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Ethics and carbon footprint calculation of kitchen fitting imports

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Thesis abstract

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This thesis was commissioned by the Finnish HtF Group Ltd. In this thesis different carbon footprint calculators are researched, examined, and recommended, and a product data sheet is created for the company's suppliers. Both tools are intended as part of the company's Corporate Sustainability Reporting.

At the beginning of this thesis, the research problem of the thesis is explained, its boundaries are defined, and the selected research method is reviewed.

The theoretical part of the thesis examines the general background of carbon dioxide and its importance for the Earth. It examines the causes of carbon dioxide emissions and related actions, focusing on some significant agreements on climate change. The section also examines the use, history, and importance of tariffs in combating the growth of carbon dioxide emissions. Lastly, the theory section, investigates the background information of both Corporate Sustainability Reporting and carbon footprint calculations.

After the theory, the thesis investigates its research environment, which covers both the company and their branch of business. The first part of this section contains information on the status of wholesale as a business both in Finland and within the entire European Union.

The second part of the research environment section also includes general information about the commissioner of this thesis.

The empirical part of the thesis discusses the baselines of the thesis project and tells about the development work of the product data sheet and the research process of different carbon footprint calculators.

At the end of the work, conclusions and recommendations are presented. Additionally, the section discusses about this thesis work′s usefulness, validity, and reliability as well as the process and potential future research.

[1] Keywords: Greenhouse gas, carbon dioxide, carbon footprint, ethics

SEINÄJOEN AMMATTIKORKEAKOULU

Opinnäytetyön tiivistelmä

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Tämän opinnäytetyön on tilannut suomalainen HtF Group Oy. Tässä työssä tutkitaan, sekä suositellaan erilaisia hiilijalanjälkilaskureita, sekä luodaan lähtötietolomake yrityksen tavarantoimittajia varten. Molemmat työkalut on tarkoitettu osaksi yrityksen kestävyysraportointia.

Opinnäytetyön alussa kerrotaan tutkimusongelma ja sen rajat sekä käydään läpi valittu tutkimusmetodi.

Opinnäytetyön teoreettisessa osassa tarkastellaan hiilidioksidin yleistä taustaa ja sen merkitystä maapallolle. Työssä käydään läpi hiilidioksidipäästöjen syitä ja niihin liittyviä toimia, keskittyen muutamiin merkittäviin ilmastonmuutosta koskeviin sopimuksiin. Työssä tutkitaan myös tariffien käyttöä, historiaa ja merkitystä hiilidioksidipäästöjen kasvun torjunnassa. Teoriaosuuden lopussa tarkastellaan sekä kestävyysraportoinnin että hiilijalanjälkilaskennan taustatietoja.

Teoria-osan jälkeen opinnäytetyössä käsitellään sen tutkimusympäristöä, joka kattaa sekä yrityksen että sen toimialan. Osion ensimmäinen osa sisältää tietoa tukkukaupan tilasta liiketoimena sekä Suomessa että koko Euroopan Unionin sisällä.

Tutkimusympäristö-osion toisessa osassa käsitellään myös yleisiä asioita opinnäytetyön toimeksiantajasta.

Opinnäytetyön empiirisessä osassa käsitellään opinnäytetyöprojektin lähtökohtia ja kerrotaan sekä alkutietolomakkeen kehitystyöstä, että hiilijalanjälkilaskurien tutkimusprosessista.

Työn lopussa esitetään johtopäätökset ja suositukset. Lisäksi osiossa käsitellään tämän opinnäytetyön hyödyllisyyttä, kelpoisuutta ja luotettavuutta sekä itse prosessia ja mahdollisia tulevia tutkimuksia.

[1] Asiasanat: kasvihuonekaasu, hiilidioksidi, hiilijalanjälki, eettisyys

TABLE OF CONTENTS

Pictures, Figures and Tables

1 INTRODUCTION

This short preface section of the thesis work gives out a short summary of the research problem of the thesis, and its scope. The section also goes through the selected research method, while analysing and arguing the chosen method, the mixed research method.

1.1 Research problem and boundaries

The research problem of this thesis is to enhance the already existing Corporate Sustainability Reporting of the commissioner company, which is a Finnish wholesale company which is specialized in the field of kitchen and furniture fittings.

The scope of the thesis is to conduct research on already existing carbon footprint calculators, examine them, and recommend the most suitable one for the commissioner, which it can utilize when importing certain consumer goods, and from certain continents. Additionally, these calculators can be used with the carbon footprint of commissioner′s own products and other operations.

In addition to the scope, a product data sheet for the commissioner′s suppliers is created. Both of these tools are aimed to be a part of the commissioner′s own Corporate Sustainability Reporting in the future.

Both of these tools are aimed to mitigate the commissioner′s environmental and social impacts, to research and possibly decrease their CO_2 emissions, and be a significant part of their own Corporate Sustainability Reporting.

1.2 Research method

The research method which is used during this thesis work is mixed methods, which is a data collecting method that combines both qualitative and quantitative research methods.

According to the articles of Delve (2022) and Dovetail (2023), the key idea of the method is that it maximizes the advantages of both data collecting methods, as it also mitigates their

disadvantages. As it is the combination of both quantitative and qualitative research methods, it enables a more thorough examination of the research question.

According to the article of Dovetail (2023), mixed methods can be utilized when either qualitative or quantitative data alone is able to give a satisfying research answer, while George (2021) points out that it is due to the fact that mixed methods research can provide a more comprehensive picture than either a quantitative or qualitative investigation alone.

Qualitative research typically has a lower sample size, which makes it difficult to generalize (George, 2021). This is mitigated in mixed methods by adding quantitative research data to bolster it. Qualitative data can help to enhance quantitative findings and that way broaden up the analysis as mixing methods allows to put findings in context and add richer detail to your conclusions.

Articles of Delve (2022) and Dovetail (2023) point out that additionally, research that utilize mixed method is able to fully comprehend the subject or phenomena they are studying.

Delve (2022) and George (2021) point out that research paradigms and disciplines are less relevant to mixed methods research, therefore providing a greater creative freedom when planning the study and allowing the researcher to include components from many study types in order to derive the most insightful conclusions.

Dovetail's article (2023) concludes in general, research utilizing mixed methods provide several benefits when examining complicated phenomena. It is able to shed light on many aspects of a phenomena in ways that are not achievable with only qualitative or quantitative data, while it also enables researchers to combine information from many sources to comprehend the issue at hand more thoroughly.

2 CO_2 EMISSIONS, THEIR SIGNIFICANCE, CAUSES, AND CONTROL

Carbon dioxide, more commonly known as CO_2, is a greenhouse gas found in earth's atmosphere and with oxygen and nitrogen, is one of the most important structural elements of earth's air (University Corporation of Atmospheric Research (UCAR), n.d.-a). It is a non-flammable gas, which appears as colourless and odourless at room temperatures.

As a greenhouse gas, CO_2 is vital as it is able to trap heat inside earth's atmosphere. However, over the ages, the amount of carbon dioxide in our atmosphere has caused the earth's temperature to rise, leading earth's climate to suffer (UCAR, n.d.-a).

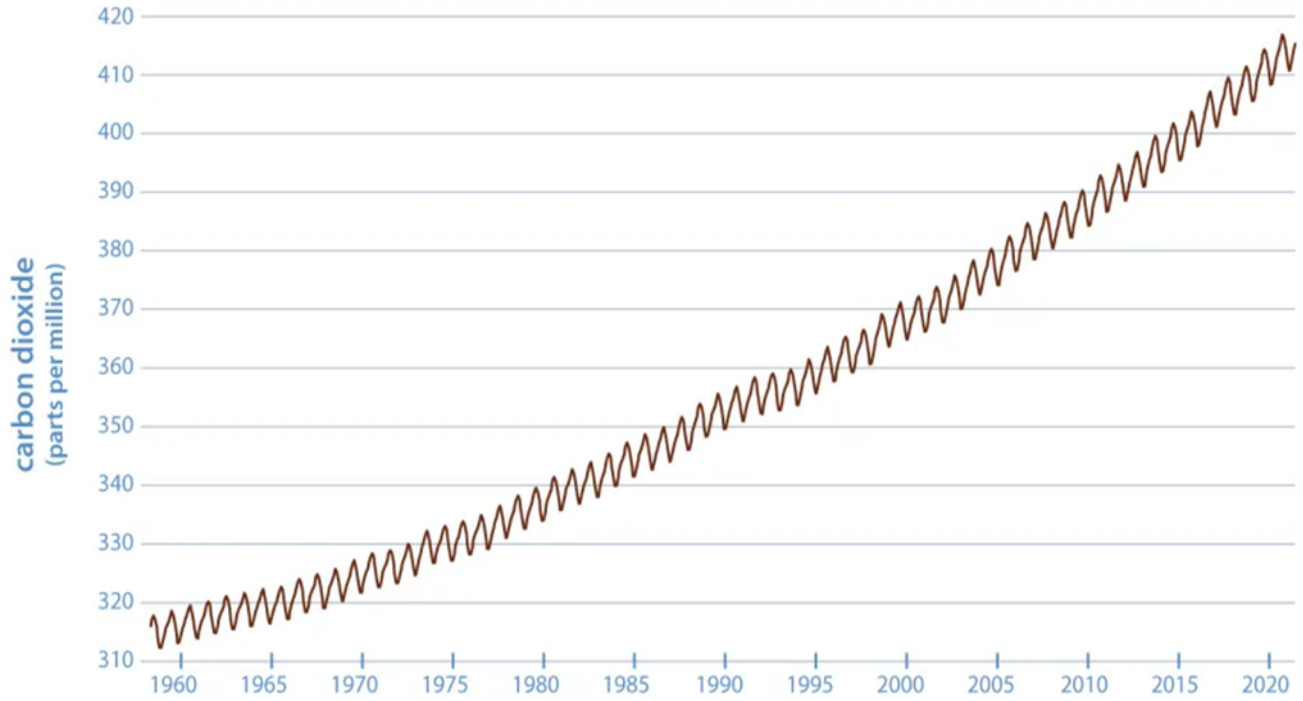


Figure 1. Keeling Curve (UCAR, n.d.-a).

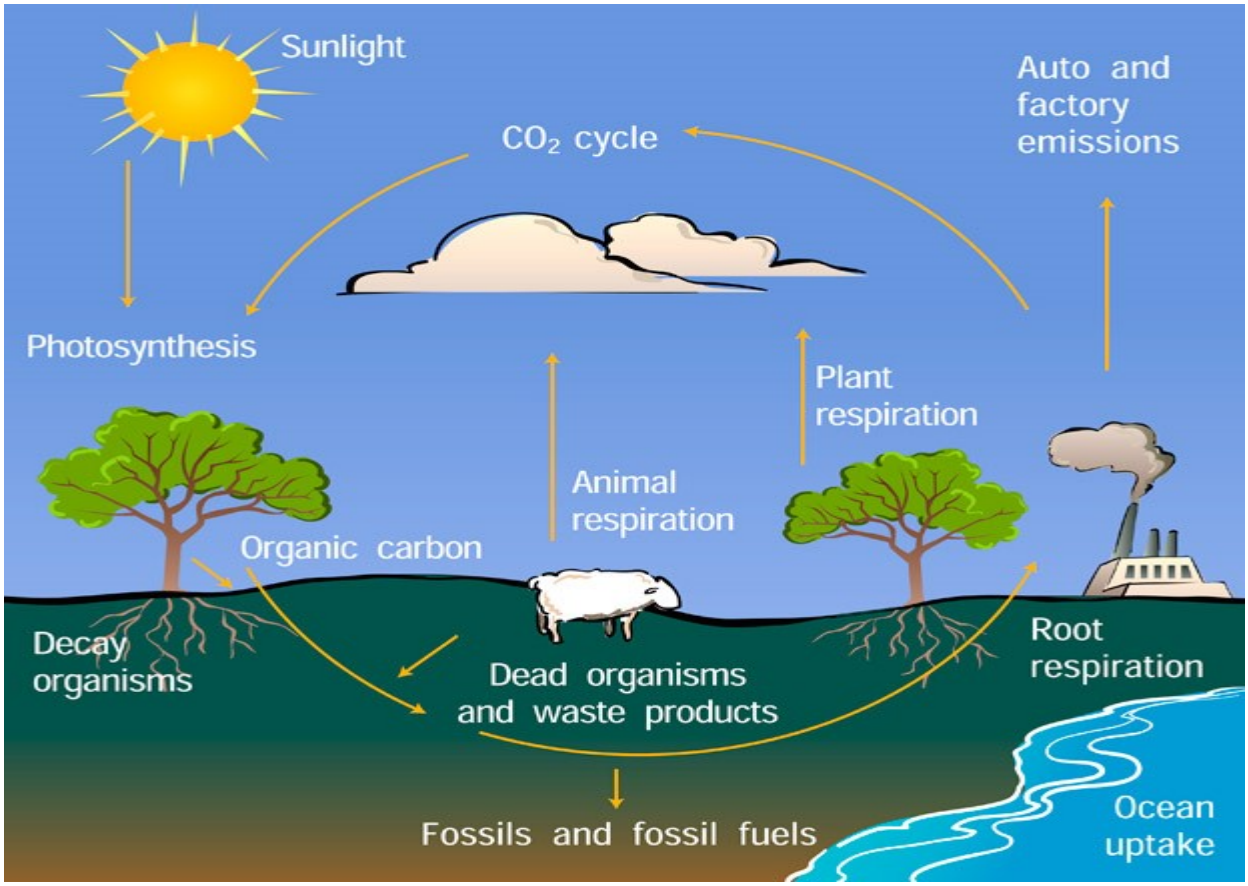
The graph above describes the annual increase of CO_2. According to Rafferty (2023), the recording was instituted in 1958 by American climate scientist Charles Keeling at Hawaii's Mauna Loa Observatory, and it is the longest running recording related to atmospheric increase of CO_2 in the world. Many scientists view the curve as a reliable indicator of CO_2 levels in the middle layers of the troposphere, as well as many climate scientists have read it as a warning sign for global warming. Nowadays, The Keeling Curve also acts as a connection between historical and present CO_2 concentrations.

