Utilizing biomass as a competitive advantage in the forest industry: A case study of a pulp and paper manufacturer in Finland

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Master's Thesis in International business operations

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Abstract for Master's thesis

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Abstract: This study explores the utilization possibilities of biomass within the forest, and pulp and paper industry in Finland, examining whether it could serve as a competitive advantage. The study emphasizes the economic value associated with biomass utilization and explores how highlighting bioeconomy and sustainability can impact customer behaviour and the surrounding environment. In the current day, where sustainability holds great importance, industrial companies, and industries, such as the forest industry, which are traditionally perceived as significant consumers of forest raw materials with high emission levels, must prioritize transparent and sustainable operations to enhance customer relationships. To accomplish the thesis objectives, three research questions have been formulated to guide the investigation of the topic. The research studies the actions of a company within the pulp and paper industry, conducting interviews with four employees from the company. Additionally, an interview is conducted with an expert in business management consulting within the pulp and paper industry. The research findings indicate a growing awareness of sustainability among customers and the public. Consequently, sustainability-related actions are increasingly influencing customer decision-making and their demands However, the extent, to which sustainability factors into decision-making remains unclear. The research reveals that the forest industry is currently suffering from image issues concerning sustainability as the industry has not accomplished to effectively communicate to the public the actions taken to ensure sustainability and the positive impacts it has had on sustainability. The findings indicate that biomass utilization is currently seen to be the favourable choice for energy production in the Finnish pulp and paper industry. The adoption of biomass over fossil fuels also enhances the industry's environmental image as it is seen as a more sustainable alternative. However, incorporating bioeconomy and bioenergy into the industry poses challenges, including quickly evolving sustainability policies, a lack of coherent understanding of bioeconomy as a concept, and uncertainties of future preferences and technological developments. The findings indicate that the interest in sustainability has risen notably in recent years. However, companies lack awareness of specific sustainability factors influencing customer decision-making. Despite sustainable actions having positively affected customer attitudes, the public is unaware of the positive impacts that the forest industry has had on sustainable development, resulting in an image problem for the industry. The findings highlight that supporting circular business models and sustainability has the potential to significantly enhance the economic stability of the industry. Additionally, even with the risk of high investment costs, favouring sustainability-friendly operations is seen as vital in achieving future success. This thesis provides the actors within the Finnish forest industry with knowledge regarding the current sustainable actions affecting customer decision-making as well as information about optimal business models and bioeconomy implementation. These approaches hold significant potential in strengthening the industry and enhancing economic stability for its stakeholders in the future.
Keywords: Bioeconomy, biomass, bioenergy, forest industry, pulp and paper industry, circularity, sustainability, competitive advantage, business model, sustainable business model
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1 Introduction

In today's world, sustainability plays a growing role in how companies within different industries are run. This is especially true for those industries that are highly connected to the environment and the use of raw materials. Being sustainable is not just a transitory trend but arguably one of the most important topics for the future of humankind. One of the central reasons for the importance of sustainability is that the population growth in the world unavoidably leads to a shortage of resources needed for everyday life. However, it does not only involve us running out of resources. An example of this is the utilization of fossil fuels. Before, the reason for shifting away from fossil fuels was the fear of running out of fossil fuels to use. Today, however, even if this concern still plays a part in the shift, the main reason for moving toward other fuel sources is the concern of what consequences the burning of such large quantities of fossil fuels has on the environment. As we are today well aware of the emerging problem of global warming, we must find ways of minimizing emissions, such as carbon dioxide, which, for example, the burning of fossil fuels significantly affects. (Portney, 2015)

To find solutions for minimizing emissions, such as carbon dioxide, alternative, environmentally friendlier economy concepts and fuel resources have become a central matter. This is where bioeconomy steps in. Bioeconomy is defined as a concept of an economy that focuses on renewable bioresources, such as biomass, efficient, eco-friendly bioprocesses, and ecologically cantered industries to produce bioproducts, jobs, and income on a sustainable level. (Patermann and Aguilar, 2018) As mentioned, one of these alternative resources that many industries, including the forest industries, have included in their production processes is biomass. Biomass is material that can be derived from both plants and animals and is commonly used in the creation of plant-based biofuels. Biomass is acknowledged as a natural and renewable resource, meaning that the restock levels of the source being utilized can return to the same level as before by natural processes either in the same or even less amount of time. Sources of biomass include for example agricultural crops, and wood in different forms, such as chips and bark, as well as waste from forestry, agricultural, municipal, and industrial sources. (Zygmunt and Pawlowski, 2016)

As with many of the big and widely discussed concepts, also sustainability can include many meanings and definitions. Some define sustainability as the maintenance of our nature and its system so that the well-being of humans can be secured (Portney, 2015). One of the most quoted definitions of sustainability is the one coming from the United Nations Brundtland Commission, which in 1987 defined the concept of sustainability as ‘‘meeting the needs of the present without compromising the ability of future generations to meet their own needs’’ (UN, 2023). One of the main principles of sustainability is the fact that the resources from the Earth are not indefinite and shall thus not be used, drained, or depraved endlessly (Portney, 2015). Sustainability is often described as having three main elements, or three ‘‘E’s’’ that are: environment, economy, and equity, which together build the base of sustainability and the pillars to achieve sustainable development. The reason for this is the argument that only when we simultaneously manage to protect the environment, secure economic growth, and advance equity, can we achieve sustainability and sustainable development. Therefore, to attain sustainability, we cannot improve the goals of certain pillars in such ways that other pillars are negatively affected, but we should rather find ways of furthering these pillars where they reinforce each other. (Cavagnaro and Curiel 2012; Portney, 2015)

Sustainability in business and sustainable business strategies can include many different practices. Sustainable business often refers to the environmental or society-related effect of a company while sustainable business strategies aim to create a positive impact on both the society and environment. Sustainability in business can, for example, include the use of renewable energy sources, the use of more sustainable materials in the process of manufacturing, and a focus on reducing emissions and depletion of natural resources while simultaneously focusing on societal issues, such as gender inequality, and human rights issues. However, doing good for the environment can also help a business strengthen its economic success. For example, many investors use metrics that measure the sustainability and ethical impact of the business. These metrics measure for example how a business supports diversity, how large its carbon footprint is, and how strongly it commits to developing the community. However, business cannot be run solely by doing good and, thus, also requires economic success. Today, effective business strategies include a focus on both environmental/social and economic success. Research has shown that initiatives related to sustainability can help boost the financial performance of a business, as it can help

to build, maintain, or even improve the company's reputation as well as answer the expectations of the customer and develop new opportunities that support growth. This indicates that sustainability-related investments can often lead to improved economic success in the long run. (Chladek, 2019; Spiliakos, 2018)

1.1 Background to the thesis and presentation of the questions

A significant contributor to emissions is the industrial sector, which, despite being a crucial part of the European economy, causes substantial pressure on human well-being and the environment by generating elevated levels of pollution (EEA, 2023; Mukhopadhyay and Pandit, 2013). By polluting the air, we not only destroy the environment but also threaten the world's economic growth. Different dangerous substances and gasses release acids that can damage and cause erosion to plants, soils, and buildings, such as industrial plants. More importantly, different particles from waste gas cause both indirect and direct effects resulting in an imbalance in the solar irradiance between the sun and the earth, which can lead to geographically dry areas suffering from even more draught, and regions prone to floods suffering from even more floods. (Yang and Yang, 2022)

In 2021, the industrial sector was the third largest consumer of energy (25.6%) within the European Union only behind transport and households (European Commission, 2023). It is, thus, important that companies within the industrial sector aim to improve their own energy consumption and environmental impact overall. Industrial companies are entities within the industrial sector that manufacture and distribute capital goods. In other words, such goods that other businesses, especially those in manufacturing and construction, use to create finished products for the end customer. The industrial companies also provide various services, supplies, and transportation. (McCauley et al., 2014; Unacademy, 2023) As the pulp and paper industry belongs among the largest industrial sectors in the world, it plays a significant role not only in the total energy consumption within the industry but also in the utilization of industrial wood. The use of such natural resources and extensive use of energy makes the pulp and paper industry also a significant factor in causing environmental impacts. (Santos et al., 2020)

Many studies have been done on the topic of bioeconomy and bioenergy. Previous research related to biomass utilization within the forest industry has studied the progress, possibilities, and barriers that the Finnish and Swedish forest industry is facing in achieving decarbonization and how biomass plays a significant role in this process (Lipiäinen et al., 2022). Another earlier research has also studied the availability and potential to utilize forest biomass in Sweden emphasizing especially the different biomass utilization purposes and its availability level (Kumar et al., 2020). Lipiäinen et al., (2022) highlight that the shift toward biobased fuels is amongst the primary tools for decarbonization and achieving net-zero emission targets and mention that the pulp and paper industry has the potential to reduce its level of CO2 emissions by utilizing bioenergy and energy-efficient heat recovery. However, to the author's knowledge, little research has been done directly on understanding, how bioenergy utilization can enhance the competitive position and the business operations of companies within the Finnish forest industry and especially the pulp and paper industry in Finland. Research done by Wan et al., (2012) has studied the opportunities and challenges that the Finnish Sawmill industry faces in the bioenergy business. However, due to the research being over a decade old and its focus on the sawmill industry, the author feels that more recent studies regarding the topic and more industry precise information are needed.

The purpose of this thesis is to gain an understanding of how the forest industry, and more specifically the pulp and paper industry in Finland is utilizing biomass, how it benefits from it, and how it could bring competitive advantage. Results gained from the research continue the study of previous research and contribute to the knowledge of how emphasizing environmental sustainability benefits companies within the forest industry not only in environmental matters but also economically.

This research will not try to determine what the best renewable energy source is. However, gaining an understanding of biomass utilization in Finland is actual, as the share of biomass in the total energy consumption is highest in Finland when compared with other industrialized countries. In 2022, the share of renewable energy in Finland’s total energy consumption was 42%. Of all the renewable energy used in Finland, around two-thirds originated from wood fuels. The biggest user of wood-based energy in Finland is the forest industry. (Motiva, 2023) A large part of the created forestry biomass is used for supplying

energy inside the forest industry. For example, pulp mills produce black liquor as a by-product in the pulping process, which they can then use as a source of energy. (Berndes et al., 2016) Pulp is created by separating and treating wooden fibre. The dry pulp is then transported from pulp mills into paper mills where it is used to create paper or, alternatively, an integrated pulp and paper mill converts the wet pulp into paper. (Davidsdottir, 2004)

Sustainable development is development where current needs are met without destroying the possibilities to meet the needs of the future (Mitlin, 1992). In business, sustainable development creates many possibilities for many different actors. It strengthens the position of suppliers with consumers emphasizing sustainability and green values, opens doors for producers focusing on environmentally safe materials and processes, and actors participating in social well-being. These types of businesses will generally enjoy competitive advantage over others as local communities will show them their complaisance while they can simultaneously see the positive effect that their green efforts have created. (Avlonas and Nassos, 2014) Gaining competitive advantage is not always about being first, but rather about eliminating obstacles hindering one's business and reducing external costs (Lowitt, 2013). Competitive advantage is the difference between companies on a comparable dimension, where one can compete better than others. For a company to achieve competitive advantage, it must create value that exceeds the value created by competitors. (Wang, 2019)

To answer the aim described above, the following main and sub-questions were created:

Main question:
What competitive advantages can biomass utilization bring to paper manufacturers/businesses related to the forest industry?

Sub-questions:

1. What are the advantages and drawbacks of bioeconomy for industrial companies?

2. What are the economic and environmental benefits of using biomass for the Finnish forest industry?
3. What business models should the forest industry use in the future for efficient use of biomass?

It is important to understand how the biomass and bioeconomy are currently being utilized and what benefits it could bring financially, as this could lead to a change of wider use of more sustainable resource alternatives within other countries, industries, and companies. By understanding how biomass and bioeconomy are currently being utilized within the forest industry in Finland, the companies could also improve their current utilization methods and processes for even better outcomes for the future, both environmentally and economically. Developing the bioeconomy is seen to create many possibilities to address the various problems that the world is facing due to a growing population, overuse of resources, degradation of the environment, and climate change. (Borgström and Mauerhofer, 2016) The understanding of bioeconomy and the possibilities that the use of biomass can bring are relevant, as we face major issues caused by a quickly growing population creating an increasing need to produce and use resources, which not only demand enormous amounts of energy but also increases the level of pollution and waste that harms the environment. (Jha, 2020)

1.2 Central concepts

Sustainability: Being sustainable means not exceeding planetary boundaries that humankind must obey to secure a sustainable future (Horton and Horton, 2019). Sustainability has also been defined as meeting the present needs without having to compromise the needs of future generations (UN, 2023). Sustainability is usually divided into three categories: social (promoting human rights, equality, and health), economic (focusing on sustaining welfare and fair resource division), and environmental (sustaining nature and its resources for both humans and other living organisms) (Kopnina and Shoreman-Ouimet, 2015).

Social Sustainability: According to Mohamed and Paleologos (2021), social sustainability means measuring human welfare. Social sustainability specifies both positive and

negative impacts that systems, activities, organizations, and processes have on social life and people. Topics integrated into social sustainability include human rights, health, social equity social responsibility, and community development and well-being. (Balaman, 2018)

Bioeconomy: Bioeconomy does not have a universal definition. However, in most definitions, the core of bioeconomy lies in the sustainable use of renewable biological resources where the processes and products created aim to meet the expectations of both the public and private sectors (Maciejczak and Hofreiter, 2013). Bioeconomy strives to determine frames for the socio-economic activity so that the biological system can be used as efficiently as possible, without destroying its possibilities of renewability and sustainability (Mateescu et al., 2011).

