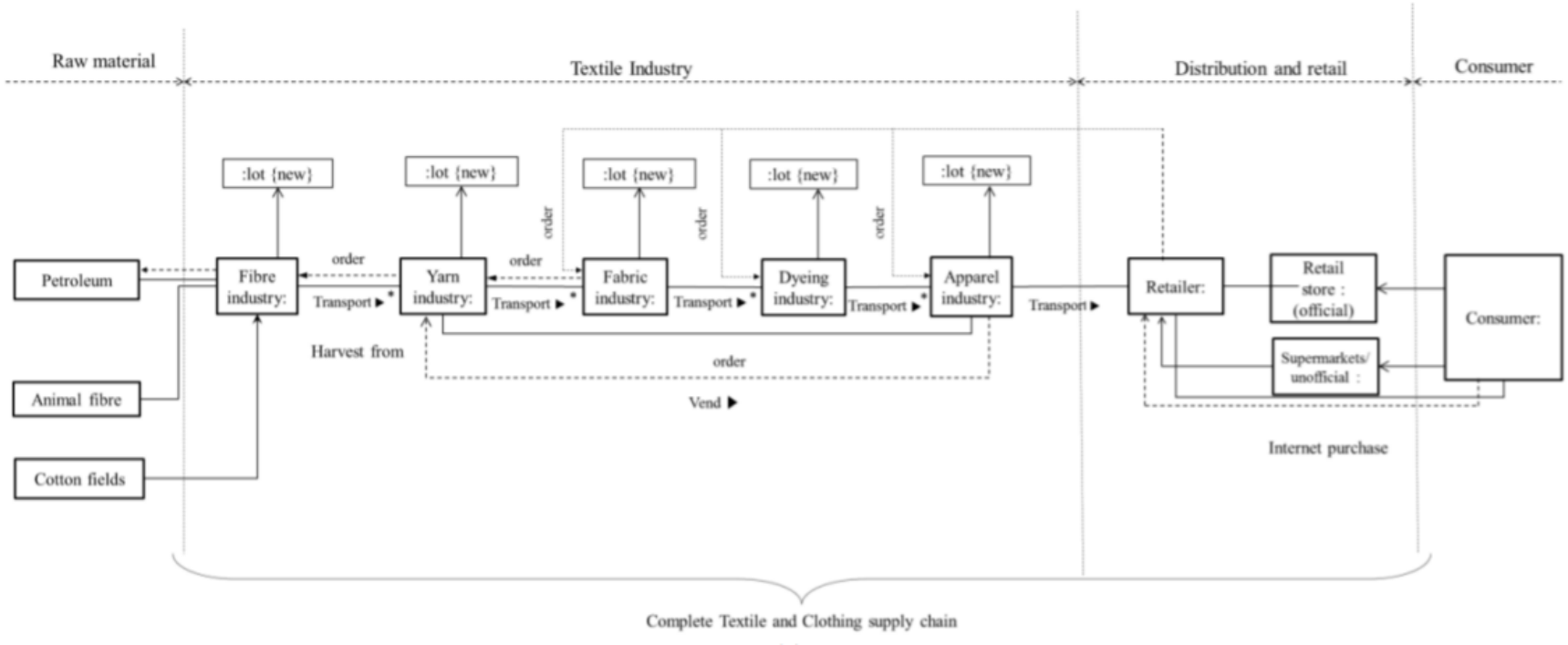
Appendix 1: Illustration of complete textile supply chain. (Kumar et al. 2017, p. 16)



Appendix 2: Overview of scope 3 upstream categories and minimum boundaries as stated in the GHG Protocol. (World Resources Institute and World Business Council for Sustainable Development 2011, pp. 34-35)