2.1 Significance of CO_2

Lindsey (2023) writes that out of all earth's greenhouse gases, CO_2 is the most significant. Compared to oxygen and nitrogen which combine a major part of earth's atmosphere, greenhouse gases take in heat that emits from earth's ground and then release it all over the atmosphere and back to ground. Natural greenhouse effect would be too weak to keep earth's temperature above freezing, but carbon dioxide is vital to keep the earth liveable for flora and fauna. Carbon dioxide also dissolves into earth's seas, and therefore lowers the ocean's pH levels by producing carbonic acid as it reacts with water molecules.

According to Earthhow (2023), one influential part of the carbon cycle is one of the basic human functions, respiration. Humans, as well as other living things, contain carbon. Through breathing, human's consume carbon, CO_2, which is contained inside the air. Plants provide animals nourishment, energy, and oxygen. Through a process called cellular respiration, cells of a human or an animal collect oxygen, which it needs to be able break down the food that is eaten. Due to the cell respiration, carbon dioxide is released back into the atmosphere after it has been consumed. This CO_2 that is created by respiring cells can then be utilized once more for photosynthesis. In conclusion, plants are utilizing the solar energy, so they could break apart the same carbon dioxide found in our atmosphere. It relies on that same carbon for plant material through photosynthesis, which then releases oxygen once more.

Dobrijevic (2022) and Earthhow (2023) write about the chemical process known as photosynthesis, which is employed by algae, plants, and certain bacteria, is what makes the planet habitable. It involves a plant converting carbon dioxide and water into nutrients and oxygen. Since there are two forms of photosynthesis, oxygenic and anoxygenic, and because anoxygenic photosynthesis is more widespread in plants, algae, and bacteria, CO_2 plays a significant role in Earth's processes and cannot be entirely regarded as the only cause of global warming. Using atmospheric CO_2 and H_2O, photosynthesis creates glucose and other carbohydrates. These are compounds that plants naturally produce on their own. In the correct conditions, photosynthesis can continue for centuries. All living things obtain their energy through photosynthesis, which also removes carbon dioxide from the environment.



Picture 1. Carbon Cycle Diagram (UCAR, n.d.-b).

The picture above crudely visualizes the carbon cycle. According to the National Energy Technology Laboratory (n.d.) only a small portion of the air that humans breathe contains carbon dioxide. It is also released from the lungs as a consequence of human body's metabolism. CO_2 plays a vital role in plant life and in the global carbon cycle. In order to survive and develop, plants absorb CO_2, convert it into carbon and oxygen, release the oxygen into the atmosphere, and then hold onto the carbon. The cycle is completed when the plant dies or is burnt because the carbon in the air recombines with the oxygen to produce CO_2. In the carbon cycle process carbon moves through air, ground, plants, animals, and fossil fuels. As plants absorb CO_2 for photosynthesis and release oxygen back into the environment, humans and animals breathe in the oxygen from the air and exhale out carbon dioxide. The atmosphere and the seas exchange carbon dioxide as well. Over time, this natural set of operations maintains steady CO_2 levels in the atmosphere. Carbon is found in soil, plants, animals, and landforms on earth. These may release carbon dioxide into the atmosphere as they break down. After entering the atmosphere, carbon can be taken up by the seas, land- or ocean-based plants, or animals that eat shells.

2.2 Causes of rise in CO_2 emissions

According to the European Commission (n.d.-b), the period spanning from 2011 to 2020 was the hottest on record, with an increase in global temperature of 1.1 °C compared to pre-industrial levels. Since an increase in temperature of more than 2 °C will have a substantial impact on the environment and human health, efforts have been made by the worldwide community to keep global warming far below the 2 °C threshold, with a target of 1.5 °C.

According to Denchak (2023) and Herring (2020) naturally occurring sources of carbon dioxide in the atmosphere include ruminant animal belches, volcanic eruptions, decomposing plants and other biomass, and ocean outgassing. These natural supplies of carbon dioxide are balanced by "sinks", or processes like soil and peat formation, intake directly into the ocean, and photosynthesis by land and marine plants. When gases, like CO_2, in the atmosphere absorb solar heat that would otherwise escape into space, our planet naturally heats. This process is known as the "greenhouse effect", which is caused by natural causes of CO_2 emissions along with other natural greenhouse gases.

Denchak (2023) writes that the greenhouse gases consist of four major ones, methane, nitrous oxide, water vapor, and carbon dioxide. Synthetic fluorinated gases are usually counted in with these four as the fifth greenhouse gas, and they function similarly as the other greenhouse gases. All these gases are naturally extracted from the atmosphere and each of them require a certain cycle.

According to Denchak (2023) and Herring (2020), the earth’s atmosphere had exceeded 400 parts per million of CO_2 in 2013. For the majority of the last 800 000 years, a significant amount of time longer than human civilization has existed, the atmospheric concentration of CO_2 was around 200–280 parts per million. This makes it the highest it has ever been throughout human civilization.

Denchak (2023) points out that in the year 2023, the levels of atmospheric CO_2 hit 420 parts per million. Compared to for example pre-industrial times, the current amount of atmospheric CO_2 is now 50% higher.

European Commission (n.d.-b) lists actions such as burning fossil fuels, deforestation, increase of livestock farming, fertilizers, and fluorinated gases as major human caused emissions. The chart below shows the percentages of greenhouse gas emissions of each economic sector in the year 2010, electricity and heat production generating the biggest amount.

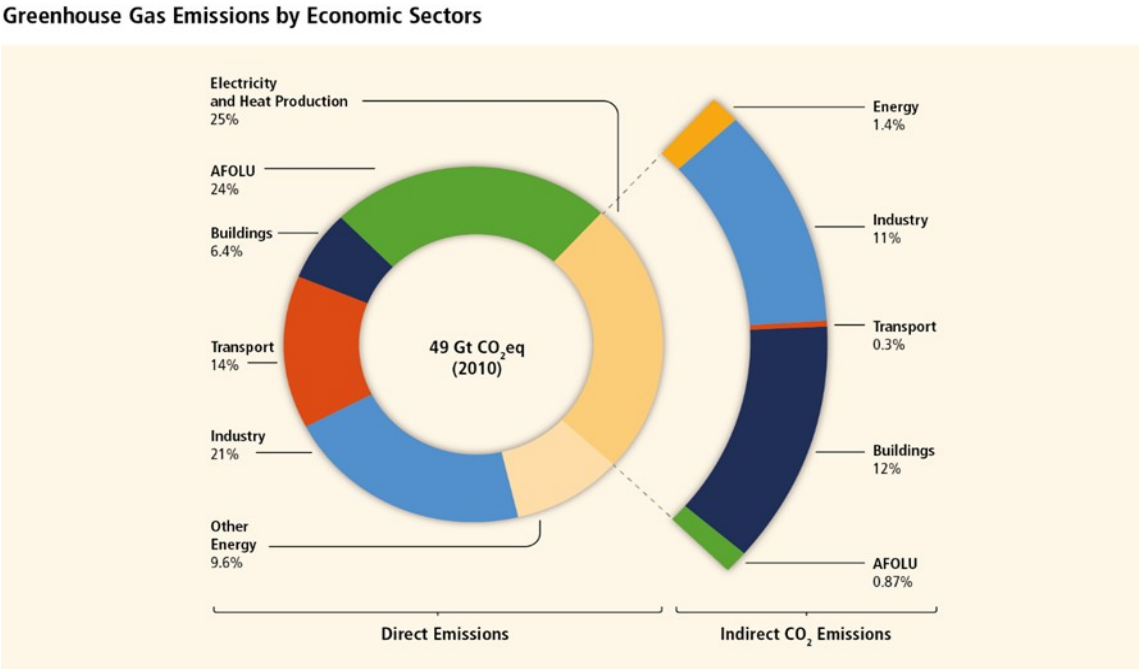


Figure 2. Greenhouse Gas Emissions by Economic Sectors, 2010 (Edenhofer et al., 2014, p. 44).

Burning coal, oil, and gas: ClientEarth (2022) states that as fossil fuels are burned, it releases large amounts of carbon dioxide to earth's atmosphere. It is studied that burning fossil fuels is the biggest factor in greenhouse effect, as in 2018 out of all worldwide CO_2 emissions 89% came from usage of fossil fuels. Coal is the biggest factor of rise in earth's temperature with contribution of 0.3 °C out of the entire increase. Burning of oil also contributes around a third of all global emissions, with recent oil spills which have had catastrophic effects to ocean's ecosystems. Lastly, burning natural gases constitutes one-fifth of global carbon emissions, even though it is usually viewed less harmful.

Deforestation: According to Hemingway Jaynes (2022), clearing the forests to use the areas for something different, such as fields or for livestock. Due to deforestation, massive amounts of carbon dioxide escape back to earth's atmosphere which causes temperatures to rise. Extreme weather, heat waves, droughts wildfires and floods are examples of

changing weather patterns which is caused by deforestation. Certain tropical forests are no longer acting as carbon sinks because they are releasing more carbon into the atmosphere than they are absorbing.

Livestock: Blaustein-Rejto & Gambino (2023) state that the argument of livestock accounting to 14.5% of human-caused emissions doesn't hold true as the true percentage fluctuates. Food and Agriculture Organization of the United Nations has released a statement where the percentage is significantly lower 11.1% as where some peer-reviews suggest the percentage being much higher by 19.6%, however, livestock contribute to carbon emissions in many ways. Natural reasons such as manure and fermentation caused by ruminating animals create methane, and enteric fermentation alone is the biggest source of emissions caused by livestock. Other more artificial sources such as feed production, energy consumption, processing of the livestock to food, and land forming to either croplands or pastures all create emissions contributing to the percentage.

Blaustein-Rejto and Gambino (2023) continue that even though the numbers are lower than before, it doesn't mean that the emissions are falling. Data suggest that the emissions are in fact going to rise as earth's population increases with human's diets containing more and more livestock-based meat, such as cattle. Even if all non-food system emissions were instantly eradicated, emissions from the food system alone would probably drive global warming over 1.5 °C if present trends for food consumption and production continue.

Fertilizers containing nitrogen: According to University of Cambridge's article (2023) out of all greenhouse gas emissions, fertilizers are in charge of about five percent. Fertilizer emissions are mostly caused by production operations, accounting for one third of emissions, whereas two thirds occur when the fertilizer is distributed on fields. The article states that manure and synthetic fertilizers release more carbon dioxide into the atmosphere annually (2.6 gigatons) than all of the world's shipping and aircraft combined.

Fluorinated gases: European Commission (n.d.-c) states that fluorinated gases are artificial gases that are employed in both industrial and daily items. Since fluorinated gases do not destroy the ozone layer in the atmosphere, they are frequently utilized as alternatives

to chemicals that wear out the ozone layer. Nevertheless, fluorinated gases are potent greenhouse gases that can cause up to 25 000 times more global warming than CO_2. In comparison to other greenhouse gases which decreased at that time, emissions of fluorinated gases rose significantly by doubling from 1990 to 2014. Due to legislations towards fluorinated gases by European Union, emissions have been reducing from 2015 onwards.

ClimateTrade (2023) lists other industries contributing to major CO_2 emissions such as food retail, construction, and transportation. The operations of markets, supermarkets, and dining establishments that sell food to customers, food, and plastic waste account for the majority of food retails emissions. For example, in the EU the yearly amount of wasted food is 57 million tons, which corresponds to 127 kilograms per resident. Building operations and construction activities, when combined with the extraction and transportation of building materials, are estimated to account for 40% of worldwide emissions. Transportation contributes around one-fifth of greenhouse gas emissions worldwide. About 40% of these are related to the movement of goods, with passenger travel, primarily air travel, making up the remaining 60%.