Business Model: The main purpose of a business model is to describe how a business is creating, delivering, and capturing value (Osterwalder and Pigneur, 2010). A business model describes actors within a business and their roles. Business models are referred to as stories that explain how businesses work. Business models can address questions about identifying business segments, understanding the values of the customers and the business, and determining how the business can provide value to the customers while generating profit and value for the business. (Zott et al., 2011)

Circular business models: Circular business models are models that cycle, intensify, extend, and dematerialize energy and material loops to reduce the investments needed for resources and minimize emissions and waste created by the organization. A circular business model enables this by recycling and extending the lifespan of materials and products or by substituting products with more sustainable service and software solutions. (Geissdoerfer et al., 2020) A circular business model strives to lead a company in creating, delivering, and capturing value in ways that improve the efficiency of resource use. In addition to lifespan extension, resource efficiency is improved by remanufacturing and repairing, as well as closing different material loops. (Nußholz, 2017)

Biomass: Biomass is organic material that originates from living organisms or organisms that have lived. This includes trees, plants, animals, algae, marine organisms, and microorganisms. Biomass does not include materials that are fossilized or in geological

formations (Lewandowski et al., 2018). Due to its universal availability, sustainability, and lower costs, biomass has become an important part of renewable energy sources. When produced appropriately, the emission levels from biomass are approximately equivalent to the carbon dioxide absorbed by plants during their growth. Consequently, the proper utilization of biomass does not cause any additional CO2 emissions into the atmosphere. (Huang, 2014)

Bioenergy: Bioenergy is a growing renewable source of energy that is created by using biomass feedstocks. Bioenergy is mainly used in heating and cooling. also plays a significant role in the generation of renewable energy and bio-blending of transportation fuels. (Wu and Pfenninger, 2023; Belyakov, 2019)

Competitive advantage: Competitive advantage refers to a company attaining a superior position in the market by outperforming its competitors (Wang, 2019). Competitive advantage can be achieved by providing lower costs than the competitor or by being able to offer products of higher value to the customer, justifying the higher prices. Competitive advantage can be gained by those capable of continually providing improved products, services, and innovations. (Porter and Linde, 1995)

1.3 Methodology

As the aim of the thesis is to understand how the Finnish forest industry is utilizing biomass and how it could be used as a competitive advantage, the research interviews will be conducted with a paper and pulp company regarding their current utilization of biomass and how they experience that it has helped the company. The questions of the interviews will be semi-structured, meaning that the questions consist of two kinds: main themes and follow-up questions. (Kallio et al., 2016)

This empirical study will compare and analyze the results gained from the interviews with the presented content and concepts in the theoretical framework using thematic analysis, which, according to Braun and Clarke (2006), is a method that can be used to identify, analyze, and report different patterns or in other words themes within the data being analyzed. This method of analysis includes coding. These codes are created according to the

content of the data and are based on the topics common to the thesis and the set study questions. The creation of the themes is guided by the theoretical framework and the conceptualizations created from the set research questions as well as the data, study aims, and objectives. (Braun and Clarke, 2006; Carson et al., 2001)

1.4 The structure of the thesis and its restrictions

The theoretical frame of the thesis includes two main chapters (chapters two and three). Chapter two introduces the concepts of bioeconomy and biomass utilization. The chapter also introduces the forest industry and observes more closely the Finnish forest industry, focusing especially on the pulp and paper industry. The chapter also includes an overview of fossil fuels and how they compare to biomass as an energy source. Chapter two also provides information about the energy sources being utilized in the Finnish forest industry and how they influence Finnish energy production.

Chapter three includes an overview of how companies can achieve success. The chapter also introduces the traditional business model canvas as well as the broader concept called the ‘‘triple layered business model canvas’’, also considering social, and environmental aspects of a business model. The chapter emphasizes the importance of stakeholder relationships and discusses how companies can gain competitive advantage over others.

The empirical part of the thesis begins in Chapter Four, explaining the planning and execution of the thesis. This chapter will also present the research methods used in the thesis as well as the analysis methods, and the different stages of the working process. The fifth Chapter of the thesis will present the results gained from semi-structured interviews conducted with the employees from a pulp and paper manufacturer located in Finland as well as an expert from the field of paper manufacturing. Chapter six will present a summary of the findings as well as address analysis of the gained results. As this thesis is qualitative in nature, the analysis will be based on the connection between the information gained from the theoretical framework and earlier studies, and the information from the semi-structured interviews. The seventh and final chapter will provide answers to the three research questions presented in the introduction. The chapter will also present the theoretical contributions provided by the findings from chapter five, as well as practical implications for the

Finnish forest industry and the company being analyzed. Lastly, the final chapter will discuss the limitations of the study and provide suggestions for future research.

A coverage matrix was created to show a clear visualization of the thesis structure (Table 1). The coverage matrix helps to visualize how the sub-questions of the thesis are connected to the theoretical framework, interview questions, and the themes created, based on the data being analyzed.

Sub-questions of the Thesis	Theoretical framework	Interview questions	Results (Themes)
What are the advantages and drawbacks of bioeconomy for industrial companies?	2.1, 2.1.1, 2.1.3, 2.3, 2.3.1, 2.3.2, 2.3.3, 3.2, 3.3, 3.4	CCQ1–CCQ4, CCQ8, CCQ11, CCQ12, CCQ15, CCQ18, EQ4, EQ5, EQ7, EQ8, EQ9, EQ10, EQ12, EQ14,	5.1 (+ sub-chapters) 5.3.1
What are the economic and environmental benefits of using biomass for the Finnish forest industry?	2.1.3, 2.2, 2.2.1, 2.2.2, 2.3, 2.3.1, 2.3.2, 2.3.3, 3.1.1, 3.2	CCQ2, CCQ5, CCQ7– CCQ9, CCQ10–CCQ12, CCQ14, CCQ15 CCQ17, EQ1, EQ3, EQ8,	5.1 (+ sub-chapters), 5.2 (+ sub-chapters) 5.3.2
What business models should the forest industry use in the future for efficient use of biomass?	2.1.1, 2.2.1, 3.1, 3.1.1, 3.2, 3.3, 3.4	CCQ3–CCQ7, CCQ10, CCQ12, CCQ13–CCQ19, EQ1, EQ2, EQ6, EQ9, EQ10, EQ11, EQ13, EQ15	5.1, (+ sub-chapters) 5.2 (+ sub-chapters), 5.3 (+ sub-chapters)

Table 1. Coverage matrix

The connection between the sub-questions and the theoretical framework and the themes are described by using the chapter numbers of the theoretical framework chapter and the results and findings chapter, where each sub-chapter presents one of the themes. In the interview questions column, the questions are described as CCQ1– CCQ18, meaning case company interview questions, or EQ1– EQ15, meaning expert interview questions.

As the thesis is aimed at analyzing the forest industry in Finland, it will not include a deep analysis of how foreign countries utilize biomass. Because the results of the interviews are based on those by employees from a pulp and paper company and an expert from the field,

the presented findings will mostly apply to the pulp and paper industry in Finland. While providing the reader with an overview of how the forest industry in Finland, particularly the pulp and paper industry, is utilizing biomass, it's important to note that the utilization may differ across the industry. Despite the thesis being restricted to examining the utilization of biomass in the forest industry in Finland, it provides readers with a comprehensive understanding of how biomass is employed within the industry.

2 Bioeconomy and biomass utilization and its effects on business

This chapter will present the central topics related to the study themes. The chapter begins by introducing the concept of bioeconomy and follows up by discussing the circular business models for bioeconomy. The chapter also discusses new and upcoming innovations that strive to minimize carbon emissions, such as the method of bioenergy with carbon capture and storage (BECCS). Next, the term biomass is discussed. The theory presented provides the reader with an overall picture of the term, its utilization purposes, and how it compares to fossil fuels. Finally, the Finnish forest industry is discussed. Based on the theory presented, the energy sources are widely used within the Finnish forest industry and plays also a significant role in the share of the country's renewable energy production.

2.1 Bioeconomy

Bioeconomy is an economy form reliant on renewable natural sources for the production of food, energy, and various services and products. The aim of bioeconomy is that humans could lay less dependence on fossil natural resources and minimize the loss of biodiversity while simultaneously creating economic growth and jobs that would support sustainable development principles. (Ympäristöministeriö, 2014)

There are several definitions of bioeconomy. In the literature, it can be described in different terms, such as green economy or biobased economy, which all usually stand for similar principles. It is also a definition that keeps on changing. The Global Bioeconomy Summit provides a refined definition of the term, characterizing bioeconomy as the knowledge-driven generation and utilization of bio-resources, inventive biological processes, and principles that enable the sustainable production and operation of products and services throughout various economic sectors. Therefore, bioeconomy can be seen to include traditional sectors related to bioeconomy, such as paper and pulp, forestry, and wood as well as newer industries including chemical, textile, packaging, and building products. (GBS, 2015; Hetemäki and Kangas, 2022)

Even if the bioeconomy has many different definitions, the common divisor for most definitions of the term is often one where the economy is based on the sustainable utilization

of natural resources (Baranano et al., 2021). These natural resources used to produce food, feed, energy, and materials, include resources from both sea and land including animals and micro-organisms, fish, forests, and crops (European Commission, 2022). According to the European Commission, bioeconomy covers all the sectors and systems that depend on resources of biological origin, such as plants, animals, micro-organisms, and derived biomass. According to the commission, the term bioeconomy also includes all the primary production sectors that produce and utilize biological resources, such as the forestry, agriculture, fishery, and aquaculture sectors, as well as all the industrial and economic sectors that use processes and resources of biological origin for the production of food, feed, energy, bio-based products and services excluding health biotechnology and biomedicines. (European Commission, 2018) According to the Forest Information System for Europe (FISE), the forest sector and the European forests are a crucial part of the circular bioeconomy, as the forest-based bioeconomy can provide several million jobs and uses both wood and non-wood materials for the production of renewable energy and bio-based products that are sustainably sourced. FISE also mentions that the forest-based bioeconomy maintains a large quantity of the cultural and regulating ecosystem services as well as livelihoods, meaning that the sector also contributes to a sustainable future and the mitigation of climate change. (FISE, 2023)

Bioeconomy is important to the future as it can help the growing problem of providing enough food and resources for the growing population by providing alternative resources such as biomass in a sustainable way. Bioeconomy can also enable the exploitation of new biomass sources such as waste streams. With bioeconomy, we are also able to produce such foods that are harmless to the health of living beings or the planet. (Bergeret et al., 2018,) Activities within the bioeconomy can be classified as natural resource-based activities, as they exploit bioresources directly and provide biomass for further processing both in activities within traditional manufacturing sectors, such as food, or wood-processing sectors, where biomass is being processed further as well as in non-traditional or newer sectors including the bioenergy, and bio-chemical sectors, where biomass and its residues are being further processed. (Baranano, 2021)

During the last decade, several countries and companies have started adopting bioeconomy strategies. The strategies have been promoted by emphasizing the importance of fighting

climate change, which the UN has in 2018 described as ‘‘the most systematic threat to humankind’’ (Achillas and Bochtis, 2020). The concept of bioeconomy has begun to spread more widely in the early 2000s and has taken an especially steep interest in recent years. The EU and the US have been areas that have been more active in adapting and advocating the concept of bioeconomy. The concept of bioeconomy is said to have two main perspectives: the perspective of using substitutive resources and the perspective of biotechnological innovation. However, the perspective of resource substitution has been spreading more widely during the 21st century. One of the main reasons why resource substitution has been the more popular concept is because studies have shown that the world has reached its oil peak, meaning that the oil levels have reached their maximum and have begun to fall leading to continuously increasing oil prices. This restricted availability of oil and increasing prices have made for example biomass an attractive option for an alternative energy, and material source. (Birner, 2018) Biomass can be considered a fundamental component of the bioeconomy, serving not only as an alternative to fossil fuels for energy applications but also as a resource for the production of various materials and chemicals (Krzysztof, 2016).

2.1.1 Circular business models for bioeconomy

Circularity as a concept has existed for a long time being influenced by several different ideas and concepts throughout time. There are many ways of describing and interpreting the concept of circular economy. However, most of these different concepts focus on either system changes or material use. The circular economy concepts that focus on material use have often three main principles. These principles include reducing and/or minimizing the use of raw materials, reusing materials, and components to maximize their utilization and long-term liveness, and recycling, enabling the reuse of valuable raw materials of high quality. These three principles are also known as the three Rs of sustainability. (UNECE, 2021; Winans, 2016) The definitions of circular economy that more focus on system change fixates on ending production cycles while at the same time utilizing renewable energy and exercising system thinking. Following the principles of sustainable business models enables a company to conduct a circular economy, where products are manufactured and produced more efficiently while simultaneously extending the product, and the

material lifespan, eventually making it possible to reuse them in new, purposeful ways. (UNECE, 2021)

Circular economy has in recent years become one of the key policy goals both in Europe and Finland. This has led to the fact that sustainability and emphasis on life cycle thinking have become more and more central. As EU's target is to become a strong, recycling-advocating society, while simultaneously promoting a circular economy. The global circular economy goals include improvements in energy and material utilization as well as an increase in the use of valuable raw materials and wastes. Bio-based materials can have a powerful impact on the alleviation of climate change through carbon storage methods. Bioeconomy can also be a vital part of ensuring both economic and ecological long-term sustainability. (Husgafvel et al., 2018)

The materials being used in bioeconomy are to a certain point circular. This sits well with the recent worldwide trend of turning toward more circular business models. The circular business model wants to find ways to preserve the values that a certain material or product, such as batteries, car tires, paper, electronics, or plastic has, and to maintain the value for as long as possible. (Jonker and Faber, 2021) The target of a circular business model is establishing a more bracing and regenerative system, where energy and material use, production of waste, and emissions to the environment are kept to a minimum or even obliterated by either limiting or closing certain energy and material loops. Circular business models aim at utilizing materials as efficiently as possible whilst in use and provide maximum benefit for as long as possible while simultaneously being able to return their residual value after the utilization. With this context in consideration, bioeconomy, and its circularity fit well into a circular business model instead of a traditional, more linear model, which instead bases on the strategy of taking, making, and disposing. As circularity and circular business models aim at reusing matter and energy, the concepts simultaneously decrease the need for new additions to the supply chains. (Achillas and Bochtis, 2020)

A circular bioeconomy concept aims at managing bio-based renewable resources more efficiently by accommodating different principles of the circular economy into bioeconomy. Due to the quickly growing humankind overusing natural resources and, thus, overstepping the planetary boundaries, it is crucial to implement such business models that

enhance circularity. With the help of circular economy and bioeconomy, we can lean away from the traditional linear economy where fossil-based resources stay in the center and rather go toward a more efficient economy, where the focus lies on biological resources, recycling, and waste management. (D'Amato et al., 2020) Hetemäki and Kangas (2022) describe circular bioeconomy as a concept that wants to build on collective principles of both the bioeconomy and the circular economy concepts, which often are linked to each other. Hetemäki and Kangas also mention that the European Environment Agency has explained that by implanting both the bioeconomic and the circular economy concepts together as one, the outcome could lead to more efficient research while simultaneously reducing various environmental pressures.