Scope 3 upstream category	Category description	Minimun boundary
Purchased goods and services	Extraction, production, and transportation of goods and services purchased or acquired by the reporting company in the reporting year, not otherwise included in Categories 2–8	All upstream (cradle-to-gate) emissions of purchased goods and services
Capital goods	Extraction, production, and transportation of capital goods purchased or acquired by the reporting company in the reporting year	All upstream (cradle-to-gate) emissions of purchased capital goods
Fuel- and energy-related activities (not included in scope 1 or scope 2)	Extraction, production, and transportation of fuels and energy purchased or acquired by the reporting company in the reporting year, not already accounted for in scope 1 or scope 2, including: a. Upstream emissions of purchased fuels (extraction, production, and transportation of fuels consumed by the reporting company) b. Upstream emissions of purchased electricity (extraction, production, and transportation of fuels consumed in the generation of electricity, steam, heating, and cooling consumed by the reporting company) c. Transmission and distribution (T&D) losses (generation of electricity, steam, heating and cooling that is consumed (i.e., lost) in a T&D system)—reported by end user d. Generation of purchased electricity that is sold to end users (generation of electricity, steam, heating,	a. For upstream emissions of purchased fuels: All upstream (cradle-to-gate) emissions of purchased fuels (from raw material extraction up to the point of, but excluding combustion) b. For upstream emissions of purchased electricity: All upstream (cradle-to-gate) emissions of purchased fuels (from raw material extraction up to the point of, but excluding, combustion by a power generator) c. For T&D losses: All upstream (cradle-to-gate) emissions of energy consumed in a T&D system, including emissions from combustion d. For generation of purchased electricity that is sold to end users: Emissions from the generation of purchased energy

	and cooling that is purchased by the reporting company and sold to end users)—reported by utility company or energy retailer only	
Upstream transportation and distribution	Transportation and distribution of products purchased by the reporting company in the reporting year between a company's tier 1 suppliers and its own operations (in vehicles and facilities not owned or controlled by the reporting company) Transportation and distribution services purchased by the reporting company in the reporting year, including inbound logistics, outbound logistics (e.g., of sold products), and transportation and distribution between a company's own facilities (in vehicles and facilities not owned or controlled by the reporting company)	The scope 1 and scope 2 emissions of transportation and distribution providers that occur during use of vehicles and facilities (e.g., from energy use) Optional: The life cycle emissions associated with manufacturing vehicles, facilities, or infrastructure
Waste generated in operations	Disposal and treatment of waste generated in the reporting company's operations in the reporting year (in facilities not owned or controlled by the reporting company)	The scope 1 and scope 2 emissions of waste management suppliers that occur during disposal or treatment Optional: Emissions from transportation of waste
Business travel	Transportation of employees for business-related activities during the reporting year (in vehicles not owned or operated by the reporting company)	The scope 1 and scope 2 emissions of transportation carriers that occur during use of vehicles (e.g., from energy use) Optional: The life cycle emissions associated with manufacturing vehicles or infrastructur
Employee commuting	Transportation of employees between their homes and their worksites during the reporting year (in vehicles not owned or operated by the reporting company)	The scope 1 and scope 2 emissions of employees and transportation providers that occur during use of vehicles (e.g., from energy use) Optional: Emissions from employee teleworking

Upstream leased assets	Operation of assets leased by the reporting company (lessee) in the reporting year and not included in scope 1 and scope 2—reported by lessee	The scope 1 and scope 2 emissions of lessors that occur during the reporting company's operation of leased assets (e.g., from energy use) Optional: The life cycle emissions associated with manufacturing or constructing leased assets

Appendix 3: Table of used data for the case company's emission observation.

Scope 3 upstream category:	Observed unit	Document type	Quantity of observed documents
1. Purchased goods & services:			
Cotton fabric	kg	invoices	50
Filling material	kg	invoices	13
Plastic	kg	service provider's annual report	1
Cardboard	kg	service provider's annual report	1
Wood	kg	service provider's annual report	1
4. Upstream transportation and distribution			
Transport to the warehouse (rail)	kg & km	service providers's annual reports and invoices	Total 220
Transport to the warehouse (marine)	kg & km	service providers's annual reports and invoices	Total 220
Transport to the warehouse (air)	kg & km	service providers's annual reports and invoices	Total 220
Transport to the warehouse (road)	kg & km	service providers's annual reports and invoices	Total 220
5. Waste generated in operations			
Mixed waste	kg	invoices	12
Cardboard	kg	invoices	12
6. Business travel			
Rail	km	internal travel reports and travel invoices	Total 80
Marine	km	internal travel reports and travel invoices	Total 80
Air	km	internal travel reports and travel invoices	Total 80
Road (Automobile)	km	internal travel reports and travel invoices	Total 80
Hotel nights	qty	internal travel reports and travel invoices	Total 80
7. Employee commuting			
Use of own car	km	internal travel reports and travel invoices	Total 80
Taxi	km	internal travel reports and travel invoices	Total 80
Train	km	internal travel reports and travel invoices	Total 80