Teter and Voswinkel (2023) write that in year 2022, which was still a time of recuperation for the industry sectors, CO_2 emissions caused by transportation sector grew over 250 Mt CO_2, hitting nearly the limit of 8 Gt CO_2, indicating a rise of 3% compared to the year 2021. This meant that the emissions rose to the levels of 2019, biggest contributor to the rise being aviation, mainly due to the industry's rebound from the Covid-19 pandemic. On comparison, over 10 million electric vehicles were sold in the year 2022, which have mitigated some of the emissions on their own part. Yet, when compared to the year 2019, emissions were still lower, due to the prolonged effects of the pandemic towards commercial flights.

According to Teter and Voswinkel (2023), CO_2 emissions of transportation industry needs to drop approximately 25% down close to 6 Gt by 2030, so that the industry would be on track with the Net Zero Emissions Scenario. The decrease should happen, despite the expected increase in demand. Achieving the decrease depends on many different elements. Such factors are laws to promote the switch to less carbon-intensive modes of transportation, scale-up and commercialization of low-emission fuels, developing more energy-saving methods, and finally, speeding up the electrification of all road vehicles.

2.3 Actions taken towards CO_2 emissions

The Union of Concerned Scientists (n.d.) writes that one of the most difficult issues that humanity has ever faced is climate change. Numerous species and ecosystems, hundreds of millions of lives, the health and sustainability of the economy, and the planet's ability to support human habitation in the future are all at risk. However, many actions have already been taken to fight against climate change.

According to the UCS (n.d.) there are many propositions different options, such as cutting emissions, building resilience, fighting disinformation, and removing CO_2 to fight climate change. With reducing emissions, the aim is to reach so called "net zero" by year 2050 at the latest, meaning balancing the carbon dioxide emissions so the amount of released carbon dioxide than the amount of which is taken out from the atmosphere. This requires setting a price for carbon through federal policy, which has already been noted in the Paris Agreement. Although it's not the comprehensive emission reduction pact, it's the best one so far.

The UCS (n.d.) states that constituting climate resilience is important since unlike reducing carbon, it is a faster way to prevent the effects of climate change. Adapting to the upcoming climate conditions by preventing growth in high-risk locations, making plans for a shortage of water, and creating communities and cities that are more resilient are actions that are vital for short-term adaptation. Mitigating disinformation considering climate change is also an important part of the fight, and ultimately when talking about removing CO_2, reforestation and afforestation are the most effective ways to actively remove CO_2 from the atmosphere. Other effective ways are for example carbon capture and storage and direct air capture.

2.3.1 The Brundtland report (Our Common Future)

According to Jarvie (2016), the Brundtland report is a document published by the World Commission on Environment and Development that explained how sustainable development might be accomplished and presented the idea. The World Conference on Environmental Development, led by the then Prime Minister of Norway, Gro Harlem Brundtland and supported by the UN, looked into the causes of environmental decline, how social

equity, economic growth, and environmental issues are related, and created policy solutions that addressed all three.

Roome (2014) writes that The Brundtland report states that environmental constraints and resources were not given enough consideration in development choices. According to the report's analysis, if emerging countries of the world adopted the same course for development as those in North America and Europe, there would be a social and environmental crisis.

The World Commission on Environment and Development (1987, p. 70) stated that usage of non-renewable resources to generate foreign exchange is the primary connection between sustainable development and commerce. Developing nations must balance minimizing harm to the environmental resource base that underpins their growth with using commodities as exports to overcome foreign exchange limits on expansion.

Roome (2014) writes that the report remarks that industrialized nations needed to lessen their demands on resources and their ecological footprints in order to prevent a crisis, while emerging nations needed to discover new avenues for development.

According to the WCED (1987, p. 70), there exist further connections between trade and sustainable development. For instance, developing countries may find it more difficult to diversify their economies beyond conventional commodities if protectionism raises obstacles to manufactured exports. Furthermore, the misuse of some resources as well as the production of potentially damaging manufactured items can lead to unsustainable development.

Roome (2014) writes that the concept of sustainable development proposed by the Brundtland's report can assist us in addressing the issues at hand. He lists social development as the essence of development, environmental limits or carrying capacity of the planet, and requirement of sustainable development at various scales, for the key points of the development process.

Roome (2014) and the WCED (1987, p. 49) point out that it may seem excessive to emphasize the fulfilment of human wants and ambitions as the primary goal of productive

activity in the context of sustainable development. Frequently, poverty makes it impossible for individuals to meet their basic needs for survival and well-being, even in the presence of products and services. The demands of people who are not impoverished, however, can have a significant negative impact on the environment. Meeting the needs and ambitions of the world's growing developing population is the main development problem. Through generating income and indirectly enhancing health and education, economic development promotes social development, which then enhances the state of a community or society's finances, health, and education.

Roome (2014) explains that sustainable development is a specific kind of social growth that takes place within the planet's environmental bounds or carrying capacity. Therefore, understanding the carrying capacity of a place as well as the effects of human activity is crucial.

The WCED (1987, p. 52) state that since the absence of alternatives puts further strain on resources, the Earth's natural resource base has to be preserved and expanded upon if requirements are to be satisfied in a sustainable manner. The existing high levels of consumption in the industrial world, the increases in consumption required in emerging nations to reach minimal standards, and the anticipated population rise will require significant changes in policy. The argument for protecting the environment shouldn't end with development objectives, but a component of everyone's moral duty to future generations and other living things.

Both Roome (2014) and the WCED (1987, pp. 46–47) propose that sustainable development is required at all levels of society, local, national, regional, and worldwide. The ecological, economic, social, and institutional characteristics of a place determine what is sustainable as well. Since they are the places where the relationships between economic growth, poverty alleviation, and environmental circumstances work most directly, growth must be restored in emerging nations. However, because developing countries are a part of the global economy, their prospects are also influenced by the rates and trends of growth in developed nations. The industrialized world's medium-term growth prospects were estimated by international financial institutions to be between 3% and 4%, which was the bare minimum for these nations to contribute to global economic expansion. If

industrialized countries could maintain those recent changes in the composition of their development toward less material-, and energy-intensive industries and the improvement of their material-, and energy-use efficiency, such growth rates could have been ecologically sustainable. As Roome (2014) concludes by saying that although the Brundtland report cannot directly advise us all, humanity may still gain from its observations and recommendations.

2.3.2 Kyoto Protocol

Wijen et al. (2005, pp. 595–596) wrote about the Kyoto Protocol, settled in 1997, as one of the most significant global environmental agreements to bespeak about human-caused climate change. Position which originated from the remark about climate change standing for an almost insolvable climate crisis for humanity, many sides' high stakes on the matter, the disputed characteristics of the agreement itself, and the visibility that the agreement has gained from the media.

The United Nations Framework Convention on Climate Change (n.d.) add that due to the complicated nature of the agreement's ratifications, it came into effect on 16 February 2005, consisting of 192 different members. The Protocol exercised the frameworks of UNFCCC, as the convention just required the nations to implement mitigation policies and actions and to submit periodic reports.

Wijen et al. (2005, p. 600) tell that the full scaled goal of the agreement was to decrease human-caused GHG concentrations by an average of 5.2% during 2008–2012, and the reduction was compared with the concentrations of the given base year, 1990. The target was mainly the net greenhouse impact, as in compiled emissions of six different GHGs, with high importance on CO_2, minus the absorption of these gases by sinks, mainly forests.

According to Climate Change Connection (2016) the Protocol divided governments into two categories, developed nations, or Annex 1 countries, and developing nations, known as Non-Annex 1 countries. Members of Annex 1 were required to submit an annual greenhouse gas inventory and have accepted obligations to reduce greenhouse gas emissions,

while members of Non-Annex were exempt from these obligations but were still eligible to participate in the Clean Development Mechanism. Ultimately, the Protocol came to an end in 2015 when the Paris Agreement superseded it.

The UNFCCC (n.d.) tells that the Protocol's annex-based structure and guiding principles served as the foundation for the agreement, since it acknowledged that industrialized nations hold the major blame for the current high levels of greenhouse gas emissions in the atmosphere, it only binds them and imposes a greater burden on them in accordance with the idea of "common but differentiated responsibility and respective capacities".

Wijen et al. (2005, p. 600) point out that the goals could've been achieved with bargaining power, as substantial and important parties received passing grades. One example of this exploitation is Russia, whose negligence of manufacturing and economic collapse would have been valid reasons to demand heavy decrease on GHG emissions, succeeded in negotiating for compensations.

UNFCCC (n.d.) states that the creation of flexible market mechanisms based on the exchange of emission permits was a key component of the Kyoto Protocol, as per the Protocol, nations were required to largely utilize domestic methods to achieve their aims. The Protocol also provided them with three market-based mechanisms, International Emissions Trading, Joint Implementation (JI), and Clean Development Mechanism (CDM), which helped them to reach their goals.

According to Climate Change Connection (2016), International Emissions Trading, or carbon trading, means that one country which has surpassed their emission cap could buy the non-used emission room of another country. Joint Implementation is when industrialized nations under the Kyoto Protocol could satisfy a portion of their mandatory reductions in greenhouse gas emissions by funding initiatives that lower emissions in other developed nations, and similarly, CDM is an arrangement that permitted industrialized nations that had committed to reducing their greenhouse gas emissions to engage in projects that lower emissions in developing nations rather of incurring more costly emission reductions in their own nations.

Wijen et al. (2005, p. 601) remark that aside from aid provided through Global Environmental Fund for developing nations, the protocol itself did not have any financial guidelines for the purpose of allocating funding as implementation.

The Kyoto Protocol was the most comprehensive environmental pact ever ratified (Climate Change Connection, 2016). The agreement demonstrated the willingness of the global community to recognize and combat climate change. Yet, as Wijen et al. (2005, p. 617) remark, despite the agreement's strong aims, it was insufficient to limit emissions generated by humans, while rifts between members also began to grow over time. Nevertheless, they point out (p. 618), that recession does not bar parties from taking technical action in response to climate change, nor does faithfulness warrant advancement in this field.

2.3.3 Net Zero Emissions by 2050 Scenario (NZE)

According to Net Zero Climate (n.d.) and the United Nations (n.d.), condition known as net zero occurs when greenhouse gas emissions let into the atmosphere are matched by their removal, and any emissions that remain are reabsorbed by the atmosphere, for example, by forests and seas.

The International Energy Agency (n.d.) writes that important sustainable development goals pertaining to energy are met under the Net Zero Emissions Scenario, NZE for short, including significant improvements in air quality and universal energy access by 2030. It is compatible, with keeping the increase in global temperature to 1.5 °C, by at least 50% chance.

UN (n.d.) remarks that the research indisputably demonstrates that the rise in global temperature must be limited to 1.5 °C above pre-industrial levels in order to prevent the worst effects of climate change and maintain a habitable world and since emissions keep rising, the Earth is currently 1.1 °C warmer than it was in the late 1800s. In accordance with the Paris Agreement, emissions must be cut by 45% by 2030 and reach net zero by 2050 in order to limit global warming to no more than 1.5 °C.

Net Zero Climate (n.d.) adds that the concept of net zero is significant because it denotes the point at which global warming ends, at least for CO_2. As the Paris Agreement emphasizes, in the second half of this century, governments must strike a balance between human emissions by sources and reductions of greenhouse gases by sinks. Since it will be extremely difficult to reduce all emissions to zero on the required period, the "net" in net zero is significant. Nations will probably need to increase removals in addition to making significant and broad reductions in emissions. Net zero needs to be persistent in order to be successful, because when a greenhouse gas is permanently removed from the atmosphere, it means that it won't eventually re-enter it through natural processes like forest degradation or ineffective carbon storage.

According to IEA (n.d.) the Scenario outlines a plan for the global energy industry to employ a wide range of renewable energy technologies to achieve net zero CO_2 emissions by 2050 without the need for land-use offsets. Decisions regarding the use of technology that are influenced by policy choices, market conditions, costs, technological maturity, and available infrastructure.

IEA (n.d.) adds that the NZE Scenario acknowledges that equitable and efficient international cooperation is necessary to achieve net zero CO_2 emissions from the energy industry by 2050, though, there is a very limited route to achieve net zero emissions by 2050.

According to IEA (n.d.) and Net Zero Climate (n.d.) to be able to achieve the intended results, all nations must participate in the Scenario, industrialized nations must take the lead and attain net zero emissions earlier than emerging market and developing economies. Nowadays, the goal of achieving net-zero emissions is being embraced by an increasing number of nations, towns, companies, and other organizations. More than 140 nations have established a net-zero objective, which accounts for over 88% of global emissions, including the top polluters, China, USA, India, and the EU. Huge numbers of businesses, cities, educational institutions, and financial institutions have also committed to taking decisive, quick action to cut global emissions in half by 2030.

According to UN (n.d.), in March 2022, a High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities was set up by UN Secretary-General António

Guterres. The Expert Group's proposals were delivered on November 8, 2022, during the 27th Conference of the Parties of the UNFCCC, or COP27 for short.