Circular business models and emphasis on bioeconomy are visible in the current global trends. As mentioned earlier, the heavy reliance on natural resources, its burden on the environment in forms, such as pollution and degradation as well as the risk of us running out of these resources has led to the development of several new environment-focused programs and concepts, such as the Fit For 55 programs, which aim to lower emissions and harm caused to the environment as well as technologies, such as Bioenergy with carbon capture and storage (BECCS), which aim at creating new solutions for lowering greenhouse gasses and thus decelerating the global warming.

2.1.2 Bioenergy with carbon capture and storage (BECCS)

The pulp and paper industry is known for being one of the sectors with the highest industrial energy consumption. This claim is true also in Finland, where in 2018, the pulp and paper industry was the largest user of industrial energy being responsible for around half of the total industrial energy consumption. (Koreneff et al., 2019) In recent years, the pulp and paper industry has also become one of the industries using most industrial bioenergy. These mills produce mostly chemical pulp from which about 50% of the wood raw material goes to the end product whilst the remaining 50% is being used for generating renewable energy. Most mills use recovery boilers as a part of the pulping process. These boilers also create large quantities of carbon dioxide, of which the majority is currently released into the atmosphere.

BECCS combines two mitigation alternatives: biomass combustion for energy generation (power, heat, and liquid fuel) and carbon capture and storage. BECCS is classified as a negative emission technology (NET). NETs are different methods within geo-engineering supposed to remove greenhouse gasses from the atmosphere and in this way reduce the negative impact that the energy systems have on global warming. The two combined mitigation alternatives used in BECCS can remove greenhouse gasses by capturing the CO2 and storing it in permanent geological formations while using biomass for electricity generation. BECCS is claimed to enable negative carbon emissions as it is used for capturing the CO2 that the burning of biomass generates. The CO2 that is captured is then stored in geological formations or used in the production of certain products through the processes of carbon capturing and utilization (CCU). (Fragkos and Siskos, 2022; The Royal Society and Royal Academy of Engineering 2018)

Even if BECCS could provide partial relief for reducing carbon emissions, it does not come without its faults. The procedure of implementing BECCS would crave much land and precise planning not to forget that the process of capturing and storing the CO2 itself creates emissions. For the beneficial utilization of BECCS, it is essential to understand how to implement it in a way that ensures the sustainability of its value chain. It is crucial to consider that the application of BECCS should not negatively affect other sustainable development goals. By adopting this approach, regions can explore ways of integrating multiple technologies and developments instead of relying solely on a single method. (Fajardy et al., 2019) Taking these factors into consideration, BECCS should not be thought of as the sole possible solution for reducing carbon emission levels but rather as a part of the solution supported by better forest management.

2.1.3 Forest bioeconomy

In recent years, bioeconomy has become a significant topic both in academic and policy circles. As the earlier chapters (2.1 and 2.1.1) explain, the forest industry can be strongly linked to bioeconomy and circular economy, due to its connection to recycling, a source of renewable energy and as a strong influencer in the circular economy, as it provides biological material, which, when handled properly, can be used circularly. (Panwar et al., 2015) However, to be able to benefit from the forest bioeconomy, much emphasis must be

put on planning and consideration. This all starts by focusing on sustainable forest management and is continued with the optimal use of wood, where the material is being utilized as efficiently as possible in every part of the production stage. (UNECE, 2021)

When talking about forest bioeconomy, we talk about the part of bioeconomy that includes forestry, the pulp and paper industry, and different wood products. Forest bioeconomy also includes the utilization of other forestry products not related to wood, such as berries and mushrooms gathered from forests, or gained as side streams of forest biomass from various industrial actions. Forest bioeconomy includes also the different operations related to forestry, such as transporting, harvesting, and forest biomass processing. Forest bioeconomy is a sub-category in bioeconomy but plays a significant role in various areas of the world. In the European Union, the dominant sector in the bioeconomy is the agriculture-, and food industry, where the agriculture industry in 2017 was responsible for around 53%, and the food industry for around 25% of the employment created by bio-industries within the bioeconomy. But a significant part of the employment created by bio-industries comes from the forest industry, which in 2017 was responsible for around 14% of the total bioeconomy employment, which equals to around 2.5 million jobs from a total of 17.5 million jobs. (Hetemäki and Kangas, 2022; Karvonen et al., 2017)

Not only does forest bioeconomy play a significant role in the bioeconomy-related job creation, but it also has a major influence on the bioeconomic value creation in the EU. In 2017, bioeconomy was said to have created 614 billion euros of added value in the EU's economy. From the EU's total GDP in 2017, bioeconomy was responsible for 9%. Of this, 4% came from the forest bioeconomy. However, the added value percentage varied greatly within regions. For example, in Finland, forest bioeconomy was responsible for around 35% of bioeconomy-related added value and around 23% of people employed by bioeconomy. In countries, such as Finland or Sweden, where the forest bioeconomy plays a meaningful role in the national economy, the strategies regarding bioeconomy and forests aim at increasingly utilizing woody biomass to reach the highest possible sustainable volumes while also aiming to reach forest biodiversity and nature conservation targets. (Hetemäki and Kangas 2022,) As the numbers indicate, forest bioeconomy and materials such as forest biomass play a major role in the EU value creation and the economy in forest-rich countries such as Finland.

2.2 What is Biomass

For plants to grow, they need to perform photosynthesis where carbon dioxide from the atmosphere and water in the soil is converted into carbohydrate. From here the other living organisms can use the energy that is stored in the plants by degrading the carbohydrate into water and carbon dioxide. Therefore, plants are extremely important sources of food and energy for humans as well as other living organisms that feed on plants. Biomass can be defined as organic resources that originate from animals or plants excluding fossil resources, such as oil gas natural gas, and coal. (Tojo and Hirasawa, 2014) Biomass is both abiotic organic matter and plant or animal-based matter that is available on a renewable level. Biomass includes wood-, plant- and agricultural crops as well as organic waste such as manure (Dufour, 2016). The definition ‘‘biomass’’ is used especially when the material is used for creating energy, fuel, chemicals, or plastic (Opetushallitus, 2023).

Biomass has been used as a source of fuel for as long as humankind has been able to make fire. Before fossil fuels became popular in the twentieth century, biomass was the main source of energy. Even today biomass plays a major role as an energy source for developing countries. There are several reasons why biomass is seen as a favourable energy source. For example, plants can work as nature’s own solar panels that can convert solar radiation into energy, store energy as well as absorb carbon dioxide from the atmosphere. (Fekete, 2013)

Even today, one of the most crucial applications of biomass lies in its utilization as an energy source. For example, in the EU around 50-60% of the renewable energy being consumed originates from biomass making it the main source of renewable energy within the EU (Göss, 2023). Biomass that is currently unexploited could provide as much as 10-20% of the global energy demand. Reasons for why biomass could be seen as a potential source of energy is that it is available in nearly all parts of the world making it a valid alternative in a situation, such as the energy crisis, where traditional sources of energy become limited or unavailable. Biomass as an energy source could also help to cut the demand for fossil fuels as well as lowering the overall energy cost. Despite biomass being among the earliest fuels utilized by humanity, there remains a lack of comprehensive guidelines on its modern

technological utilization. This has to do with the fact that a big percentage of biomass is the residue of different crops and plants making the residues distinct from each other in a molecular- and microscopic matter. The residue used for creating biomass also often has several useful bioactive substances such as antioxidants that could be useful for other purposes. These factors make it quite difficult to produce biomass, as it requires a great amount of thought to be able to utilize the raw materials in the most sustainable and useful way. (Bonechi et al., 2017).

Biomass is used as material for biofuel. Biofuels extracted from biomass are wood shavings and pellets, firewood, nutshells, and certain fruit stones from fruits, such as avocados or olives. From the above-mentioned material, firewood is the least processed, as it usually is burned directly. The wood shavings are created when either agricultural or forestry biomass is being crushed, meaning, that the chips can vary in size depending on the manufacturing process and the materials transformation process. The pellets are the most refined forms of biofuel created by pressing biofuels with binders. As these materials continue to be generated as by-products in growing quantities, they can be seen as a promising option for generating thermal energy while concurrently serving as a means to mitigate CO2 emissions. (Perea-Moreno et al., 2019) The main sector utilizing biomass for bioenergy within the EU is the heating sector where biomass is used both in networks and centralized district heating plants typical in Scandinavia and in decentralized wood stoves used by many residences in other EU countries (Göss, 2023). As Figure 1 shows, in 2016, renewable energy sources accounted for around 17% of the total energy consumption in the EU. From this, bioenergy was the main source, as it answered for nearly 60% of the total renewable energy sources. The figure also shows that most of the bioenergy (74.6%) is being used within the heating and cooling sector while bioelectricity and transport biofuels combined only accumulate to around 25% of the total bioenergy consumption. (European Union, 2019)

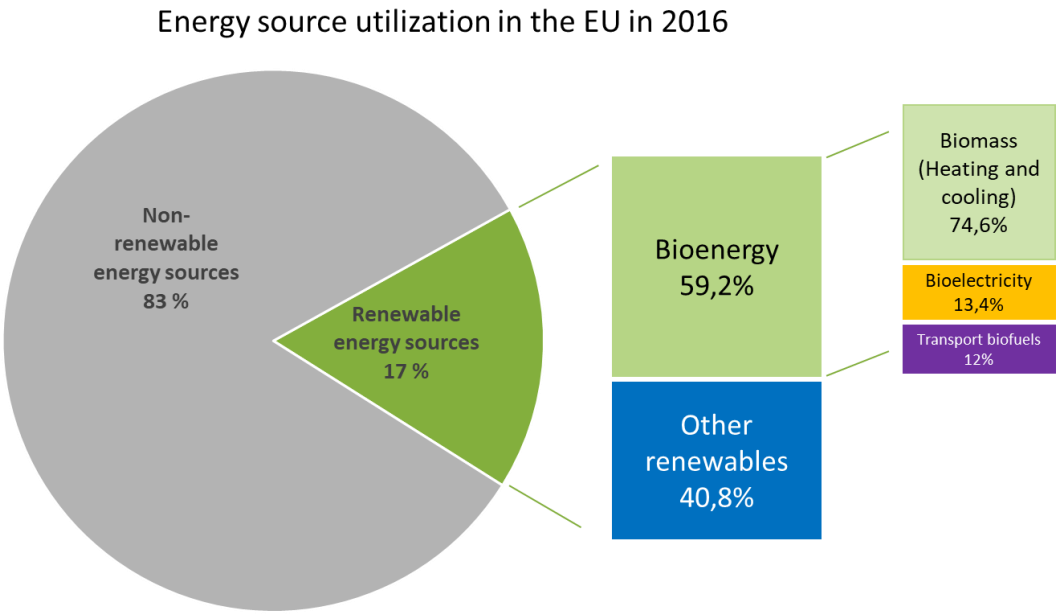

Figure 1. Energy source utilization in the EU in 2016 (European Union, 2019)

In Finland in 2019, renewable energy sources accounted for 35.1% of the country's total energy supply, referring to the total use of resources. 43% of the final energy consumption came from renewable energy, and 85% of the renewable energy was biomass, where 90% of all the biomass originated from solid biomass. This solid biomass largely originated from the forest industry (sawdust, bark, and chips) as well as the pulp and paper industry, which produces black liquor as a side product. The solid biomass is mostly used in the heat and electricity process as well as in district heating plants. (IEA Bioenergy, 2021) The biomass that is created from pulp and paper mill waste is largely being used in industrial and conventional procedures. The majority of this biomass generated is based on woody features and is used as energy or fuel sources within the pulp and paper industry as well as other industries. As Figure 2 according to Haile et al. shows, different biomass materials originating from the pulp and paper production process are being used for different purposes within different industries. For example, the black liquor that the pulp and paper industry produce as by-products in the paper production process is being utilized for energy within the pulp and paper industry. (Haile et al., 2021)

Type of waste	Utilization scheme	Industry
Black liquor	Energy	Pulp and paper
Sawdust	Furniture and building	Construction
Sludge	Compost	Agriculture
	Energy	Pulp and paper
	Cement base	Construction
Fly ash	Binder Components	Construction
	Soil Amendments	Agriculture/Forestry
	Cementitious Material	Construction
Dregs	Fertilizer	Agriculture
	Wastewater treatment	Environmental technology
Grits	Building	Construction
Lime mud	Fertilizer	Agriculture
	Building	Construction
	Stabilization	Environmental technology

Figure 2. How biomass materials from pulp and paper production are used across various industries (Haile et al., 2021)

It is important to remember that biomass is not an emission-free energy alternative. Biomass is often referred to as a carbon-neutral source of energy as materials used for biomass, such as trees and plants, can absorb nearly the same amount of CO2 during their growth as the burning of biomass creates. However, many of these theories often forget to take into consideration the amounts of carbon dioxide that is created during the processing of biomass. However, even with this in consideration, biomass is seen as an environmentally friendlier energy option if the process and utilization are executed carefully and could thus play a significant role in replacing fossil fuels. (Speight, 2022)

2.2.1 Biomass versus fossil fuels

The rapidly growing world population and its rising need for energy significantly contribute to the risk of depletion of fossil fuels. Furthermore, the extensive use of fossil fuels will keep generating elevated CO2 emissions, thereby continuously influencing global warming. The global population is expected to reach approximately 11.2 billion by the year 2100, indicating that the demand for not only fossil fuels but also all other raw materials will continue to rise. However, there are ways of delaying this rapid consumption. Essential ways of delaying the rising consumption include improving energy efficiency

and exploring new fossil fuel reserves. However, arguably the most significant factor in delaying consumption is to rapidly develop and start utilizing renewable energy alternatives. Bioenergy plays a significant role in achieving the EU's targets of increasing renewable energy utilization in the energy mix. By 2030, the aim is to reach 32% of renewable energy source utilization in the total gross energy consumption. In a world striving to reduce its dependency on fossil fuels, biomass plays a significant role as the renewable carbon source for renewable fuels, various chemicals, organic mass, and carbon products. (European Union, 2019; Henrich et al., 2015)

As mentioned, the fossil fuel resources in the world are not limitless. This underscores the importance of deriving energy from a more sustainable source, such as biomass, which can be produced by utilizing various renewable sources, including waste and plants. Another benefit of utilizing biomass is the fact that fossil fuels like coal or oil often require importation from other countries, whereas many nations can generate bioenergy from their domestic resources. (U.S. Department of Energy, 2015)

While biomass is not emission-free, it considerably reduces CO2 emission levels compared to fossil fuels This is because the sources used to create biomass, like plants and trees, absorb CO2 through photosynthesis, as shown by IEA Bioenergy (2023) in Figure 3. This makes biomass that originates from trees and plants renewable, and the energy that is gained and utilized nearly carbon-neutral. (Pang, 2019) Using wood-based bioenergy as a source for heating and cooking can also result in lower CO2 emission levels. However, this is not achieved if the utilization of wood is not processed right, as the smoke generated from wood contains damaging pollutants such as carbon dioxide. Another factor that could compromise the sustainability of utilizing wood as a biomass resource is harvesting wood too intensively, outpacing its natural growth and leading to deforestation. However, utilizing modern wood-burning stoves and pellet stoves, and adopting sustainable wood harvesting practices can decrease the pollution level arising from wood combustion. Additionally, it holds the potential to prevent deforestation, making wooden biomass a more sustainable alternative compared to fossil fuels. (EIA, 2022)

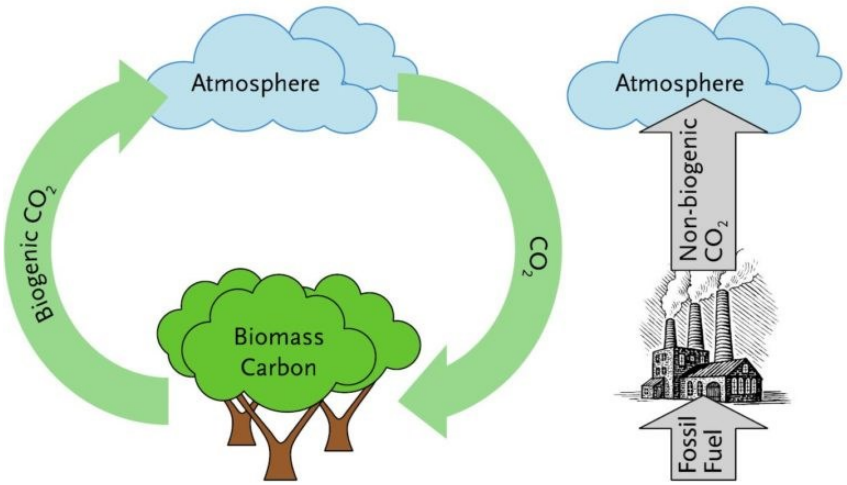

Figure 3. Biogenic versus non-biogenic CO2 emissions according to IEA Bioenergy, 2023

There have been discussions about whether using biomass instead of fossil fuels is any better. Even though burning biomass creates as much, or even slightly more CO2 emissions than fossil fuels, such as coal, the utilization of the raw materials has significant differences. Burning fossil fuels releases carbon into the atmosphere that has been stored in the ground for millions of years. This process results in the release of a new greenhouse gas. On the contrary, burning biomass releases such carbon in the air that is part of the biogenic carbon cycle and is for the most part balanced by the carbon dioxide that is being captured during its growth. This signifies, as illustrated in Figure 3, that the combustion of fossil fuels increases the total carbon emissions in the atmosphere, whereas burning biomass returns the same carbon to the atmosphere that was initially absorbed during the growth of plants. (IEA Bioenergy, 2023; NREL, 2023)

2.2.2 Forest biomass

In 2017, 17.7% of the global gross final energy consumption came from renewable energy. Of the total renewable energy consumption, around 73% came from biomass making it the biggest source of renewable energy (World Bioenergy Association, 2019). Of this, 85% came from the forest industry or the forests. Most of this forest biomass (over 70%) was derived from fuelwood, but also from charcoal, recovered wood, residues from traditional forest product manufacturing as well as forest harvest residues. Forestry-derived biomass has two major classes: primary feedstock, taken directly from the forests, and secondary

feedstock, generated as by-products in forest manufacturing. The primary feedstock consists of tree remainders left from harvesting (tops, branches, and stomps), stems or whole trees that do not qualify for merchandising and are left after harvesting, and stems recovered from disruptions such as forest fires, insect infections, or other sorts of diseases. Secondary feedstocks consist of chips, bark, sawdust, black liquor as well as tall oil from pulp, and sawmills that are the by-products created in the wood-processing stages. (Titus et al., 2021)

In industrialized countries, forest biomass that is being used for bioenergy is often derived from forests that have multiple purposes, including pulp and saw log production. The raw materials that the forest industry provides for bioenergy feedstocks mostly consist of by-products produced from pulp and paper production, sawn wood, as well as thin trees and remains from forest management. (Berndes et al., 2016) Forest biomass also has other uses than just energy. It can also be used to produce different materials and several different services for other ecosystems (Anttila and Verkerk, 2022). Forest biomass can be utilized for different bioproducts, such as chemicals and other materials (Cambero and Sowlati, 2014).

2.3 The forest industry in Finland

Wood processing and forests play a significant role in the Finnish industrial sector as well as the Finnish economy. Wood processing belongs amongst the most important sectors in the context of Finnish exports, constituting approximately 19.2% of the overall value of Finland's export activities. In contrast to its size, Finland is the country whose economy relies most on the forest sector and its forests in general. (Metsäteollisuus, 2022a) The forest sector is the term that is used to describe the forest industries and forestry. According to the European Commission, the term ‘‘Forest-based sector’’ or forest sector covers forest resources, as well as the consumption, production, and trade of forest services and products. (European Commission, 2013) Finland has long traditions in the forest industry and has been dependent on it throughout history. This dependence has fostered a substantial level of expertise and experience in the field of forestry. The forest industry is also an important factor as an employee in Finland as it in 2019 provided jobs for around 40,000 people. (Metsäteollisuus, 2022a; Ministry of Agriculture and Forestry of Finland, 2022a)

Modern pulp and paper mills as well as sawmills in Finland utilize industrial by-products for energy production or production of other products. Many of the traditional mills have been transformed into biorefineries, where the utilization of the wood material is taken to the next level by producing bio-based products and different biomaterials from the wood residues and waste. (Ministry of Agriculture and Forestry of Finland, 2022a)

2.3.1 The Pulp and Paper Industry in Finland

The pulp and paper industry in Finland plays a significant role in the country's national economy. In 2021, paper and cardboard were the most significant export products in Finland as 6.4 billion euros worth of paper and cardboard was exported. Pulp also stands out as one of Finland's most important export products, with exports totalling around 2.6 billion euros in 2021, ranking it as the sixth-highest export category in the country. (Metsäteollisuus, 2022b) Mechanical pulp was implemented in the Finnish paper industry in 1959. Before this, paper was produced by hand, using old rags and clothes. Throughout the years the Finnish pulp and paper industry has developed into one of the backbone industries in Finland, which has also led to the fact that industrial buildings, such as power plants, waste facilities, and chemical, and sewage plants were built to operate around pulp and paper mills. Not only do the Finnish pulp and paper industries provide jobs, but they also work as providers of electricity, waste disposal, and district heat. (Pakarinen et al., 2010)

Finland's forest industry generates substantial volumes of pulp, paper, and mechanical forest industry products. According to the data in Figure 4 by Statista, Finland was the second-largest pulp producer in Europe in 2021, producing a total of 9.3 million metric tons only behind Sweden, where the corresponding figure was 10.1 million metric tons. When combined, Finland and Sweden were responsible for around 60% of all the pulp produced by the Confederation of European Paper Industries (CEPI) countries in 2021. (Statista, 2023a)

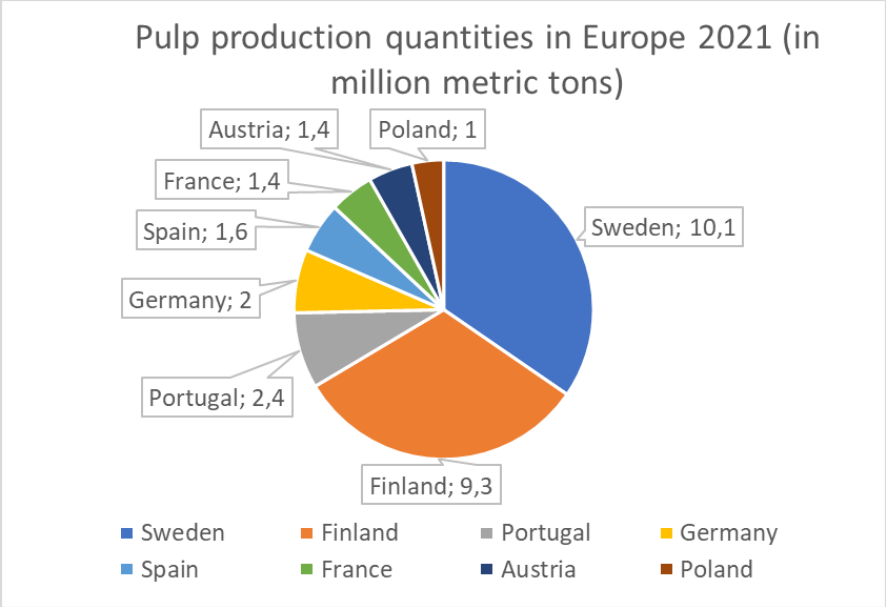

Figure 4. Pulp production quantities in Europe 2021 (Statista, 2023a)

Finland is also among the biggest paper and board manufacturers in Europe (see Figure 5). In 2021, Finland produced the fourth most paper and board amongst the most significant paper and board producing countries in Europe with a quantity of around 8,7 million metric tons right behind Sweden, which produced around 8,9 million metric tons of paper and cardboard. In 2021, Germany was the biggest paper and board manufacturer with a total of around 23,1 million metric tons produced paper and board. (Statista, 2023b)

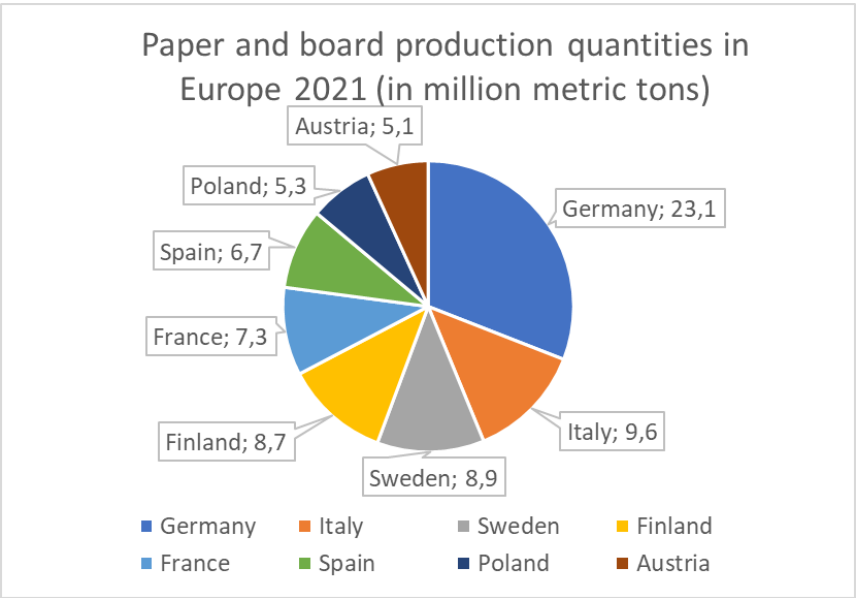

Figure 5. Paper and board production quantities in Europe 2021 (Statista, 2023b)

When comparing the Finnish paper and pulp mills to the mills in the rest of the European Union, Finland stands in most comparisons above average. For example, the Finnish mills can be seen as large, modern, and efficient when compared to the mills in the EU. The mills in Finland also utilize electricity and steam being by-produced in the mills, improving their energy efficiency. The statistics from 2019 indicate that the Finnish market pulp production is the most energy-efficient in the EU, even accounting for the additional heating requirements of the country's geographical location, which is considerably colder than that of most EU countries. (Fisher, 2019) Therefore it is no coincidence that Finland and Sweden operating alike within the pulp and paper industry, are seen as forerunners of operations related to energy efficiency and decarbonization of the pulp and paper industry. For instance, both Finland and Sweden generate significant quantities of kraft pulp and possess exceptionally large domestic forest biomass resources. These factors enhance the countries' potential to generate bioenergy, consequently improving their energy efficiency. (Lipiäinen et al., 2022)