Yet, as UN (n.d.) points out, government commitments made thus far are far from sufficient as the current national climate policies of all parties of the Paris Agreement would result in a significant rise in global greenhouse gas emissions of over 9% by 2030 when compared to 2010 levels. In order to reach net zero, all governments, primarily the largest emitters, must dramatically increase their nationally decided contributions and take decisive action right once to start cutting emissions.

IEA (n.d.) emphasizes that the NZE Scenario is just one of the many roads, not the chosen path to net zero emissions, as there are other ways to reach net zero CO_2 emissions globally by 2050 and numerous uncertainties that might affect any of those paths.

2.4 Tariffs and why are they collected?

According to the National Geographic Society (2023) and Radcliffe (2024) tariffs, also known as a customs duty since the terms are frequently used synonymously, are a form of trade restriction that nations adopt to increase the relative cost of imported goods over domestically produced goods and are usually imposed as taxes or charges on imports, which are then finally transferred to final consumers.

Radcliffe (2024) adds that tariffs are employed by developed nations with established sectors, but they are also frequently established for the safety of emerging industries and their economies. Five biggest reasons for usage of tariffs are, domestic employment protection, developing industries, consumer protection, reprisal, and national security.

The National Geographic Society (2023) and Radcliffe (2024) point out that tariffs have varying benefits. Since they establish the policies and bear the financial burden, importing nations stand to gain the most from tariffs. The main advantage of tariffs is that they generate income from imported products and services. Since import costs are artificially inflated, domestic sectors also gain from less competition. Over time, the impact of trade barriers and tariffs on consumers, businesses, and the government changes. In the near term,

increased costs for items may cause firms and individual customers to spend less, leading to certain firms benefitting during this time, and the government gaining more money from tariffs.

Radcliffe (2024) writes that over time, a lack of competition might cause these enterprises to become less efficient, and the arrival of equivalent products could cause them to lose money. The long-term impact of subsidies on the government is a rise in the need for public services since rising costs, particularly for food, reduce disposable income.

The National Geographic Society (2023) adds that tariffs have the potential to escalate trade disputes between nations and worsen pre-existing tensions between governments, resulting in both political and economic repercussions. They conclude that tariffs influence global markets and relationships on a daily basis, for both good and bad, and the public should be aware that tariff talks are taking place behind the scenes and that they continuously influence people's consumption, even if they are invisible to them and affect everything they consume.

2.4.1 General Agreement on Tariffs and Trade (GATT)

According to National Geographic Society (2023) the General Agreement on Tariffs and Trades, established in 1948, was one of the first initiatives to control global commerce. Its goals were to lower tariffs, establish international standards, and facilitate trade by opening up talks.

According to the editors of *Encyclopaedia Britannica* (2024), upon its conclusion by 23 nations in Geneva in 1947, GATT was regarded as a provisional agreement until a successor from United Nations was established, yet such an agency did not materialize, causing GATT to expand upon in several subsequent discussions.

Editors of Encyclopaedia Britannica (2024) and Majaski (2023) state that the key principle of the GATT was trade without discrimination, which required all members to open their markets equally to one another. Each GATT signatory was expected to be treated equally

with the others. This is referred to as the "most-favoured-nation principle" and nowadays it is also a feature of the World Trade Organization (WTO).

Majaski (2023) writes that when determining tariffs, the majority of countries used the most-favoured-nation principle, which essentially replaced quotas. In response, tariffs, which are still a trade barrier but are preferable to quotas, were gradually reduced in several rounds of subsequent discussions.

Editors of *Encyclopaedia Britannica* (2024) note that additional general guidelines included standardized customs laws and each signatory country's duty to seek tariff reductions at another's request. As an escape clause, contracting nations might change agreements if trade concessions caused disproportionate losses for their local producers.

According to editors of *Encyclopaedia Britannica* (2024) and Majaski (2023), as a result, it turned out to be the most successful tool for liberalizing global commerce, and it significantly contributed to the enormous growth of global trade in the second half of the 20th century. In the long run, modifications of the agreement ultimately resulted in the WTO being established in 1995, absorbing the GATT implementation organization. By that time, 125 countries had ratified its agreements, addressing over 90% of world commerce.

2.4.2 Carbon Border Adjustment Mechanism (CBAM)

According to the European Commission (n.d.-a) and Finnish Customs (n.d.), Carbon Border Adjustment Mechanism, or CBAM, is the newest tool of the European Union to fight carbon leakage. Carbon leakage happens when EU-based businesses relocate their carbon-intensive manufacturing to nations with laxer climate regulations than the EU, or when EU products are replaced by more carbon-intensive imports. CBAM is adapted with the goods from outside European Union that are brought to European Union.

Finnish Customs (n.d.) points out that even though terms such as "carbon duty" and "carbon tax" were used in public discussion, these are not applicable, since CBAM is a paid certificate rather than a duty or a tax.

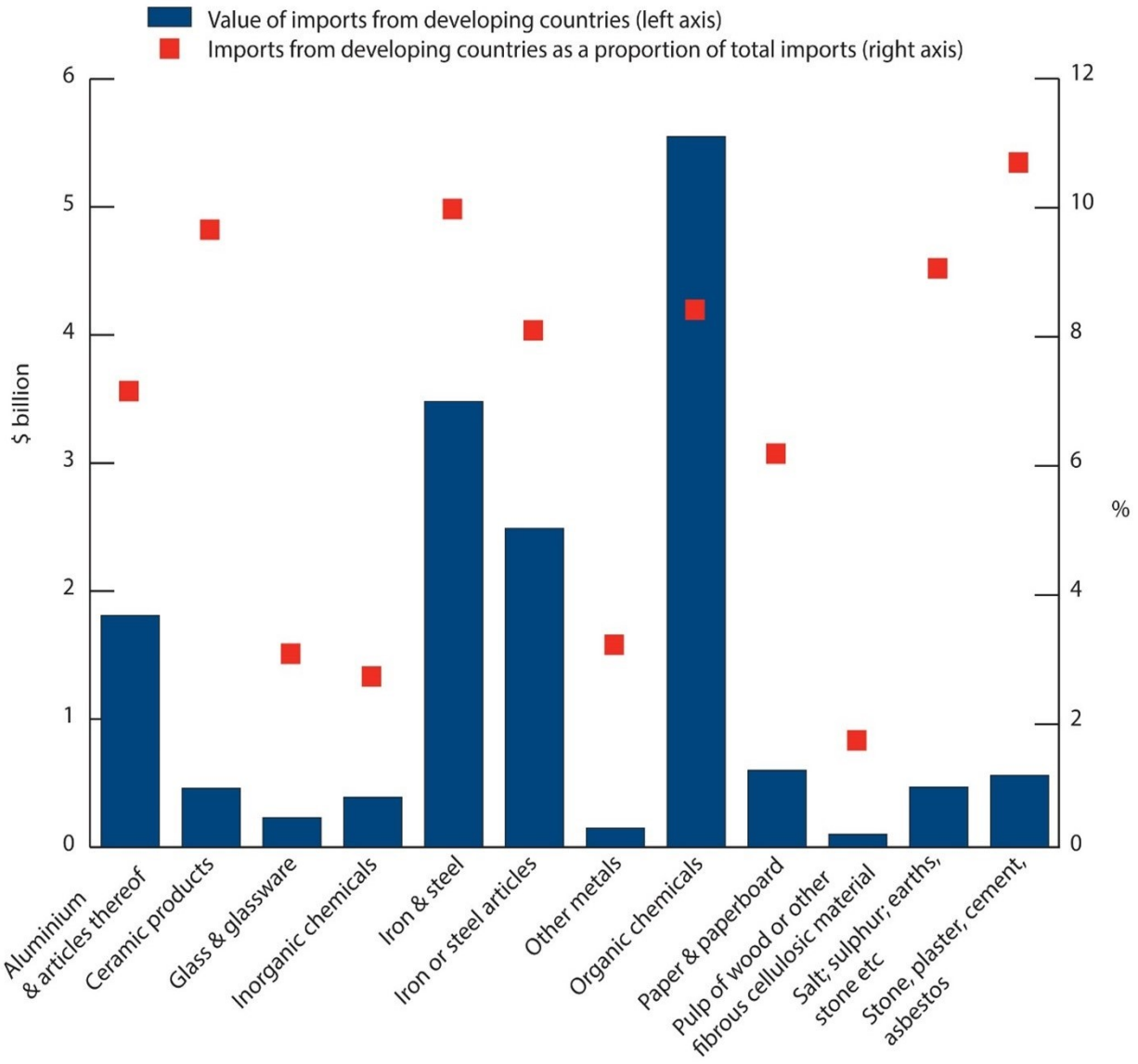


Figure 3. EU imports of carbon-intensive products from developing countries, 2019 (Lowe, n.d.).

The graph above shows the value and amount of carbon-intensive imports from developing countries to EU in 2019. Lowe (n.d.) argues that on account of its overall imports, the EU wouldn't face significant costs by exempting developing nations from the CBAM. Of all the sectors covered, only imports of stone, plaster, and cement from developing nations make up more than 10% of total imports, although other sectors, like iron and steel, are nearly as large.

Ministry of Economic Affairs and Employment of Finland (n.d.-a) notes that CBAM is introduced with more precise products, considering iron, steel, aluminium, cement, fertilizers, hydrogen, and imported electricity.

According to Finnish Customs (n.d.) and Ministry of Economic Affairs and Employment of Finland (n.d.-a), the aim of CBAM is to allocate prices of the imports to better represent their carbon content, while guiding and urging foreign manufacturers, developing countries, and distributors inside EU towards reducing emissions. Before, carbon leakage inside the European Union had been fought with free allocation of emission rights in sectors prone to carbon leakage.

Finnish Customs (n.d.) and Ministry of Economic Affairs and Employment of Finland (n.d.-a) add that this allocation is part of the EU's own Emission Trading Scheme (ETS), which is now gradually renounced while simultaneously CBAM is taken into use from the beginning of the year 2026. CBAM was put to use with a transition period on 1 October 2023.

The European Commission (n.d.-a) and The Ministry of Economic Affairs and Employment of Finland (n.d.-a) states that a cautious, predictable, and appropriate transition for public authorities and enterprises, both EU and non-EU, will be made possible by the phased implementation of CBAM over time. There will be two phases to the introduction of CBAM. Importers of the goods covered by CBAM are only needed to disclose information on the product's emission content for both direct and indirect emissions during the first phase, which runs from October 1, 2023, to December 31, 2025.

The Ministry of Economic Affairs and Employment of Finland (n.d.-a) adds that the duty of acquiring emission data and any potential carbon price paid in the place of origin remains with importers. Reports are due quarterly, and the importer will be charged an error fee if they are not submitted. Importers must submit the first CBAM report by January 31, 2024.

The European Commission (n.d.-a) states that as the permanent system kicks in on January 1, 2026, importers will have to report annually how much was imported into the EU the year before, together with the amount of embedded greenhouse gas emissions. After that, they will turn in the matching number of CBAM certificates. The weekly average auction price of EU ETS permits, stated in euros per tonne of CO_2 emitted, will determine the certificate's price, while throughout the years 2026–2034, the EU ETS free allocation phase-out will coincide with the CBAM phase-in.

2.5 CSR responsibility and carbon footprint calculations

Lesiewska (n.d.) writes in her article that reasons to calculate carbon footprint vary for different institutions, both public and private. Among these are the fact that the carbon footprint is a significant predictor of market competitiveness and, more importantly, that businesses will soon be required to report indirectly on environmental issues due to the plenty of new laws and regulations being introduced.

According to Lesiewska (n.d.), other reasons include no greenwashing which simply means openness in environmental advocacy efforts, and management, as making choices is facilitated by knowing where in the value chain the majority of emissions are produced. In addition, regarding customer needs is a key reason as the consumer's increased awareness influences their choice of alternatives.

According to Carlson (n.d.), Corporate Sustainability Reporting, CSR for short, is intended to show the company's many stakeholders, including workers, investors, suppliers, and communities, how it uses data to track progress toward sustainable development targets.

Carlson (n.d.) adds that consumers, particularly those who wish to connect their beliefs with their financial decisions, are increasingly demanding environmental, social, and governance (ESG) transparency, which includes these yearly reports. Readers should be aware of what to look for because these reports include a lot of information.

Silvola (2021) writes that during 2021 in Finland, a couple of hundred different companies published their CSR report, while approximately forty companies verified their data with an external certification authority.

Silvola (2021) emphasizes that Finnish companies reported about their CSR fairly well, and on a global scale, Finnish public companies were already the international leaders in the scope of reporting as well. Yet, in comparison, on an international scale the certification of CSR information was less than in comparison countries. Need for certifications grow when international effects come to play, as in various ESG classifications, companies get extra points for certification, and listed companies need to do well in comparisons in order to attract investors and financiers.

2.5.1 CSR reporting

Cote (2021) writes that companies utilize reports on corporate social responsibility to convey CSR initiatives and their effects on the society and environment, both internally and externally. Environmental, ethical, philanthropic, and economic are the four areas into which an organization's CRS activities may be divided.