2.3.2 Energy sources used in the forest industry

The forest industry requires extensive amounts of electricity and heat to operate and is a significant part of the total energy consumption, especially in countries, such as Sweden or Finland, where the forest industry plays a big part in the country's economy. Statistics from 2021 show that the Swedish forest industry's share of the country's total electricity use was around 14%. The same statistics are even slightly higher in Finland where the forest industry in the same year was responsible for around 20% of the country's total electricity consumption. (Swedish forest industries, 2020; Swedish forest industries, 2021; Tilastokeskus,2022)

The energy sources used in the Finnish and Swedish forest industries heavily rely on wood-based fuels. In 2019, the Swedish forest industry's energy consisted of around 96% wood-based fuels while the respective number in Finland was 87%. The remaining energy sources for both countries consisted mainly of oil, natural gas, coal, peat, purchased electricity, and heat. These figures are notably high when compared with Europe's total energy consumption within the pulp and paper industry, which in 2016 consisted of about 40% fossil fuels in the fuel mix. The forest industries use steam for different manufacturing

processes. The steam is generated by burning wood residues and black liquor. Both the Swedish and Finnish Pulp and paper industries are producing a large part of their steam need on their own. However, the mills are not capable of producing all their steam needs on their own, which is why part of the steam is purchased from third-party energy companies on-site to whom certain boilers are outsourced. The mills in Sweden and Finland can produce around 30-50% of the electricity they consume. In addition, the mills purchase electricity from the grid. (Lipiäinen et al. 2022)

The modern pulp and paper companies in Finland are run by a combined approach that uses wood by-products such as bark, sawdust, recycled wood, waste wood, and black liquor as well as process waste to produce energy and heat (Ministry of Economic Affairs and Employment of Finland, 2017). Pulp and paper manufacturers generate energy-loaded biomass in several parts of the production. The quantity of biomass generated varies based on the technological level of the mill, the quality of wood, and the paper grades produced. The energy that is recovered from the biomass conversation is then used in different operations within the mill. This approach can assist mills in enhancing efficiency, reducing capital costs, and operating in a safer and more eco-efficient manner compared to traditional methods that rely on burning fossil fuels for energy. (Gavrilescu, 2008)

Biomass is also mentioned to play a significant part in different climate goals set by the European Union (EU), such as the one called Fit For 55, which aims to reach climate neutrality in the EU by 2050 (Meth, 2021). Thus, as the production of renewable energy in the EU heavily relies on biomass (see Chapter 2.2), the forest industry also plays an important role in achieving these goals, given its substantial role as both a producer and consumer of renewable energy. However, the ambitious goals will also require significant changes from companies. Particularly businesses within the pulp and paper industry with high emission levels and energy consumption can face increased emission trading costs or carbon tariffs. To answer the new regulations of reducing emission levels, companies are required to make substantial technological investments and changes in the production processes. (Confederation of Finnish Industries, 2021) Energy scenarios published by the EU Commission state that biomass use is most likely increasing its share in energy consumption. The level of increase is believed to depend on the development of energy savings, electrification, and other renewable raw material developments. The EU scenarios recognize

biomass sources, such as lignocellulosic grasses, wastes, and residues to have the biggest growth potential. (Göss, 2023)

2.3.3 The forest industry's role in Finnish energy production

The Finnish Forest industry is a major producer of renewable energy and the raw materials used for its production in Finland. In 2018, 30% of Finland's total energy consumption was supplied by bioenergy, with nearly all of it produced from wood-based fuels. From this, nearly half (45%) stemmed from black liquor derived from the pulp while the rest originated from different side streams. Black liquor is the main wood-based energy source in Finland. The increased use of black liquor is also among the main reasons for the increase of wood-based energy. (Forest, 2019; Ministry of Agriculture and Forestry of Finland, 2022b) Of all the energy that the Finnish forest industry produced in 2019, 87% was renewable energy. Finnish woodworking enables up to around two-thirds of all Finnish renewable energy production (Metsäteollisuus, 2022a).

Of the wood-based bioenergy produced in Finland, 80% is produced by using by-products and other remains from the forest industry, forestry, and harvesting operations. In Finland, most of the city centers located outside the Finnish capital region use district heating plants. In these plants, the main energy source is wood in the form of residues and pellets. The fuel for heating plants is sourced from the rural areas surrounding the mills, constituting a significant portion of income for both forest owners and biomass operators. (Ministry of Economic Affairs and Employment of Finland, 2017)

Being heavily involved in the country's renewable energy production also brings economic advantages to the Finnish forest sector, with emphasis on the considerable business opportunities presented by wood-based biofuels and chemical production within the forest industry. Additionally, as the forest industry already has existing infrastructure, particularly in the biorefinery business, the industry gains a notable competitive advantage over other actors within the business. However, other countries are also putting focus on their biorefinery business within the forest sector. Even though this aggravates the global competition, it also grows the market for the actors. (Hämäläinen et al., 2011)

3 Business success and competitive advantage

This chapter is set to present factors affecting business success. The chapter will also provide knowledge on how competitive advantage is gained. First, the chapter introduces the concept of business model canvas by Alex Osterwalder and Yves Pigneur, which can help companies understand their needs and challenges related to economic success. The chapter continues by providing knowledge of the extended version of the concept by Alexander Joyce and Raymond Paquin, which also considers environmental and social sustainability layers. Next, the factors influencing business success, the significance of customer relationships to business success and sustainability, and strategies for attaining competitive advantage are discussed.

3.1 Business Model Canvas

The business model canvas (BMC), invented by Alex Osterwalder and Yves Pigneur, is a tool that companies use to visualize, describe, challenge, and invent or change existing business models. The canvas is used by several global leading companies and is a globally well-known analysis method. (Osterwalder and Pigneur, 2010) The BMC is said to offer entrepreneurs a better overall understanding of the value creation of the business where value propositions lay at the center of the analysis (Sort and Nielsen, 2018). The BMC also serves as a framework for users to design a comprehensive evaluation process that, from the outset, takes into account how valuation can influence decision-making (Ferranti and Jaluzot, 2020).

One of the main goals of a business model is to describe how a company can create, deliver, and capture value from products or services. (Toro-Jarrin et al., 2016) According to Osterwalder and Pigneur, a business model can be described by nine building blocks (figure 6) that together build the business model canvas. Together, these blocks are supposed to build a logical picture of how a company plans to generate money, and how it can achieve the goals of achieving economic value. The nine presented blocks cover the main four areas within a business, which are customers, infrastructure, offer, and financial viability. The nine building blocks in the original BMC are customer segments, value propositions,

channels, customer relationships, revenue streams, key Resources key activities, key partnerships, and cost structure. (Ferranti and Jaluzot, 2020; Osterwalder and Pigneur, 2010)

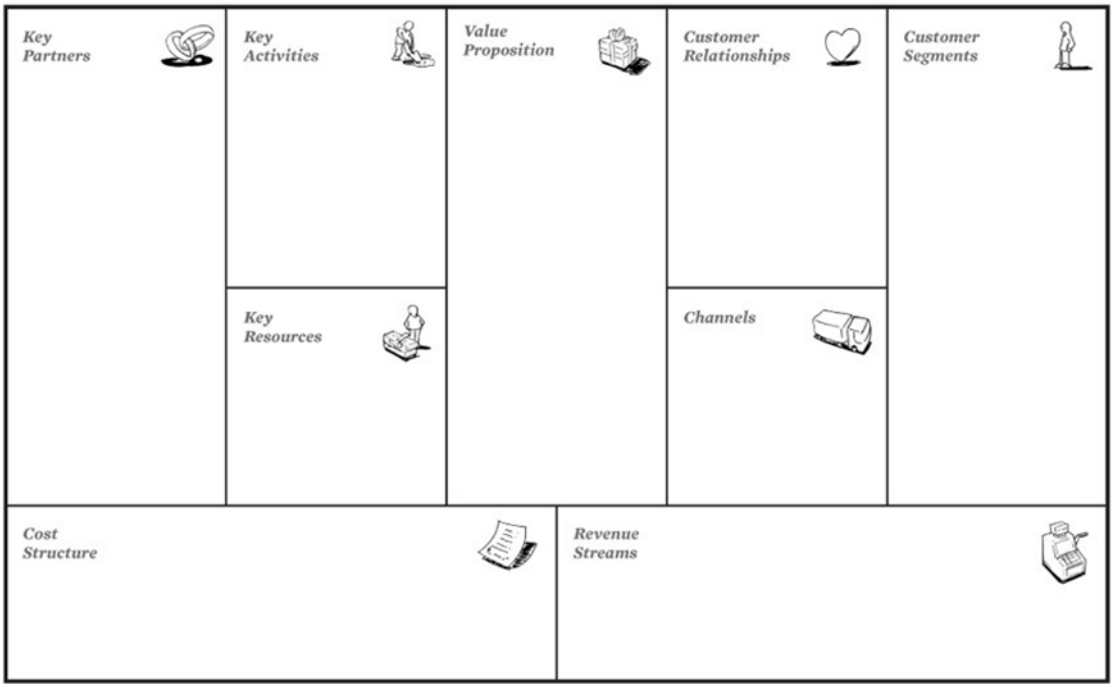

Figure 6. Business Model Canvas according to Osterwalder and Pigneur, 2010

By using these nine building blocks presented in the BMC, the stakeholders can build a clearer understanding of the uniqueness of the business as the canvas demonstrates the ways that the business can capitalize, deliver, or build on the value that the business offers. This also makes it easier for investors and customers to understand the business's potential and how the business could benefit them. (Fogarassy and Finger, 2020; Sort and Nielsen, 2018)

Due to the simplicity and universality of the business model canvas, a business model presented by the canvas model, most often makes the model easy to understand. The canvas also helps to include only the necessary information while still providing enough information so that the idea or model can be discussed with others. The business model canvas is also praised for its simplicity, practice orientation, and the possibility of using the canvas even when starting from scratch. (Ching and Fauvel, 2013) The BMC has also been praised for its application to nearly all business model types (Plenter et al., 2017; Toro-Jarrin et al., 2016).

Even if simple to use, the business model canvas does not come without its flaws. The BMC has been criticized for not including a broad analysis of the competition or considering the competition structures, which would describe for example the number of competitors in the market or the supply and demand levels within the market. Another criticism that the BMC has faced is that it does not include formulating the business goals and key performance indicators. (Ching and Fauvel, 2013) As mentioned above, one of the BMC's advantages is it being universally applicable to almost all business models. This universal and simplified manner of approach can become an issue when creating business models that are supposed to be precise. The problem with the traditional BMC is that it does not provide enough possibilities to describe certain important factors. (Plenter et al., 2017) The nine building blocks of the BMC are considered to cover relatively comprehensively the main needs of a business model. However, one problem mentioned about the model has been related to it limiting the user to analyze only one business model at a time when in reality, companies continuously need to adapt to both internal and external changes impacting the business. This is why also business model methods should consider the ability to continuously transform and evolve the model. (Fritscher and Pigneur, 2020)

3.1.1 Sustainable business model canvas

The BMC is a great tool for analyzing decisions made at the business level. In the traditional BMC, the emphasis lies in creating economic value as the businesses create value for their customers and in return gain financial value from the customers. Yet, the traditional BMC, with a focus on economics, fails to incorporate the ecological aspects of the business adequately. The model is unsuccessful in addressing the requirements of the circular economy, which requires a more extensive analysis across multiple layers. (Chen et al., 2020) Several practitioners claim that a sustainable business model that includes anticipatory management, long-term planning, and both monetary and non-monetary value creation for all stakeholders, must take into consideration the needs of all stakeholders including social and environmental dimensions on top of the economic necessities. This has led to the creation of new sustainable business models, such as the Triple-layer Business Model Canvas (TLBMC) by Alexander Joyce and Raymond Paquin, including economic, social, and environmental layers. (Ensign et al., 2021; Geldres-Weiss et al., 2021)

The pressure of responding to the widely spoken sustainable concerns has been increasing also among businesses. On top of economic issues, businesses are today also expected to respond to issues related to social inequalities, environmental issues, the use of raw materials, energy demand, and technological development. The TLBMC by Joyce and Paquin was created for the exploration of business models that are sustainability-oriented. The economic layer of the model is like that by Alex Osterwalder and Yves Pigneur. However, in addition to the original BMC, the social layer focuses on the stakeholder perspective, and the environmental layer focuses on the life cycle perspective. Together these layers create a broader and more articulated business model describing how businesses create value on all three layers and recognize sustainability initiatives at both operational and strategic levels more comprehensively. Joyce and Paquin mention that the TLBMC can help businesses overcome barriers that currently are stopping them from implementing changes that are sustainably oriented. (Joyce and Paquin, 2016; Geldres-Weiss et al., 2021)

In the TLBMC, the social layer (figure 7) is created to build on an approach of stakeholder management to explore the social impact of a business. According to Joyce and Paquin, a stakeholder management approach aims at balancing the business's stakeholder interests instead of aiming at maximizing the company’s winnings. Stakeholders include a collection of individuals or entities including customers, employees, the community, and shareholders, who have the potential to influence or be influenced by a company's actions. (Joyce and Paquin, 2016) The social layer also shows the interaction between the organization and its stakeholders (Abbasnia et al., 2023). Not only does the social layer aim at understanding the relationship between the company and its stakeholders but it also helps to clarify, which negative social impacts occur from the relationship between the company and its key stakeholders and what social benefits the relationships generate (Garcia-Muina et al., 2020).