According to The Ministry of Economic Affairs and Employment of Finland (n.d.-b), the Accounting Act amendment approved on December 29, 2016, mandates that specific businesses provide corporate social responsibility reports. Large businesses that are significant to the public interest, such as listed firms, financial institutions, and insurance providers, and whose average staff count surpasses 500 throughout the accounting period, are required to report. Furthermore, the financial statement must be 20 million euros or more than 40 million euros in turnover for the firm.

The Ministry of Economic Affairs and Employment of Finland (n.d.-b) states that the law, which is based on an EU directive, requires the businesses to provide reports on their own policies relating to human rights, the environment, labor and social concerns, and the battle against bribery and corruption. In addition, the firms are required to provide a brief overview of their own business strategy and disclose any risks associated with their respective business lines and management.

Liljeström (2023a) adds that the new Corporate Sustainability Reporting Directive (CSRD) aims to standardize the contents of the sustainability reports, and to increase their reliability. Based on this, evaluating organization′s responsibility and the impact of non-financial information on the business itself is easier for decision-makers, investors, consumers, and other stakeholders.

According to Liljeström (2023a) CSRD fulfills many already existing regulations and principles, such as the UN′s targets of sustainable development. The directive also brings demands for the content and the trustworthiness of the data provided in the CSR reports. Following the reporting requirements demands reporting according to the European Sustainability Reporting Standards (ESRS).

According to Liljeström (2023b), ESRS is a new sustainable development reporting standard for organizations operating, as well as the ones with business activity in the EU. Its aim is to clear reporting requirements considering sustainability by handing out a frame which every organization under CSRD should follow. ESRS consists of twelve standards which are divided into two groups, and which help the organization to report their ESG actions.

Liljeström (2023b) writes that group A, called Cross-cutting standards, consists of two standards, General Requirements and General Disclosure. Cross-cutting standards are multidisciplinary standards, and they are applied in all standards.

Liljeström (2023b) continues to write that group B, called Topical standards, consists of the ten other standards, Climate Change, Pollution, Water and Marine Resources, Biodiversity and Ecosystems, Circular Economy, Own Workforce, Workers in the Value Chain, Affected Communities, Consumers and End-users, and Business Conduct. Topical standards give a comprehensive view of how the actions of an organization effect their society and environment.

According to The Ministry of Economic Affairs and Employment of Finland (n.d.-b), an organization can withdraw information from their CSR report considering the negotiations, the events, or the topics that came up during them, if the company reasonably believes that disclosing the information would seriously damage their ability to conduct business. In this instance, nonetheless, it is a need that the missing data does not impede an accurate and fair comprehension of the course and outcomes of the business's activities as well as the implications of the financial situation.

Cote (2021) concludes that a corporation can inform internal and external stakeholders about its goals, initiatives, and results through CSR reports. The publication of a company's CSR report serves as both a marketing and public relations event and a communication tool if it has been proactive and effective in its CSR endeavors. Companies can utilize these reports to showcase their accomplishments and integrate social responsibility into their corporate identity, particularly in light of the absence of obligatory rules.

2.5.2 Carbon footprint calculation

According to Eckley Selin (2024), carbon footprint is the quantity of CO_2 emissions connected to every action taken by an individual or another entity, such as buildings, companies, or a country. It covers both the direct emissions that come from burning fossil fuels for transportation, heating, and manufacturing as well as the emissions needed to generate the energy needed to power the goods and services that are consumed.

Eckley Selin (2024) adds that carbon footprint deviates from reported per capita emissions of a nation, for example those reported under the UNFCCC. Carbon footprints concentrate on the greenhouse gas emissions related to consumption rather than those related to production. In general, they account for emissions related to international transport and shipping, which are not included in typical national inventories, and they also cover emissions linked with items that are imported into a country but are manufactured elsewhere.

According to Eckley Selin (2024), various carbon footprint calculators exist for individual people, companies, and other institutions. Greenhouse Gas Protocol by The World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), as well as ISO 14064, a standard of International Organization for Standardization, are two frequently utilized methods for determining an organization's carbon footprint.

NGS Finland (2023) writes that GHG Protocol is in nowadays established in a widespread use, and it is utilized in CSR reports according to the ESRS standards. GHG Protocol classifies emissions into three emission classes, so called ″scopes″. The scopes are divided in accordance to how close to the company itself the emissions are generated and if they themselves can influence them. Scope 1 includes the company′s direct emissions, Scope 2 includes the indirect emissions of energy consumption, and Scope 3 includes all the other indirect emissions generated by the company′s whole supply chain.

According to Tarleton (2023) company′s direct emissions are for example direct emissions coming from sources that a company owns or controls, such as refrigerant losses and fuel and vehicle utilization. Indirect emissions from energy consumption are for example emissions resulting from the purchase of heat, steam, electricity, or air conditioning, and other

indirect emissions related to a range of actions taking place outside of a company's direct control and occurring across its value chain.

NGS Finland (2023) points out that typically the majority of company's carbon footprint, up to 80–90%, comes from Scope 3 emissions. As an exception, companies that use a significant amount of fuel in their own operations, generating Scope 1 emissions.

According to NGS Finland (2023), generally speaking, companies calculate and report their emissions using two separate GHG standards, the Corporate Standard, which is used for corporate emissions, and the Corporate Value Chain Standard, which is used for Scope 3 emissions and is complementary to the Corporate Standard. Furthermore, firms can utilize a project-specific standard called Project Protocol to report the emission impacts of individual projects, and a product-specific standard called Product Standard to report the effects across the product's life cycle.

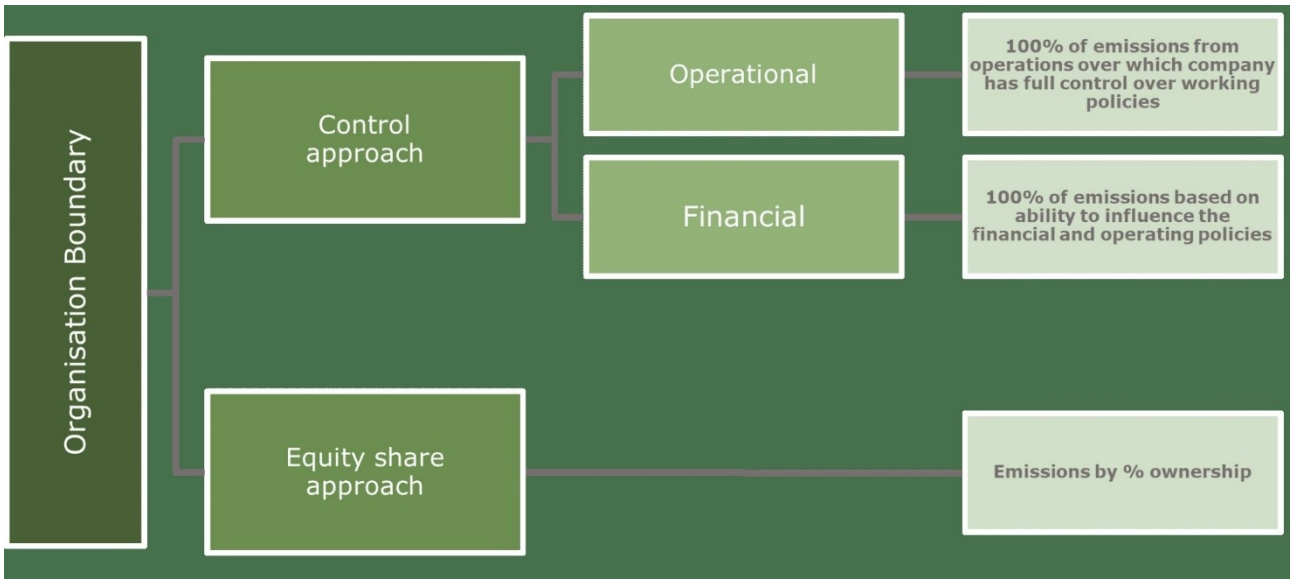


Figure 4. Company's different calculation approaches (Tarleton, 2023).

According to Tarleton (2023), when a company begins their carbon footprint calculation, they need to settle what operations should be covered by the scope of their carbon footprint. Establishing an organizational barrier involves a company choosing and using a methodical way to combine its greenhouse gas emissions. The figure above shows the division of approaches.

According to Tarleton (2023), emission data can be according to control approach or equity share. Reporting data according to control approach means all the emissions coming from the company's own controlled operations, and it can be divided into two different sections, financial and operational control. Financial control means that a company is able to direct the activity's operating and financial policies in order to earn financial rewards. Operational control is whether the company or one of its subsidiaries is fully capable of carrying out its operational policies inside the company. Equity share represents financial gain. Companies report their emissions from operations based on their equity stake in such activities under this method.

Figure 5. Typical carbon footprint calculation formula (Tarleton, 2023).

The figure above shows a typical carbon footprint calculation formula. According to Tarleton (2023), activity data is a numerical representation of the actions performed inside the company. This includes energy consumption, which covers the fuels and power that a company uses, and vehicle use as companies must report emissions from company-owned vehicles. It is important to note that in this case, emissions from vehicles that are not owned by the corporation should be included in Scope 3's value-chain emissions. This information may come from direct fuel use or mileage claims. In addition, fugitive gases which are emissions brought on by greenhouse gas leaks from the machinery or operations.

Tarleton (2023) writes that an operation's or activity's emissions intensity is reflected in its emission factor. To connect each of a company's operations to the corresponding emissions, they must choose an appropriate emission factor. Companies can use a variety of databases to determine the intensity and ensuing emissions of their operations. Some are free to use and available to the public, while others need a licensing charge.

3 RESEARCH ENVIRONMENT

This part discusses about the research environment of the thesis work, examining the current global and domestic state of the branch of business and the company itself.

3.1 Branch of business

According to Finnish Commerce Federation (n.d.-a) wholesale benefits retailers, other businesses, and public administrations. Over time, wholesale has expanded the range of services it offers, and imports are a significant component of wholesale as well. Although wholesale generates far more income than retail, there are fewer workers and businesses overall in the former.

During the year 2023, comparing July to June, the seasonally adjusted turnover of the total trade rose (Statistics Finland, 2023). As the graph below shows, biggest major component of the industry, wholesale, continued to see a sharp decline in turnover adjusted for working days as compared to the prior year.

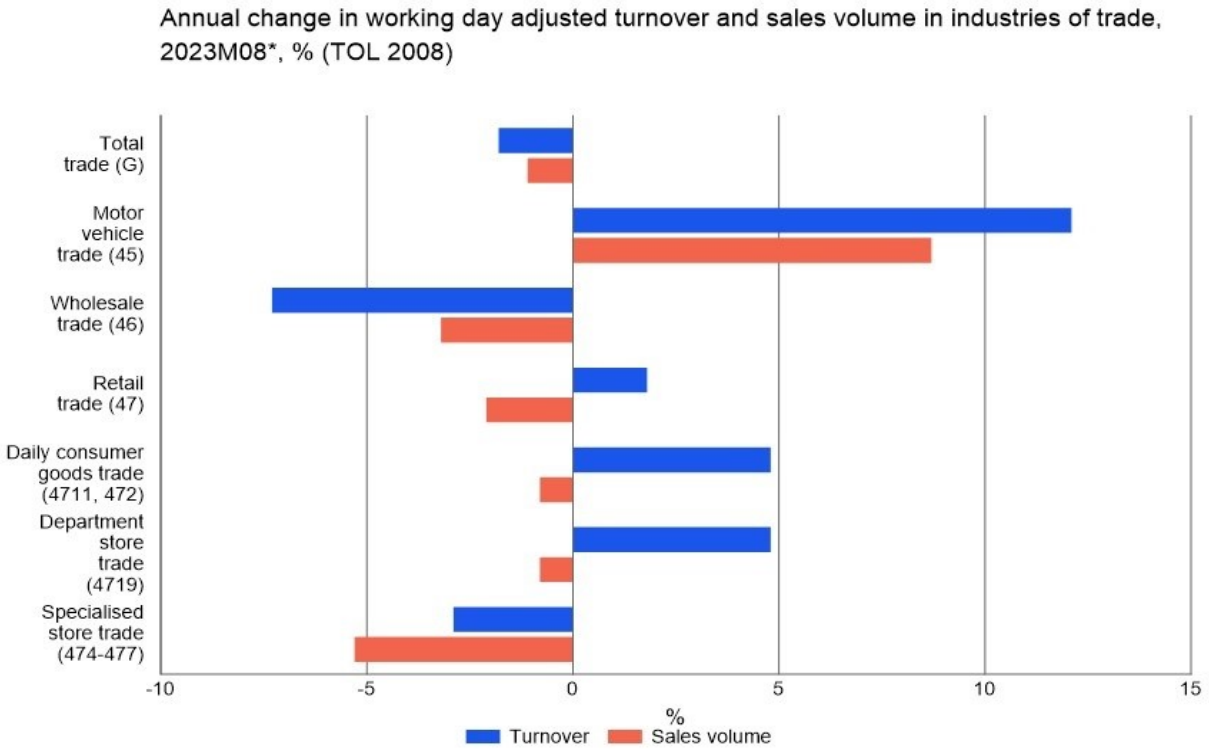


Figure 6. Annual change in working day adjusted turnover and sales volume in industries of trade, % (Statistics Finland, 2023).