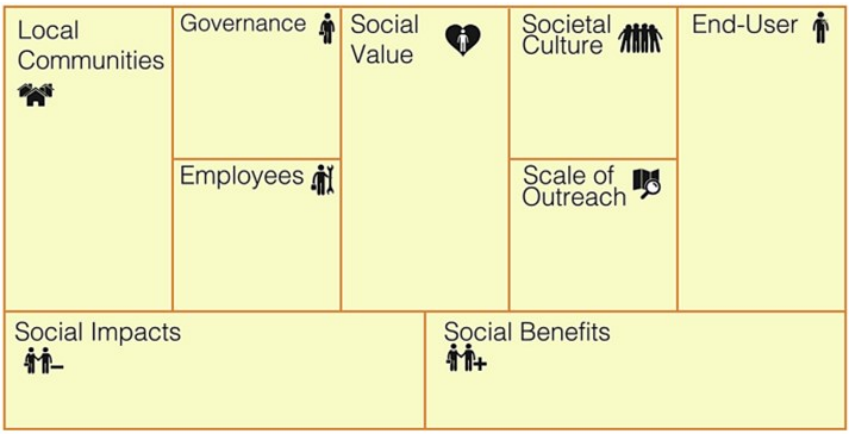

Figure 7. Social stakeholder Business Model Canvas (Joyce and Paquin, 2016)

In Joyce and Paquin's canvas, the environmental layer (Figure 8) describes the life cycle perspective of impacts related to the environment. The background for this perspective comes from a research and practice called Life Cycle Assessments (LCA), an approach that measures the environmental impacts of a product or service through its whole life cycle. (Joyce and Paquin, 2016) The purpose of the layer is to gain an understanding of what environmental benefits could occur from a company's sustainability actions and what negative impacts are caused during the life cycle of their products and services. The layer helps companies to recognize the biggest issues considering their environmental impacts as well as clarifying the company's most significant circularity and sustainability practices. (Garcia-Maina et al., 2020) By using the environmental layer of the TLBMC, an organization is also able to understand how it could generate more environmental benefits instead of creating more environmental impacts (Pardalis et al., 2020).

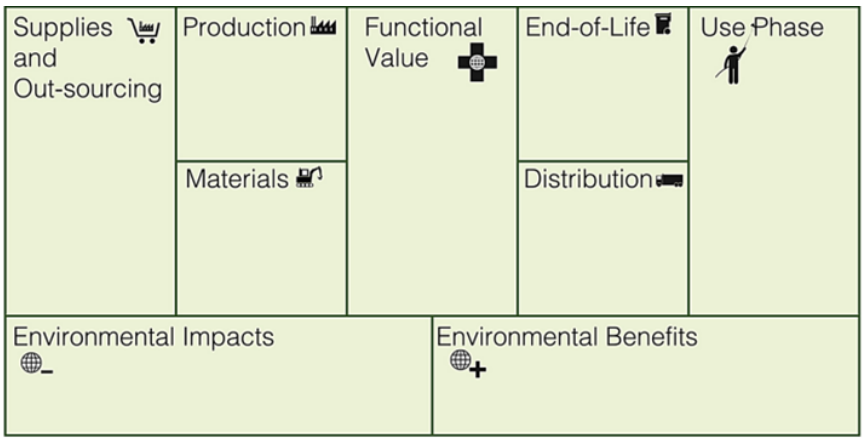

Figure 8. Environmental Life Cycle Business Model Canvas (Joyce and Paquin, 2016)

While the TLBMC offers a comprehensive understanding of the three pillars of sustainability, it alone cannot assess the potential of the solutions it presents. Therefore, it should be followed by a more in-depth analysis (Garcia-Muina et al., 2020). The TLBMC also provides only a summary of the factors being analyzed and, thus, often lacks many necessary details. This however is not a disadvantage of the tool per se, as the main point of the tool is to provide an extensive overview of the business model itself and, thus, could lead to new ideas, deeper analysis, and innovations being developed. (Joyce and Paquin, 2016)

One topic central in all layers of both business model canvases is people and the relationships between the business and the stakeholders, whether they be the customers, employees, or communities. Especially when combining these layers, it is clear that strong relationships and good interaction between the company and its stakeholders can positively impact the success of the company as maintaining and developing the relationship leads to positive outcomes for both parties. (Joyce and Paquin, 2016) The stakeholder centricity is no surprise as the relationship management between the company and its customers as well as other stakeholders has continuously been seen as an important factor affecting the success of a business. Today, when customers are more involved in the service process and require more interaction between the customer and the employees, the relationships must be managed well so that both parties can achieve the desired outcomes from the relationship. Connections and relationships represent important intangible assets and should be managed strategically to ensure effective relationship management. Theories also suggest that competitive advantage is possible to achieve and maintain by utilizing the specific features related to such assets, as customer relationships. (Angelini, 2018)

3.2 Customer relationships and sustainability

It is widely acknowledged that strong relationships are essential and bring advantages to the company, customers, shareholders, and stakeholders. Today, instead of treating customers as a homogenous entity, companies should approach them more individually. However, this does not mean that every customer should be given equal attention. The business needs to recognize its key customers, whom they believe they can build long, sustaining relationships with. (Gordon, 2013) Managing the relationship between a company and the customer is an essential part of the company's success. A better understanding of the

customer's background, needs, satisfactions, and preferences can help the company with its key business decisions. When the business understands its customers' needs, it is easier for them to prioritize investments regarding services, products, technologies, and processes leading to improved customer experience. However, it is equally important for the business to have a clear vision of its own business and how customers see it. To know one's own business, one must be able to understand the current performance level as well as understand how well the customer expectations and needs are currently met. (Villani, 2019)

The concern of increasing pollution levels and resource consumption related to businesses has increased the addressing of environmental challenges. When these challenges are compounded with the increasing focus on environmental concerns and the implementation of regulatory policies by governmental and environmental agencies, industrial businesses have found themselves pressured to integrate various environmental sustainability practices into their manufacturing processes. From a business point of view, this means focusing on the prevention of pollution, minimizing waste, as well as reducing energy and raw material consumption. Naturally, as the environmental issues have been lifted by the governments, customers have become more environmentally aware and are much less accepting concerning irresponsible actions toward the climate than ever before. By cutting business-related costs at the expense of the environment, a business is at serious risk of damaging its reputation and could end up losing important customer relationships as well as harming its economic stability. Given the current trends, for a business to succeed in the future, increased effort needs to be put into strengthening its relationships with the customers, society, and the environment. Focusing on environmental sustainability can benefit both business-to-customer and business-to-business relationships. By pursuing environmental sustainability, a company brand can become more attractive to the customers, which is why businesses must inform the customers about their sustainability values and actions, as these factors can create new, or strengthen existing customer relationships. (Valls Giménez, 2018; Vesal et al., 2021)

3.3 Factors affecting business success

There are many ways a business can affect its business success. One of the key elements for business success and good business performance is innovation. Innovation includes

both technical innovations, which help to create new operations, services, and technologies, and non-technical innovations such as marketing or managerial innovations. Marketing innovations are often related to the interaction between the customer and company, which aims at creating better value for both sides. In this type of interaction, both parties can create greater value as by participating customers more, companies can create more profitable long-term customer relationships while the participating customers can gain offerings that better fit their needs. (Ngo and O'Cass, 2013) A company cannot succeed without customers. Even with a multitude of customers, in theory, only a handful among them might actually be potential customers for a specific company. This is why, a customer is often far scarcer than a product, service, channel, or new innovations. Brands, services, or products are not able to generate revenue on their own. The only actual source of revenue for a business is the customer. Creating great value for the customer is as important as gaining value from the customer, as value generation to the customer determines whether or not the customer will do business with the company in the future, how valuable the customer will be to the company, and if the customer will recommend the company for others. Due to these reasons, a business must understand the customer's needs as this can create a competitive advantage over the competition ultimately leading to positively affecting the business's success. (Peppers and Rogers, 2016)

Due to the sustainability issues affecting the whole world, the importance of ecological preservation and sustainable utilization of natural resources is greatly emphasized. This has also led to a widespread focus on assessing the impact of businesses and their activities on the environment. There are many ways in which current business activities are causing harm to the environment. Such problems are for example destruction of forests, and air and water pollution. These problems that businesses cause have also been acknowledged by communities and the people making it clear that businesses must put great effort into emphasizing their green values. For a business to operate strongly and successfully, it must create value. Due to the current emphasis on sustainability, green management for companies does no longer mean that companies just try to create a good image but is rather a necessity for companies that want to operate also in the future. (Putri et al., 2020)

3.4 How competitive advantage is gained

Competitive advantage means having an edge over the competitors. Competitive advantage is gained by providing the customer with greater value than the competitors. The gained competitive advantage will, in return, enable the business to gain greater value than the competing businesses (de Haan, 2015). To provide the customer with greater value than competitors means offering better benefits and services, enabling the business to charge equal or even higher prices, or providing lower prices than the competitors. Building and sustaining a company successfully often relies on establishing competitive advantage over competitors. This advantage, developed over time, forms the foundation for the company's most crucial and loyal customer base. (Ehmke, 2008)

As mentioned above, to gain competitive advantage, a company must provide the customer with something that benefits them and differentiates the company from its competitors. To attain differentiation, a business must offer a distinct product with unique benefits, implement an alternative delivery system that provides unmatched solutions, or adopt a distinct marketing approach that enhances the efficiency or ease of reaching customers. (Zekiri and Nedelea, 2011) Differentiation can be achieved in many ways, but the decisive factor is whether it benefits the customer and their needs or not. For some, a positive customer experience might be the decisive factor. This is why it is important to focus on providing the customer with the best possible customer service through the different touching points between the company and the customer during the customer relationship. For others, the deciding factor may lie in quality, price, location, or production methods. Production methods can include such factors as using organic or environmentally friendly alternatives during the production process. (Ehmke, 2008)

To be competitive in the current, customer-led economy, the business needs to become more customer-centric. Companies need to understand the needs and desires of their customers. They also need to remember that the customer journey does not end with the purchase, which is why it is crucial to focus also on the post-purchase stage, as this can lead to stronger customer relationships and even strengthen the brand identity. (Valls Giménez, 2018) Customer centricity and innovativeness are common concentration points within such industries as the manufacturing industry. This means that companies do not only focus on product innovation but also on differentiation within their service. When businesses

combine service differentiation with customer centricity and innovativeness, they are able to perform on a higher level than the industry average. When these different factors are combined, a company can achieve better utilization of its resources, create more efficient production, products, and services, and strengthen the relationship between the customer and the business. (Gebauer et al., 2011)

A business that seeks sustainable development must aim at creating long-term profits (Valls Giménez, 2018). The same mindset must be adopted to gain sustainable competitive advantage and value. In most definitions, creating sustainable value means that one supports a more sustainable world via different practices and strategies that continue to create value both for the company's shareholders and stakeholders (Cardoni et al., 2020). To be able to sustain competitive advantage, a company must be able to provide sustainable value to its employees, customers, and other stakeholders, such as local communities or the surroundings that in some way have a stake in the business and its actions. Chris Laszlo has created a visualization (Figure 9) that helps one to understand the correlation between sustainable value and emphasizing shareholder, and stakeholder value. Through the visual representation, Laszlo emphasizes that if value is exclusively generated for either stakeholders or shareholders, the company cannot establish solid and sustainable value creation, as both parties are essential for sustainable growth and success. Companies unable to create value for either stakeholders or shareholders cannot succeed. However, when companies manage to create value for both parties, they can achieve sustainable growth and value. This way of managing is driven by innovation, which can lead to cost reductions, product differentiation, and asset growth. (Laszlo and Zhexembayeva, 2017)

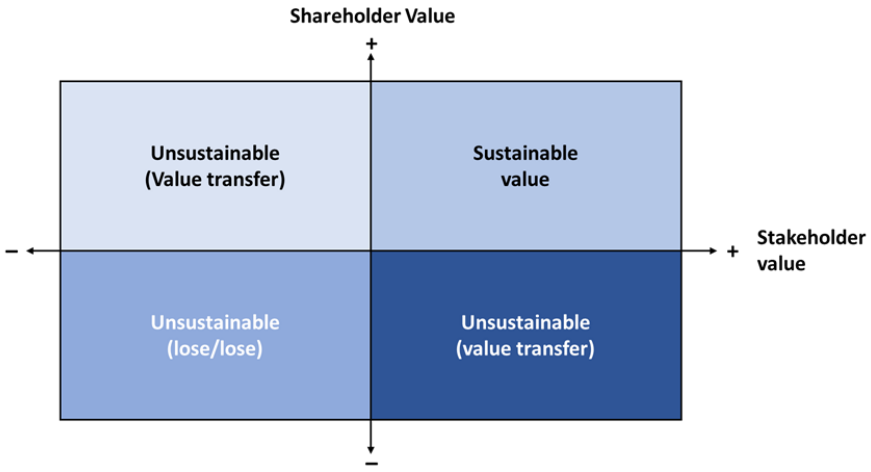

Figure 9. Sustainable value after Laszlo and Zhexembayeva, 2017

To gain sustainable competitive advantage, the business must be able to provide both the customers and the business with sustainable value. This means that the business must provide the customer with something unique or impossible to imitate while simultaneously using the company's resources and capital efficiently (Bhandari et al., 2022; Cardoni et al., 2020). When a company can provide a unique value-creating strategy that none of the competitors are currently using or are capable of duplicating, they can achieve sustainable competitive advantage. Sustainable competitive advantage can be gained through trust. Trust is established when all parties are confident that they will not exploit the vulnerabilities of others. It is not possible to achieve sustainable competitive advantage if there are competitors with equal resources and mobility within the same market. However, if there are significant entry barriers, such as taxational benefits, strong brand identity, or visible mobility barriers, such as resources difficult to re-configure, sustainable competitive advantage can be achieved. (Kontu, 2019) as mentioned above, to achieve sustainable development, a company must focus on fulfilling the needs and desires of both the internal and external stakeholders. Meeting the needs of both internal and external stakeholders requires that the business makes decisions with positive impacts on people, the planet, and the economy (Karkowska, 2020).