According to Finnish Commerce Federation (n.d.-b), the primary business divisions of wholesale trade are wholesale trade in daily consumer goods, wholesale trade in utilities and consumer products, wholesale trade in agricultural products, wholesale trade in construction, wholesale trade in information and communications technology, and wholesale trade in fuel These divisions are based on products, operations, and partners.

The wholesale sector employs 10.6 million people in Europe, with over a million diverse businesses contributing significantly to the continent's economy (EuroCommerce, 2020, pp. 8–12). This implies 5% of all jobs inside the European Union, where value-added from wholesale accounts for 660 billion euros. As an industry, it is highly diverse and flexible. Microbusinesses, (companies with ten or less workers), make up 91% of the EU's wholesale industry, while SMEs, (ten to 250 employees), account for 9% of all EU wholesale businesses. Both kinds of businesses are adept at adjusting to shifting demands from customers, for instance, and as a result, their supply chains are both incredibly sophisticated and specialized and efficient and adaptable.

Legislation imposing a progressive tax on high-carbon imports depending on the amount of CO_2 released during production has also been adopted by the European Parliament (Armstrong, 2023).

The EU’s economy depends heavily on import, and it also contains a lot of complex information about the movement of products and the laws that importers must follow from the EU (EuroCommerce, 2020, p. 15). Additionally, import includes the distribution of commodities within EU borders. Since certain items are made outside of the EU, the importer is legally obligated to assume full responsibility for the goods’ origin and quality. These processes can be highly problematic for SMEs in the EU.

Armstrong (2023) writes that in addition to counteract the advantages of EU firms moving to areas with laxer environmental regulations, the tax seeks to exert pressure on nations outside of the EU to impose a price on CO_2 emissions. EU generates 1.5 times the global average of carbon dioxide per person when accounting for population size. However, these numbers do not include emissions related to imported products and services, the majority of which are produced in industrial nations that still largely rely on fossil fuels,

adding to their carbon footprint. For example, in 2023 the EU had a larger per capita carbon footprint than China, with 11 tons of CO_2 equivalent annually compared to 8 when local consumption of goods made outside is considered. The graph below visualizes the carbon footprint of import to the EU in 2018.

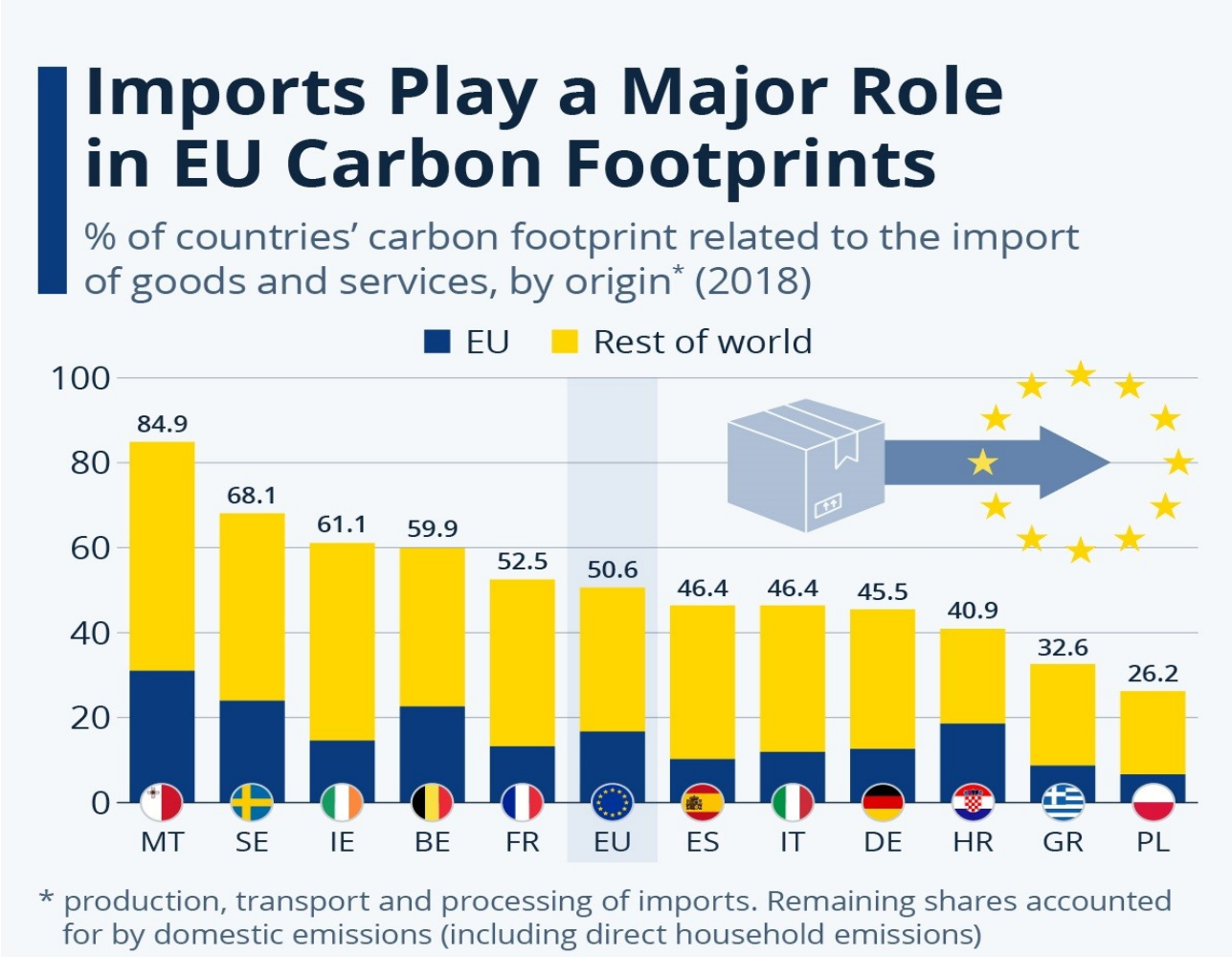


Figure 7. Carbon footprint caused by imports in 2018, % (Armstrong, 2023).

Two significant obstacles facing wholesale in the EU are movability and sustainability (EuroCommerce, 2020, p. 19–20). The wholesale trade may help society progress toward a low-carbon and circular economy by encouraging energy efficiency and making use of renewable energy sources. Distributors may also influence the shift to more sustainable living by emphasizing packaging improvement, sourcing, trash management, and building design. Promoting more fuel-efficient and environmentally friendly driving, as well as logistical optimization and the use of local partners to designate better routes in order to reduce traffic are also actions taken by the wholesale industry in Europe.

3.2 The company

According to their website (n.d.) HtF Group Ltd. is a Finnish wholesale company, founded in 2016, and located in South Ostrobothnia, head office located in Seinäjoki. Under the concern operates four subsidiaries, and between them operate around seventy employees and staff members. The company both imports and produces goods and services for their customers which are mainly Finnish furniture industry companies, or smaller carpentry shops.

Two of the concern's subsidiaries operate on the wholesale of furniture fittings. Helatukku Finland, which is a wholesaler that supplies wide scale of clients with furnishings and building supplies (HtF Group co., n.d.). Customers of Helatukku include, among others, kitchen and fixed furniture producers, carpenters, hardware and interior design retailers, and the furniture sector.

The other subsidiary, Suomen Helakeskus, is specialized in the import of fitting accessories (HtF Group Ltd., n.d.). The company holds a supply of fitting accessories, such as hinges, pulls, interior panels, drawers, rails, sliding doors, and kitchen and bathroom sinks. Their customers originate mainly from the furniture, bathroom, and kitchen industries.

In addition, HtF Group Ltd. also produces lights, and their accessories, with service and digital concepts to support them (HtF Group Ltd., n.d.).

In 2022 their revenue was 23.3 million euros (HtF Group Ltd., n.d.). The concern's international operations are concentrated in Europe, but also to East Asia. They manage their product development along with their distributors, and altogether the company holds over 7000 different product items.

4 ETHICS AND CARBON FOOTPRINT CALCULATION

This section consists of the baselines of the project, which give both general and more in-depth background information and reasons for the thesis' objectives. After that, the development process of the project is discussed, covering both the product data sheet, and the research of the carbon footprint calculators.

4.1 Baselines of the project

The goal of the project is to produce a product data sheet for the commissioner company, HtF Group Ltd., which they could send to their own suppliers. The form should comprehensively contain factors affecting the carbon footprint, as well as the suppliers' own declaration of the ethics of the products.

In addition, the purpose is to research already existing carbon footprint calculators and provide recommendations for the commissioner. Alternatively, a very own carbon footprint calculator could be then created for the commissioner from the gathered information. Test calculations are performed with existing calculators to calculate the carbon footprint of the company's own manufactured products.

This thesis project was initiated in the spring of 2023, when the researcher of this thesis, during his internship at the commissioner, enquired the about a possible topic for his thesis. The commissioner offered the researcher a topic related to the analysis of the carbon footprint of their imports. The thesis project was implemented in September 2023. The purchasing manager and one of the directors, whose areas of responsibility are logistics and procurement of the company of the commissioner acted as their contact persons.

Basically, as a company's intrinsic value is important that the company and its personnel understand what kind of effects the company's operations have on their environment and the surrounding society. However, in the bigger picture, the foundation of the project starts with EU-level directives, which are thus integrated into national legislation. This is from where, for example, CSR obligations concerning large companies are based. In addition to

the company's own values, however, CSR would also offer the company a commercial benefit, and a project like this would have a positive effect on the company's business.

Actually, these obligations would not yet affect the commissioner due to the size of the company. However, many large companies are already able to do the reporting in question reliably, and thus, through their subcontracting chains, are able to "pass on" the reporting obligation to smaller companies as well.

Due to the current situation, the CSR obligation also then affects HtF Group Ltd. Thus, the company strives to be able to provide information related to responsibility reporting on to its major customers, who will then also report the information in question forward again.

Regardless of the size of the company, CSR will also affect the commissioner before long, which is why the company tries to gain advance with the project rather than being left behind in reporting. The company has already started its own responsibility reporting project, where it pursues to regularly produce reporting according to the ESRS standards every financial year. The regularly collected information through the process remains as internal company information, which it can then offer to its own customers if necessary.

CSR done inside the company also provides the commissioner with a competitive advantage, as they are able to offer their customers already existing information. Thus, their customers do not have to rely on default values of their business branch, as utilizing those could also negatively affect their own ratings.

By creating a product data sheet for the company, which comprehensively reviews the product, as well as the supplier's responsibility, the commissioner's own responsibility reporting would get a significant boost. Utilizing a carbon footprint calculator would also enhance the company's already existing responsibility reporting. By considering the carbon footprint of, for example, their own domestic production the commissioner receives important information from that field.

4.2 Development process

The development process of the thesis project started in the beginning of 2024. Both projects began at the same time, with the emphasis first on the initial data sheet, as it was at that point still the smaller side project. As the data sheet was close to being finalized, the development and research of carbon footprint calculator was also properly begun. This section goes through the development process of the data sheet and research of the carbon footprint calculators.

4.2.1 Product data sheet

Initially, the data sheet for the commissioner′s suppliers was a smaller side project of the thesis. Over time, the data sheet gained more importance and eventually became an equal part of the thesis work. Similarly to the research and creation of the carbon footprint calculator, which was the primary objective of this thesis at first, proposition for the creation of the initial data sheet came from the commissioner as well.

The information covered by the product data sheet would have a significant part in the commissioner′s own CSR. From the point of view of Corporate Sustainability Reporting, it is essential that information related to the company's operations is documented, so that external parties are then able to verify it.

Essentially, the concept of the data sheet was to create a form consisting of basic product information for the commissioner′s suppliers. Suppliers would then provide the required information and send the filled form back to the commissioner. In the first meeting with the commissioner, it was discussed that the information in question could encompass such data as product name, raw materials of the product, gross weight of every product group delivered, manufacturer, and the place of manufacturer. Additionally, the distance and method transportation would be required. As a more specific information considering the products, it was suggested that the form should also include its own column for the possible Environmental Product Declaration (EPD) number.

The researcher was provided with two different product data sheets by the commissioner to use as research material. Both of the forms were used by the commissioner's associate companies. The table below shows the initial version of the product data sheet.

Table 1. The first version of the product data sheet.