4 Methodology

This research has been conducted using a qualitative research methodology. Unlike in a quantitative methodology depending on statistics and numerical data, this research is conducted by a case study researching the chosen topic, individual, in-depth semi-structured interviews with persons involved in the topic as well as data related to the topic (Khan, 2020). The methods and steps in qualitative research can vary considerably, but these types of studies usually have many similarities. According to Puusa et al. (2020, p. 18), the ten common methods/steps included in qualitative research can be listed as follows:

1. the selection of a topic
2. setting research goals
3. formulating the research questions
4. presenting the research limitations
5. the development of a theoretical framework with the help of literature
6. choosing and justifying the research approach
7. the selection, description, and justification of the methods and the material
8. gathering of the material
9. interpretation and analysis of the material
10. presentation of the results and evaluation of the research reliability

The objective of qualitative research is not to determine the frequency or extent of a phenomenon but rather to explore different perspectives on how a specific topic can be viewed (Puusa et al., 2020). Therefore, the qualitative research method was believed appropriate for this study, given that the research questions do not seek specific statistics or numerical data. Instead, the aim is to achieve a more profound understanding of the issue and the potential factors influencing it. Another reason why the qualitative research method is fitting in this case is that one of its main objectives is to comprehend the identified problem and study questions from a ground-level perspective. The method is especially useful in studies that strive to understand the opinions, beliefs, and social context of populations. (Markovic and Alecchi, 2017) The research questions in this study could potentially benefit from the inclusion of statistical data. However, to obtain a broad understanding of the research questions, it is essential to understand the human experience side concerning

topics such as sustainability. This involves a significant amount of human interaction, feelings, beliefs, and opinions, requiring a more nuanced method of analysis that goes beyond the reliance on numbers and statistics.

By using a qualitative research method, the researcher usually strives to understand the chosen topic in the research through the eyes of the people related to the topic. Therefore, the researcher is interested in the experiences, feelings, and thoughts of the people involved. Several different methods are used to understand the experiences and feelings. By using these methods, the researcher is capable of better understanding the overall picture of the topic that is being investigated. (Puusa et al., 2020) A qualitative research methodology also means that the analysis of the data used in the research is significantly connected to the researcher's subjective interpretation, meaning that out of various routes, one specific interpretation is chosen. (Khan, 2020) In this research, the subjective researcher bias is avoided by using many different material sources and in doing so having a wider perspective on each topic. In the interviews, the interviewer is not trying to lead the interviewee to any specific answer but rather gives the interviewee space and freedom to speak according to their thoughts and words. Having an interviewee from an external source helps mitigate the risk of receiving biased opinions solely from one company's perspective during the interview discussions. Every person is also given the opportunity to comment on the interviews afterward as the transcripts of the interviews are sent to the participants eliminating the possibility for the interviewer to manipulate, change, or misunderstand any of the comments in the interviews.

4.1 The method for collecting data

This research used case studies as a method of collecting data. A case study is often described as an intensive, in-depth study strategy, where a person, group of people, or an individual unit is being analyzed (Flyvbjerg, 2011). In this research, the in-depth study was done by analyzing an international paper manufacturer located in Finland. The researcher studied how this company has utilized biomass within the mill and how this has affected their operations. This company was seen to be fitting for the research as the company's Finnish mill has recently taken into use an investment that enables the mill to switch its energy sourcing from coal to renewable bioenergy. The company under examination has a

long history of operating in the industry being amongst the leading paper manufacturers in the world. It employs over 12,000 individuals across various mills across multiple continents. The number of employees working in the company's Finnish mill is over 500.

In order to build a comprehensive understanding of the unit being analyzed, a case study usually includes several different data collection methods, such as interviews, documents, focus groups, observations, and online resources (Mihas, 2023). This study analyzed the chosen unit by interviewing its employees and then coding, theming, and comparing the answers with data gathered from secondary sources.

The method used for gathering data for qualitative research should be able to ensure the reliability, stability, and validity of the research. The data collection method should be able to provide such results that can be relied on, not depending on the time of the measurement or the person behind the measurement, and measure such data that creates actual benefit for the research question. One of the common data-gathering methods in qualitative research is the so-called verbal technique, meaning interviews and questionnaires. (Markovic and Alecchi, 2017) For this qualitative research, semi-structured interviews were used as a method of collecting data. The biggest difference between the different interview types is the degree of the structuring of the interview. This refers to how strict or free the proceeding and discussion of the interview is. (Puusa et al., 2020)

4.1.1 Semi-structured interview

As mentioned above, this research was executed by using semi-structured interviews as a method of gathering data. The main purpose of a semi-structured interview is to gain systematic information about topics central to the research, but also to allow the emergence of new topics and issues and gain additional information related to these new topics. Semi-structured interviews are often used in such situations, where some earlier knowledge exists but the subject needs additional information and research (Wilson, 2014). A semi-structured interview often starts with a number of specific questions, but the rest of the interview can differ depending on the interviewee's thoughts and participation as well as the interviewer's leading and way of steering the conversation (Sachdeva, 2008). In this study, all the questions were planned beforehand, but the order, or in some cases even the

form of the questions could differ in each interview depending on the answers obtained from previous questions.

In addressing the research questions, obtaining insights directly from the employees was essential to understanding the changes that the transition from fossil fuels to renewable energy sources had brought to the case company. Most of the information needed was also the type that could not be directly answered through statistics or closed questions. A considerable number of the questions were open in nature. During the interviews, these questions frequently extended the conversation, leading to the emergence of new topics. This, in turn, offered broader perspectives on many subjects and could even introduce viewpoints that the interviewer had not considered. Unlike a structured interview, which obeys a specific order and script with limited room for additional or modified questions, a semi-structured interview enables the interviewer to pose both open and closed questions and adjust the form or sequence of predefined questions. This flexibility allows for better adaptation to the conversation and responses from the interviewee (Wilson, 2014).

4.1.2 Introduction of the interview questions

This study involved conducting four semi-structured interviews, involving a total of five participants. One interview was conducted with two individuals simultaneously. Three of the interviews were conducted with employees from the case company being analyzed, and one interview was done together with an expert from the field of paper production, not associated with the case company. The interviews were conducted using two different layouts. The first layout was a base of nineteen questions, which were presented to the selected employees of the case company. The first questions were related to biomass utilization within the case company and what changes the employees felt that the switch towards bioenergy has brought the company. The questions also related to biomass's relation to customer relationships, surroundings, and the environment, and the employee's thoughts and views on biomass as a raw material option. Later questions were related to bioeconomy and its effect on business, employees' view on the future of bioeconomy affecting business operations, and the importance of utilizing forest-based resources. However, the question formulations and order could vary slightly between the interviews.

The second base of questions differed from the first one, as this base was presented to the person outside of the company working as an expert within the field. For this reason, the decision was made to direct some of the presented questions toward the expert's field. This layout consisted of fifteen questions in total. Of these sixteen questions, some were the same as in the first layout presented to the employees, as these questions were more general, while the rest of the questions were directed more toward the expert's own field. The first questions presented to the expert were related to the Finnish paper industry and its future. The following questions were directed toward sustainability's effect on the industry and the creation of customer relationships as well as biomass's importance in the future as a part of energy production. The later questions were related to emphasizing bioeconomy within the industry, what improvements companies could be making regarding efficiency and implementing bioeconomy to the business operations, and what the possible difficulties in implementing bioeconomy were. The final questions presented to the expert were related to customers' attitudes towards sustainable values, whether there had been visible changes in the attitudes lately, and what the companies within the industry could do to improve their positions in the competition. This interview was also conducted so that the order or the form of the questions could vary slightly from the template created beforehand, as this made the flow of the conversation smoother.

The interview questions in both layouts were designed to answer the set study questions as widely as possible. Every question presented in each layout was directed to at least one of the sub-questions presented in the introduction chapter, to answer them from every angle imaginable. The interview questions were also designed so that they covered all the segments presented in the study's theoretical framework.

4.1.3 Implementation of the interviews

All interviews were conducted between May and June 2023. The employees from the case company being interviewed were selected together with another employee from the company as their positions were most fitting to the topic of the study. The expert being interviewed was introduced to the author through the author's connections. The working positions of the employees and the expert fit well into the topic, which made them suitable candidates for the interviews. As seen in Table 2, the positions of the interviewees from

the company varied from sustainability directors to technical customer service managers, powerplant managers, and environmental managers, while the expert was the CEO of a business management consulting firm specializing in the development of paper mill operations and turnaround process management.

No.	Interviewee	Position	Interview length	Date	Industry
1	Respondent A (case company employee)	Sales Manager & Technical Customer Service Manager	52 min	10.05.2023	Paper manufacturing
2	Respondent B (case company employee)	Sustainability director	64 min	05.06.2023	Paper manufacturing
3	Respondent C (case company employee)	Power plant manager	40 min	06.06.2023	Paper manufacturing
4	Respondent D (case company employee)	Environmental Manager	40 min	06.06.2023	Paper manufacturing
5	Respondent E (Expert)	CEO	52 min	26.06.2023	Business management consulting within paper industry

Table 2. Interviewee positions

All the interviews were conducted through Microsoft Teams. The interviews were conducted online, as it made the scheduling of the interviews much more flexible for both parties. The length of each interview was approximately one hour. The language of the interviews varied between Finnish, Swedish, and English, depending on the native language of the person(s) being interviewed. It is important that interviews are conducted as neutrally as possible so that the risk of distortion and bias can be minimized. Studies have also shown that when interviewees are interviewed in their native language, they are more open and relaxed, and this may also help the interviewees to express themselves more authentically and provide answers with more depth. (Welch and Piekkari, 2006)

Every person being interviewed was contacted beforehand either by e-mail or by phone. Here, all the participants were given a summary of the study's topic, its goals, and its structure. The author also gave information about himself and his background during this conversation. It is important that the interviewees present themselves and their backgrounds, as this sets the tone for the entire interview by building trust between the participants. (Brinkmann and Steinar, 2018) All interviewees were asked if they would accept the interview being recorded for the author to transcribe the interviews afterward. The interviewees were also informed of their right to leave questions unanswered or ask clarifying questions at any time during the interview. After the interviews, the author transcribed and proofread each interview thoroughly to avoid any mistakes related to the information gained from the answers. Lastly, to avoid misunderstandings or other errors, every interviewee was sent the transcript of the interview, where they had the possibility to correct any errors that might have occurred during the interview. All the above-mentioned actions are related to the ethics of the research. In studies that focus on people, some of the most important ethical principles are confidentiality, privacy protection, and trust based on information. The responsibility to ensure the ethical correctness of the research lies on the shoulders of the author, which is why it is important that the researcher is aware of how to behave according to what is ethically right. (Hirsjärvi and Hurme, 2022)

4.1.4 Method of analysis

This research has used the thematic analysis method in analyzing the gathered data. Thematic analysis is used to identify, analyze, organize, report, and describe themes or patterns within the qualitative data that is being used (Nowell et al., 2017). this research used thematic analysis to theme the data obtained from the transcribed interviews and the chapters in the theoretical framework. The themes help to create patterns of meanings that support the central concept of the study and thus provide a framework that the author can use to organize the observations gained from the data. (Clarke and Braun, 2016) According to Clarke and Braun (2006), a thematic analysis process includes six steps. These six steps are:

1. Familiarization of the data (transcription and reading through data)

2. Generation of codes (systematic coding of interesting features related to the entire set of data)
3. Search for themes (using the data gathered from the codes to form potential themes)
4. Review of themes (revising if the potential themes are suitable to the coded data and entire data)
5. Definition and naming of themes (refining and defining chosen themes and clarifying the names of the themes)
6. Report production (selection of attractive and vivid data examples, the relation of the analysis to the set research questions and chosen literature, and production of the analysis)

The answers gained from the interviews were summarized by coding. As mentioned in the process steps of a thematic analysis, one step includes the creation of codes on the data being analyzed. The codes create small analysis units that capture and help visualize features relevant to the presented research questions. The codes are building blocks for the themes created (Clarke and Braun, 2016). In this study, the coding was executed by giving the text entities obtained from the interviews descriptive expressions or codes that helped to describe the content of the answer (Kananen, 2017). To make the coding process clearer, the codes were marked with the same colours as the answers that were seen fitting to the specific code (see Figure 10).

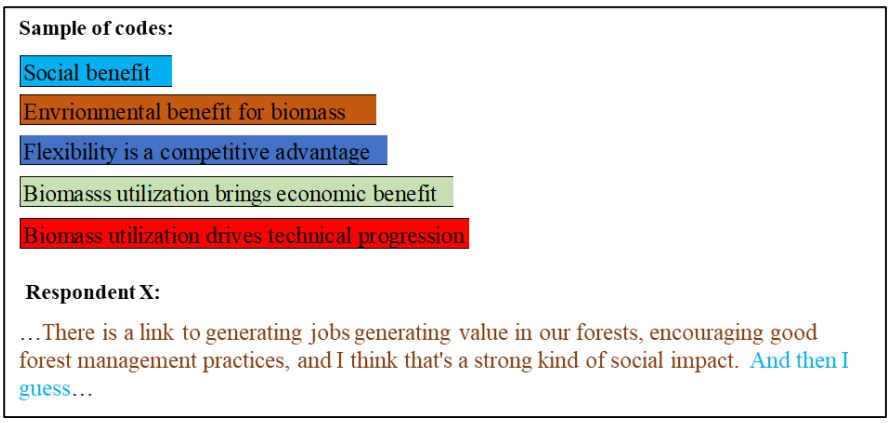

Figure 10. Example of coding

After the coding was done, the next step was to start finding patterns or themes within the data. The themes in this research were created to help identify and describe the correlations within the gathered data. By using thematic analysis, the researcher was able to also find

such connections that could have otherwise been left unnoticed. Themes were created by combining the found correlations between the numerous codes created earlier. Thematic analysis is for situations, where one needs to highlight the similarities and differences within the data. The thematic analysis method also helps to find unexpected insights that could otherwise have been overlooked. (Nowell et al., 2017) The coding created a total of eleven potential themes. Finally, as seen in Figure 11., the eleven themes were combined into three larger themes becoming the definitive themes of the research. The three themes are presented as sub-chapters in Chapter Five. The themes chosen for this research are ‘‘sustainable business practices’’, ‘‘economic and competitive strategies’’ and ‘‘future-forward planning’’. With these three themes, the author is hoping to answer the set research questions as comprehensively as possible.