Tuotteen nimi Name of the product	Raaka-aineet Raw materials	Kokonaispaino Total weight	Valmistaja Manufacturer	Valmistuspaikka Manufacturer's location	EPD-numero (Jos saatavilla) EPD number (if available)	Kuljetustapa Method of transportation	Kuljetusmatka (km) Transport distance (km)
						Land	
						Sea	
						Air	

The product data sheet was constructed on an Excel spreadsheet. The appearance of the form was very minimalistic, and it did not have anything excessive in addition to the form itself. The table consisted of all the information which was previously discussed with the commissioner. After the first review, the commissioner suggested that the method of transportation section could contain a choice for the different modes of transportation, since at first, the method could only be added into the cell by writing it. Therefore, the method of transportation could be specifically chosen for each product and would not require it being separately written by the supplier. For this, a dropdown list containing the most common modes of transportation, land transport, sea transport and air transport, was created. Now the supplier could choose the wanted mode as they are readily available. The dropdown list is visible in the table above.

During the second discussion, it was decided that the significance of the product data sheet in the thesis project, and therefore additions to the form would increase. In addition to the already existing information, it was decided that the form should also contain data regarding the sustainability aspects of the products. Information such as the energy consumption of the product, and if the product is completely recyclable and if not, then the percentage of the recyclable material should be stated, would be added to the data sheet. These kinds of additions to the product data sheet would also enhance the form's significance in the commissioner's own CSR and would broaden the scale of it.

In the same meeting it was discussed that the product data sheet could also encompass the more ethical side of the suppliers. For example, the form could also include a section where the supplier assures that among other things, child labor is not used during the production and that the local labor legislation is being complied with anyway. Since insurances like this would also support the commissioner′s own values, it would therefore be a good addition to their CSR.

There were a couple of notable ways on how the ethics of the supplier′s operations could be guaranteed through the product data sheet. Most simple way is that the operating principles of the commissioner could be directly announced at a general level, which would thus bind suppliers to follow them. Alternatively, a list of operating principles could also be drawn up, which would be given to the suppliers along with the product data sheet, which they would then sign, authorizing the suppliers to follow the commissioner′s operating principles. Lastly, an existing list of the operating principles could be given with the product data sheet. This would require the existing list to be up to date with the commissioner's operating principles.

Table 2. Second version of the product data sheet.

Company name	Contact Person	Position	E-mail address

Articles	Product name and number		Raw materials	Portion of recyclable materials	Production		Product's energy consumption	Environmental Product Declaration		Transportation method and distance	
Sort the articles clearly by product group	Product name	Product number	Indicate all the raw materials of the product	If the product contains recyclable materials, state their percentage by weight	The country of origin of the raw materials	Country of production	State the energy consumption of the product, kWh/product group	Does the prodcut have an EPD-number? (mark "X", if yes)	If yes, provide the EPD-number	Transportation method	Distance of transportation, km

The table above shows the product data sheet after the mentioned recommendations. The simplistic appearance of the table remained, apart from the color of the background changing to gray, so that the table itself would not blend into the spreadsheet too much. Also the structure of the table remained similar to the first version, meanwhile the content of it was significantly increased.

First significant addition to the table was the section where the contact person of the supplier could add their contact details. Required information for this section is the name of the supplier company, the name, and the position of the supplier′s contact person as well as their email address. As the contact person is most likely to fill out the product data sheet, having their information readily available in the sheet is helpful. For example, if there would be possible questions, they would be easily forwarded to the contact person. This saves both time and the commissioner from the trouble of searching a potential contact from the supplier.

The table itself, while retaining many aspects of the first version, was made more comprehensive. Smaller changes to the table were a short instruction which was given to each section on how to fill out the information above the cells as well as the changing the form to be completely in English, as before it was both in Finnish and English.

As some suppliers could transport several different products, a very own section for articles was made, to which the supplier can sort all different product articles that are in the delivery. Additionally, product number was also added to expand the basic product information. On the contrary, the section containing the total weight of the different products was cut out, as it was unnecessary information to have alone.

Suppliers were still required to list all raw materials of each product. In addition, suppliers were now required to state the recyclability of the products in percentage by weight. This means that the supplier calculates whether the product is completely (100%), or only partially (for example 75%) recyclable. Section that encompassed the production information was also modified. Location of production remained in the form, while the manufacturer was cut out and replaced with the raw materials′ country of origin. As it was suggested by the commissioner, a section for the energy consumption of the products was added. There the supplier states the energy consumption of the product group in kilowatt-hours (kWh).

The section containing the EPD number of the product remained as same, with a small addition where the supplier marks ″x″ into a cell if the product has an EPD number and then provides the number to a cell next to it. Transportation method and distance remained as

same, as well as the dropdown list which contained the modes of transportation from the first product data sheet.

After the second review of the product data sheet, the commissioner provided recommendations, such as deepening the basic product information, as well as the environmental impact, especially the carbon footprint if already calculated, of the products further. The commissioner also provided copies of their ethical guidelines both in Finnish and English, so they could be added to the product data sheet. The guidelines were added into their own sheets before the actual product data sheet, so they would be readily available and easy to read for the suppliers.

Sections regarding measurement and mass data of the products and their packaging were added to extend the basic product information. The supplier is asked to state the measures of a singular product and its package in millimeters. Similarly, the supplier provides the mass data of both a singular product and its package in kilograms. These mentioned additions to the data sheet are visible in the table below.

Table 3. Basic product information of the product data sheet.

Company name	Contact Person	Position	E-mail address

Articles	Product name and number		Product information		Packaging information		Raw materials	Portion of recyclable materials
Sort the articles clearly by product group	Product name	Product number	State the measurements of a singular product, mm (LxWxH)	State the weight of a singular product, kg	State the measurements of a singular package, mm (LxWxH)	State the weight of a singular package, kg	Indicate all the raw materials of the product	If the product contains recyclable materials, state its percentage by weight

A section for the product's carbon footprint was added as well. There the supplier can state the carbon footprint of the product if it has been calculated. The carbon footprint is stated in kilograms of carbon dioxide equivalent (kg CO_2e). This addition is visible in the table below. Apart from these additions, the structure and layout of the product data sheet remained as it was before.

Table 4. Environmental information of the product data sheet.

Production		Product's energy consumption	Carbon Footprint	Environmental Product Declaration		Transportation method and distance	
The country of origin of the raw materials	Country of production	State the energy consumption of the product, kWh/product group	If the product's carbon footprint has been calculated, state below in kg CO2e	Does the prodcut have an EPD-number? (mark "X", if yes)	If yes, provide the EPD-number	Transportation method	Distance of transportation, km
						Truck	
						Ship	
						Plane	

4.2.2 Carbon footprint calculator

The objective of this part of the thesis was to research some existing carbon footprint calculators and find out if the commissioner could use one of them, or alternatively, assemble its own simple calculator from the standards of existing calculators. The aim is to compare these calculators, especially their efficiency and user-friendliness, and through the comparisons recommend the most suitable one for the commissioner.

A carbon footprint calculator would be a useful tool in the commissioner′s CSR. In addition, the calculator would also be of great importance in terms of further use because there is also a strong need for a calculator in terms of the commissioner′s own production line.

Three carbon footprint calculators that were chosen to be investigated more thoroughly were HITU, Y-HIILARI, and The 2030 Calculator. All of the calculators were freely available, with The 2030 Calculator being its own website, while HITU and Y-HIILARI were both constructed on an Excel spreadsheet. All of the calculators already were also at least familiar for the commissioner, as the commissioner had done their own calculations with Y-HIILARI and The 2030 Calculator in the past and had familiarized themselves with HITU. LED mirror was chosen for the target product of the test calculations. The target product encompasses three different sizes of a same model, and they are all manufactured by the commissioner themselves.

The 2030 Calculator: Created by Doconomy, which is a Swedish applied impact solutions provider. As mentioned, the calculator operates on its own website, using it is free and it requires the user to create an account on their website. The 2030 Calculator is essentially for calculating the carbon footprint of different products, and the calculations are strictly cradle-to-gate. This means that the calculator encompasses the partial life cycle of a product.

The structure and layout of The 2030 Calculator is clear and easy to follow. When user opens the website, they are greeted with a short information page about the calculator's general background. When user starts the calculations, the website opens up an empty product list or alternatively all the products of which the user has already calculated the carbon footprint. If the user already has existing products in their library, through the list they can search certain items by product name. Additionally, the user can also narrow the list to contain only certain item categories if they have several different articles in their library.

The structure of the calculator itself is also clear and easy to follow. The calculator is divided into five parts, ″Product″, ″Material Acquisition And Processing″, ″Packaging″, ″Product Assembly And Distribution″, and ″Results″. In the first section the user names the product which is calculated, states the product type and category and the product's weight in grams. Additionally, user can also provide a product code, such as EAN, if the product has one.

The second section the requires user to list the product data. The user names every component and states its weight in grams, and then picks the material category and subcategories of each component from already existing lists. The user can also pick the quality of the materials which are used in the components. Lastly, the user provides the supplier location, and mode of transport of each component, and additionally the processes that the parts go through.

In the third section the user lists the packing materials used with the product, and their suppliers and modes of transport similarly as with the components. Fourth section requires the user to provide manufacturing location, energy source, total energy consumption,

brand distribution centre location, and the mode of transportation. Energy source can be chosen from already existing options, and the total energy consumption is automatically calculated by the website based on materials and their weight. The mode of transport also has an existing list of different options for transportation. Fifth section gives the results as the title suggests. As mentioned, the carbon footprint is stated in kg CO_2e, and the impact of each step, material acquisition, processing, assembly, packaging, and distribution, are given as percentages. From that the user can easily compare and evaluate the impact of each step and use them to find more sustainable solutions if needed.

As The 2030 Calculator saves the products on their website, the user is not required to perform calculations again and again every time when the carbon footprint is required. This also removes the need to store every product′s results somewhere else as the website does it for the user. The calculator also keeps the date of when the data was last modified, which helps the user to keep track on the validity and topicality of product′s carbon footprints. The calculated carbon footprint is stated in kg CO_2e and is readily available in the library next to the product name individually. The user is able to access and edit, or alternatively delete, the products easily through the product list.

The 2030 Calculator is structured well. Sorting the packaging materials to their own section is good as they should not necessarily be included in the components of the actual product itself. Locations of for example suppliers can be added very precisely, which helps to gain accurate data. In addition, the amount of different modes of transportation is beneficial in that regard too. As the website calculates the energy consumption, it saves the user of the trouble.

On the downside for The 2030 Calculator, materials and their subcategories are limited, which prevents gaining as accurate results as possible. This is noted by the developers themselves also. Material processes are also limited only to bigger industrial processes, leaving out the smaller processing options. The ability to choose material quality also renders as pointless, as more often than not, the website would only offer ″average″ as the quality anyways. Having both mode of transportation, and processes in the same column can also be somewhat confusing.

HITU: An Excel-based carbon footprint calculator, which was developed by Seinäjoki University of Applied Sciences and created by Ilmastoapu Ltd. HITU is also aimed for calculating carbon footprint of products and can be used both in cradle-to-gate and cradle-to-grave calculations.

The layout and structure of HITU are both clear easy to follow. It is divided into several spreadsheets, each one containing a part of the calculation process. When the user opens the calculator, they are greeted with a page where they can write basic information, such as company name, product name, date of the calculation and name of the user, about the calculation which they are going to perform. On this page the user can also decide whether the calculation is limited to cradle-to-gate or cradle-to-grave. Below this information, the page shows the results of the calculation, dividing them into emissions by life-cycle stage and emissions by emission sources. These results can be viewed either in percentages or kilograms. In addition, tables for both product′s material distribution, as well as waste emissions are visible. Similarly, these results can also be inspected in percentages or kilograms.

Next spreadsheet contains the materials of the product. The function is very similar to The 2030 Calculator, as the user lists all the materials individually to the table in the spreadsheet. The user names the component, picks the material class, the material of the component from the calculator’s list, and then provides the quantity of said material. Unlike in 2030 Calculator where the amounts were all in grams, HITU has a larger variety of units, such as kilograms, square metres, cubic metres, and litres, which the calculator picks according to the chosen material.

HITU divides transportation of materials into its own separate table under the materials. The function is similar to The 2030 Calculator, as also in HITU, the user names the components which are transported to them, picks the mode of transport, carrier, and the distance. Production is completely separated on its own spreadsheet in HITU and compared to The 2030 Calculator this section is more comprehensive. The spreadsheet consists of tables for energy consumption of manufacturing processes, fuel consumption of manufacturing processes, transportation during manufacturing, auxiliary materials used in

production and their transport, waste in manufacturing, and allocation of emissions from production facilities to the product being calculated.

To energy consumption, user can give every individual component′s manufacturing process′ description and its energy consumption in kWh or alternatively pick a process from the calculator′s own list from which the consumption is automatically calculated. User also chooses the form of energy from the calculator′s list. Fuel consumption is fairly similar, user gives each individual component′s process description, type of fuel, and the amount of fuel consumed. Transportation during manufacturing is also very similar to transportation of materials as the user chooses the mode of transportation, carrier, and distance. HITU also provides tonne-kilometres of each component as informational data.

Auxiliary materials require the user to individually list auxiliary material classes, materials, amount of materials, method of transport, carrier, and distance. Although the list of material classes is very narrow, as it only includes three different classes. Waste in manufacturing requires the user to state the waste in percentages of each component to be manufactured. Similarly to transportation section, HITU gives the amount of waste in kilograms as informational data. Finally, in allocation of emissions, the user picks the type of emission source, emission source, and gives the amount of consumption per year. After this the user gives the relative share of the product in the total consumption and the number of manufactured products in a year so it is possible to calculate one product′s share of emissions of production facilities.

Alternatively, if the user chooses to calculate product′s carbon footprint fully from cradle to grave, two additional spreadsheets for transportation and use, as well as end of the life cycle pop up. For transportation and use the user gives data about transportation of the finished product, energy consumption during use of the product, consumption of materials during use of the product, and waste during use of the product. Transportation consists of the same method of transportation, carrier, distance, and tonne-kilometres, while energy consumption requires type of energy, form of energy, and consumption during the product's entire life cycle.

Consumption of materials during use of the product requires the user to pick component's material class, material, and the amount of them consumed during the product's life cycle. To waste during use of the product the user gives the product's waste fractions and their amount in kilograms. Similarly, to end of the life cycle section, the user is required to allocate all types of waste and their amounts in kilograms that come from product disposal. All of the sections calculate the kg CO_2e of each section, and the summed up results are then visible on the first spreadsheet as mentioned in the beginning. The user is also able to see all the emission factors as well as other factors used in the calculator, and they can also create a product sheet consisting of the data which was discussed above. The product sheet can be utilized to help out in the beginning of the calculations.

HITU is well structured and easy to follow. Each spreadsheet also provides instructions on how to fulfil certain points. Compared to The 2030 Calculator, HITU is generally more comprehensive, with the ability to calculate both cradle-to-gate and cradle-to-grave being one of the significant differences. Results of the calculations can be viewed in a broader scale as the calculator provides the results both in relative representation (%) and absolute representation (kg), while providing additional data at the same time. Separating both material transportation and manufacturing processes to their own sections also clarifies the calculator and makes it easier to follow. The ability to view every component's individual share and kg CO_2e from the product's total mass helps the user when investigating which parts create more emissions. Also, having the ability to create a product sheet for future calculations and the access to emission factors are helpful for the user. The user can utilize the product sheet also in other ways, such as a product declaration for customers and associates.

While HITU holds many benefits there are also some negative aspects. Even though the manufacturing processes in general are greatly more inclusive compared to The 2030 Calculator, it does not provide more production methods and similarly focuses on bigger industrial processes. HITU also requires the user to list packaging materials to same section with other materials, which can distort the results. As HITU functions on Excel, it does not save the calculations anywhere else as starting a new calculation deletes all the previous data. Therefore, the user is required to save the results or to utilize the product sheet

which also needs to be saved. Some of the emission factors are also required to be updated yearly.

Y-HIILARI: Developed by Finnish Environment Institute, Y-HIILARI is an Excel-based calculator. Compared to the previous calculators, it is aimed for calculating the carbon footprint of the entire company′s operations.

Like HITU, which is also an Excel-based calculator, Y-HIILARI is also divided into several different spreadsheets, and every sheet is meant for an individual emission source. When the user opens up the calculator, spreadsheet containing the final results of the calculations opens up. Similalrly to HITU, this spreadsheet automatically fills up as information is entered in other spreadsheets. From this spreadsheet the user can find a table where every emission source′s results and the total carbon footprint are visible. The results of the calculations in this table are given in kg CO_2e as well as in t CO_2e. Next to this is a smaller table which shows the result′s division into different scopes in percentages. Below the tables the user can see the same results, but in graphs.

Next spreadsheet addresses the electricity consumption. This requires the user to give annual electricity consumption into a table. All of the tables in Y-HIILARI have a kind of a colour code to help the user in filling out the tables. Cells which are blue are the ones which the user fills out, and cells which are yellow are the ones where the calculator hands out results. To this table the user can fill their own emission factor if they have an existing one. Below this the user fills the electricity consumption in MWh/a (megawatt hours per annum) of their estates and chooses the type of electricity from an existing list. The table then calculates the results and states them in kg CO_2e. Below the table is another table in which the user is able to compare the direct and indirect emissions of different types of electricity. Next to this, same results can be viewed in a bar graph. These two do not include in the total carbon footprint and are only additional data.

Next spreadsheet consists of the company′s thermal energy consumption data. This table requires the user to fill in the annual consumption of fuel which their company uses. The consumption can be given either in MJ (megajoule) or kWh (kilowatt hours). If the user′s company produces their own thermal energy, they can fill in the percentage of that also.

The table then gives out the results of each fuel in kg CO_2e. The table gives the sum of the results both for greenhouse emissions caused by fossil fuels and calculated greenhouse emissions caused by biofuels used in thermal production. The results are again visible also in a bar graph on the spreadsheet.

After this the user is required to fill out their company′s transportation data. On this spreadsheet the user is able to use either tonne-kilometres or fuel consumption as a value. If the user chooses to use tonne-kilometres, they fill out distance in kilometres and load in tonnes to cells next to the carriers which are used, the calculator then calculates total direct emissions from driving and fuel production with the given information. Diesel is used as assumed fuel in these calculations. The results are summed together and are shown in kg CO_2e.

With fuel consumption the user fills out the consumption of diesel and alternatively other fuels used in the carriers, from which the calculator then gives the direct emissions from diesel consumption in kg CO_2e and fuel production emissions with the given data also in kg CO_2e. These results are also summed together. Regardless of the chosen values, the calculator then shows the total road transport emissions without fuel production, total emissions from fuel production, and their subtotal in a smaller table below.

After this, again to a different table, the user can fill out data of different methods of transportation, ship transport, rail transport, and air transport. This table uses tonne-kilometres as values and gives the direct emissions of all transports as results. User can′t choose alternative fuels in this table as it uses the assumed ones. After these the calculator gives results for direct and indirect greenhouse gas emissions caused by the transport of raw materials and products in their own cells, both emissions again in kg CO_2e.

The user can also calculate alternative fuel emissions, but the calculator and it′s results might not be adaptable with the proper calculations. Alternatively, if the user is able to gain a part or all of the information in this section, they can fill them in the calculator and continue forward, or at least use them to help with the calculations on this spreadsheet.

On the next spreadsheet the user fills in the amounts, tonnes per annum, of different waste fractions through the recycling or incineration process into their own cells. User also

fills in the distance to the recycling point in kilometres after which the table calculates each individual waste fractions kg CO_2e, as well as the emission of transport with the given claim of bio sharer and direct emission of transport with diesel. After this, the table breaks down the emissions of waste handling and waste transportation, and then sums them up into the total greenhouse gases from waste management, results given in kg CO_2e.

On the final spreadsheet the user fills in the data of public transport consisting of travel kilometres and hotel nights. Firstly, the user gives the flight data, as in the distance flown in kilometres. These are divided into short and long domestic flights, flights into Europe, and long flights. The table calculates each option′s direct emissions without renewables and emissions caused by fuel production in kg CO_2e as subtotal. After this the user breaks down the same data for kilometres driven by car, divided to diesel and petrol cars, as well as kilometres travelled by taxi, bus, and train from which their subtotal is summed. Finally, the user gives the yearly hotel nights and their cost per day in euros, which gives the last subtotal, after which all of them are summed together giving out the total greenhouse emissions caused by public transport in kg CO_2e. Every spreadsheet′s total emissions are then calculated together, and the results are visible in the first spreadsheet as mentioned.

Y-HIILARI is the most comprehensive of the examined calculators. The spreadsheets of the calculator are divided clearly for their own emission sources, and the instructions are clear on every sheet. The subtotals and totals of every emission sources are also clearly visible on their own spreadsheets as well as on the proper result spreadsheet where the calculations are comprehensive and specific while also being easily readable. The colour code of the tables and the possibility to view the emission factors are helpful when performing the calculations.

On the other hand, this calculator can first feel very overwhelming, especially if the user is not familiar with these kinds of tools. Even though the division between emission sources is clear, the structure of the individual spreadsheets can also be incoherent, and it might require time to get familiar with contents of each spreadsheet. Similarly to HITU, as Y-HIILARI is an Excel-based calculator, the results must be saved to somewhere else, if other calculations are required with the tool.

5 CONCLUSION

From this thesis project, the commissioner can gain useful tools to enhance their Corporate Social Reporting. The product data sheet meets the requirements which were discussed before and during the development process while all of the carbon footprint calculators that were examined during this thesis project proved to be both usable and considerable options. From the researcher′s point of view, this project was successful at what it was set to achieve.

With the product data sheet, the commissioner is able to gain important data from the products that they are acquiring, while also ensuring that the ethical side is also secured. As the sheet is in English, it can be utilized both with domestic and foreign suppliers. Excel-base also ensures the possibility to make additions or other edits to very easily in the future.

All of the carbon footprint calculators that were examined during this thesis work were viable options and hold many benefits for themselves. As the need for a calculator was more on the commissioner′s own production, the emphasis should be on either The 2030 Calculator or HITU-calculator. Both are very similar to each other and have very similar aspects, such as the structure and the general layout.

The 2030 Calculator has the ability to save all the product data inside its own product library, which compared to HITU is beneficial for the user as it saves them from the trouble of saving the product data into many different places. Compared to HITU, The 2030 Calculator has significantly less materials and product categories available on their website, problem that is noted by the developers also, which can warp the results and give out false information. One disadvantage that both calculators share is the fact that material processing is rather vague, which can also impact the results negatively.

HITU’s ability to perform two kinds of calculations benefits the user more in the long run, and altogether it is more comprehensive as a calculator than The 2030 Calculator. Therefore, to the calculations of commissioner′s own production HITU would be more beneficial than The 2030 Calculator.

As Y-HIILARI is intended for calculating the company′s all operations, it does not necessarily fill the commissioner′s needs. Nevertheless, when looking from the point of view commissioner′s CSR, Y-HIILARI could also be utilized as it gives more comprehensive picture of the commissioner′s operations. If there is need for these kind of calculations, the commissioner could perform them with Y-HIILARI. After all, the commissioner should be able to enhance their CSR reporting through the tools that were either developed or otherwise recommended in this thesis work.

5.1 Usefulness analysis, validity, and reliability

This thesis work could be labeled as useful as the need for research and tools came from the commissioner themselves. As the commissioner′s branch of business is facing significant changes in the near future, executing this type of project is an effective way to prepare for the upcoming changes. With the tools which are examined in this thesis work, the commissioner is able to take steps towards these upcoming changes in advance, therefore making this project useful for them.

The points discussed above can be used to justify this thesis work′s validity as well. Every tool that was either created or examined during the process can also be validated, as all three carbon footprint calculators which were researched meet the required standards and are already well-known tools. Whether the commissioner chooses to implement ay of them in their operations or not, every calculator is a valid option in these types of scenarios. Similarly, the product data sheet that was created during this thesis project was conducted according to the needs of the commissioner. The ethical guidelines that were added as part of the product data sheet were composed by the commissioner themselves also which enhances the validity of the finished tool in question. In conclusion, this thesis work can be viewed as valid project.

This thesis work′s reliability can be argued with the fact that due to the topic, there was plenty of information available to research. As the timeline of the topic is also very broad, the researcher was able to explore both older information as well as very new information and generate a comprehensive combination out of the data. A part of the research material was also handed to researcher by the commissioner themselves, therefore making them

as reliable as possible. A lot of information also came from different governmental sources, which can also be used as arguments towards the reliability of this thesis work.

5.2 Process and future research

During this thesis process, the researcher gained a lot of knowledge and new information about a topic that was not very familiar in the beginning. From the historical aspects, such as The Brundtland Report and The Kyoto Protocol to newer actions such as CBAM and CSR reporting, it was new information. Through the process, the researcher also gained a lot of new knowledge about different branch of businesses, and their parts in the global economy as well as different standards and other legal actions that are being used to fight global warming.

Although the thesis process ultimately went without major problems and other obstacles, there were some points that could have been managed better. The biggest issue was the researcher′s time-use, since with proper time management many obstacles could have been tackled more easily. Also, information seeking could have been managed better by the researcher. Searching information more chronologically could have made writing the thesis easier process and helped also to keep track of time. Additionally, the researcher could have utilized the help of guiding authorities more, as more than often the researcher only relied on themselves. Apart from these facts the process still was still fairly peaceful.

Due to the thesis′ topic, future research is possible to conduct. As the situation with different standards and other legal actions can change in short amount of time, many of the aspects that are examined in this thesis work might not be sufficient enough in the future. Enhancing the product data sheet could be one possible future research target as it might need updating or some of the information there is not up to date anymore. Similarly, the carbon footprint calculators might not be sufficient enough in the future and the commissioner needs a new tool as replacement. Additionally, the commissioner might need a completely new tool which it can utilize in their CSR reporting in the future. As long as the environment′s conditions remain unstable, it is rather obvious that more new and comprehensive researches and studies are needed so the global warming can be fought more effectively.

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