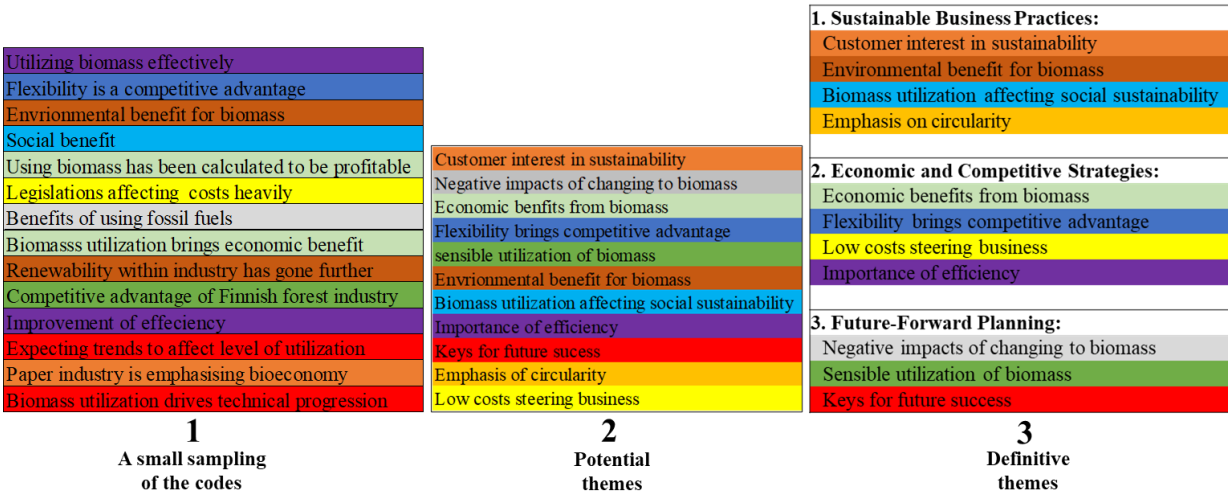

Figure 11. Example of theming

When the coding and theming of the data were completed, the results and findings were presented in Chapter Five. After this, the key results were analyzed based on the theory created for the work, and suggestions were given on how the findings could be used.

4.1.5 Credibility of data

The credibility of data can be enhanced in various ways. Prolonged engagement is a technique in which the researcher has maintained long and intensive contact with the phenomena under investigation or with the respondents participating in the research. This

technique is employed to build trust between the respondents and the researcher and to gain a broader understanding of the phenomena being studied (Lincoln and Guba, 1986). In this research, prolonged engagement was achieved by the researcher having a background in working within the field of paper production, as well as having trustworthy contacts within the industry. This background not only allowed for a broader understanding of the topics being studied but also facilitated the identification of the right individuals to contact and seek guidance for determining the appropriate approach methods for the study.

One way to ensure the credibility of data is by triangulating data sources. This involves comparing and cross-checking the consistency of information gathered through different methods and at various times during the research. Methods for implementing data source triangulation include, for example, comparing interview data with observational data, examining the consistency of statements on a particular topic over time, and comparing perspectives from different viewpoints. (Patton, 1999) As mentioned earlier, one method of gathering data for this research was by conducting semi-structured interviews. In this research, triangularity was accomplished by comparing the answers from the interviews with each other. As mentioned in Chapter 4.1.2, the question templates presented to the employees from the case company were all identical, even though some additional questions might have been added. This made it easy to compare the different perspectives on the same questions between the employees in different positions. As mentioned earlier, one of the interviews was conducted with an expert from the field of paper production who was not affiliated with the company. Even though the question template was not identical to the questions for the employees, some of the questions occurred in both question templates. The questions that did occur in both templates were then compared with each other and as the expert was not affiliated with the company, the answers gained from this interview eliminated the risk of having bias between the answers gained from the expert and the employees. Triangulation was employed in the secondary data analysis within the theoretical framework. This involved comparing various definitions and statements to construct a more reliable and accurate representation of the phenomenon.

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5 Results

This chapter presents the results gained from the interviews. The chapter is divided into three sub-chapters each representing one of the three themes created on the base of the content of the interviews as well as the sub-questions of the research.

While the study's interview sampling may have been limited in terms of numbers, the individuals interviewed have diverse backgrounds that cover a broad spectrum of topics relevant to the research subject. Every person being interviewed had long working experiences within their relative fields and were thus seen as suitable candidates for responding to the set interview questions. As mentioned earlier in Chapter 4.1.3, and illustrated in Table 2, the positions of the interviewees covered everything from sales management to sustainability, environment, and power plant management. Additionally, the interviews also included insights from an expert with long working experience in business management consulting within the paper industry, giving this analysis depth and neutral viewpoints on the discussed matters.

5.1 Sustainable business practices

As highlighted in the literature review (Chapter 3.1.1), a correlation between sustainability and business practices is clearly visible. This connection was also raised repeatedly during the interviews conducted with both employees and the expert. The topics that were consistently raised included customer interest in sustainability, environmental benefits from biomass usage, the integration of circular practices in business operations, and the impact of environmental practices and biomass utilization on social sustainability.

5.1.1 Customer interest in sustainability

Each interviewee expressed the belief that customer interest in sustainability has increased in recent years. Respondent D (environmental manager) stated that interest and awareness regarding sustainability have not only increased within the customer base but also among citizens in general, and they believe that the significance of sustainability will continue to

rise in the future. noted that customer concern regarding the carbon footprint has been on the rise. Despite the controversies surrounding burning biomass for energy, the company's recent investments in transitioning from coal to biomass have received highly positive feedback from customers.

Every interviewee also felt that sustainability actions are affecting customer behaviour and decision-making as it is more visible in the customer's operations as well. Respondent A (sales manager and technical customer service manager) indicated that an increasing number of customers are presenting requests and demands related to sustainability when doing business. Respondent C (power plant manager) explained that for the company to stay competitive in the tough competition, it must be able to answer the demands that follow from the customer's increased interest. Respondents B and D also noted a noticeable shift in the market, observing that customers are now more demanding of sustainability-related data. According to respondent B, the customers seem to analyze and compare sustainability-related improvements and actions, such as emission levels, more closely than in the past.

> ‘‘*…you start to see a little bit of a transition in the market from (customers) being happy with any data, any certification, any target, to more granular analysis of what the progress has been since last year and how does a company’s performance stack up to what other peer companies are providing. And then ultimately you start to see in some companies’ benchmarks of action in terms of which companies they want to do business with and which companies they see to have too high CO2 footprints’’.* **Respondent B, June 2023**

Respondent B continued by saying that they have also started to see these sustainability-related business actions influencing customer buying decisions. Respondent E, (CEO of a business management consulting company), backed this statement and felt that sustainability has become more visible in the annual reports provided by companies. Respondent E believed that the current trend could extend to the point, where companies could face challenges in securing funding for new investments unless they can demonstrate well-

thought-out plans detailing the incorporation of sustainability and a strong focus on environmental well-being.

Respondent E emphasized that the pressure and motion for change invariably originate from the customer. Respondent B highlighted that addressing the sustainability-related needs and demands of customers could enhance a company's chances of reaching new customers by providing offerings that competitors do not. This statement was strengthened by respondent A mentioning that emphasizing bioeconomy and circularity has also improved the company image by enabling attendance at different meetings and conferences, which has increased the company's potential customer group. However, respondent B mentioned that customers are often much more forgiving and less demanding when they are dependent on a company. However, respondent B concluded by saying that it is good to see that sustainable criteria are playing a bigger role in decision-making today as they felt that sustainability-related actions should be taken seriously.

> ''*…indeed, I start to see that which I think is good because sustainability shouldn't just be a* ''*tick-boxing'' exercise, it really should influence decisions.''* **Respondent B, June 2023**

5.1.2 Environmental benefit from biomass and circularity

Biomass is not an emission-free alternative and creates approximately the same amount of CO2 emissions as coal (IEA Bioenergy, 2023). Still, the use of biomass comes with much potential to benefit the environment.

One of the environmental benefits of using biomass, according to two of the interviewees, is the reduction of fossil fuel emissions. Respondent A mentioned that by burning biomass instead of using fossil fuels, we don't pump, or dig up fossil fuels at the same level, which naturally reduces the amount of created fossil fuels. Respondent D emphasized that burning biomass does not lower CO2 emissions levels, but rather the CO2 emissions related to fossil fuels. Respondent C, being interviewed together with respondent D, grounded the above statement by reminding that the EU's emission trading legislation governing the emission levels has established rules where wood biofuel that is obtained from sustainable

sources is considered carbon-neutral. Respondent B also mentioned that by switching to biomass, the geographic location of the raw material is now for the most part much closer to the mills utilizing it, when compared to the use of fossil fuels, which often had to be bought from long distances.

Two of the interviewees also mentioned that not only does the switch from fossil fuels to biomass decrease the level of fossil emissions, but also the level of other emissions. According to respondent A, this is due to biomass being burned at a different level than for example dry coal, which has enabled decreased nitrogen oxide levels. Respondent C additionally remarked that, besides the reduction in nitrogen oxide, there has been a significant decrease in sulfur dioxide levels, as biomass contains almost no sulfur.

> ‘‘…biomass *fuels contain almost no sulfur at all, and both of them, both sulfur and nitrogen oxide emissions, have dropped enormously’’.* **Respondent C, June 2023**

On top of the emission-related benefits of using biomass, three respondents also mentioned that biomass utilization could be beneficial to forest management. Respondent B stated that not only does the use of biomass generate jobs for people working within the forest industry, but it also generates more value for the forests encouraging better forest management. The respondent highlighted that the ongoing planting and management of the forest contribute added value to the forests, thereby sustaining the carbon cycle, of which biogenic emissions are a part. Both respondents A and E mentioned that the volume of the Finnish forest has increased substantially during the last decades. The respondents also believed that utilizing forests to a certain extent can be beneficial for forest management. They believed that this is well executed in Finland, where the utilization is below the rate of forest growth. However, respondent A believes that the present perception of forest utilization continues to cast a negative light on the image of the forest and paper industry, as the industries have not managed to effectively communicate to the public that reasonable forest utilization can be environmentally beneficial.

Two out of five respondents being interviewed also believed that biomass is an important part of achieving the different climate goals equal to the earlier mentioned Fit For 55 goals

(see Chapter 2.3.2). Respondent C underscored the significance of biomass in meeting climate goals, emphasizing that there are not many other easily applicable alternatives currently available. To address concerns linked to biomass utilization for energy and improve its environmental sustainability, Respondent B mentioned that the potential of BECCS technology (see Chapter 2.1.2) has been explored. However, respondent B also reminded that the technology is still being developed and is currently prohibitively expensive to implement. Therefore, it is currently not a viable option for the company.

The industry not only promotes circularity through the efficient utilization of renewable raw materials like biomass but also aligns closely with circular principles in the use of paper itself, which is shown, for example, through the high level of renewability of the paper, emphasized by both respondents A and B. Respondent A mentioned that not only do the products being produced come from renewable sources but they can also be recycled and composted. The respondent went by saying that traditionally, paper and cardboard have been among the most recycled products.

5.1.3 Bioeconomy and biomass affecting social sustainability

As mentioned in Chapter 2.1, bioeconomy is a form of economy where the production of food, energy, and products depends on renewable sources such as biomass. According to Mohamed and Paleologos (2021), social sustainability measures the well-being of humanity. Balaman (2018) mentions that social sustainability specifies both the negative and positive impacts that systems, activities, organizations, and processes have on people and social life. Respondent A mentions that every person coming to work for the company must take part in training. During the training, they learn the importance of working sustainably and safely, as well as how these aspects are executed at this specific company. The company's emphasis on bioeconomy has also strengthened social sustainability by spreading sustainable awareness. Respondent A indicated that the company consistently communicates sustainability-related news and investments to customers through newsletters and on various occasions when individuals visit the mill. The respondent mentioned that these information methods have seemed to pique people's interest, which, at the bare minimum, creates curiosity. Respondent B also connected the bioeconomy to having a positive impact on social sustainability by stating that most employees are most certainly happy to work

for a company that is committed to doing their part in securing the future and respecting the climate targets.

> ‘‘*I think everyone wants to go home from work knowing that they're working for an enterprise that's committed to the future and living up to the climate targets of the company and Europe’’.* **Respondent B, June 2023**

Biomass utilization supports social sustainability by creating new jobs in the surrounding areas. Respondent C explains that the supply chain related to biomass creates more jobs for wood harvesting, thinning of the forests, transportation, and many other operations related to the supply chain. On the contrary, respondent C mentions how the use of fossil fuels means less work for the communities as, for example, gas being used comes through pipes, and coal is usually transported from long distances. Respondent C notes that by prioritizing environmental sustainability and renewable resources in the company operations, the company actively contributes to averting climate catastrophes, thereby generating significant benefits for social sustainability as well. Respondent C further highlights that the company's transition from fossil fuels to renewables not only enhances air quality by reducing diverse emissions but also leads to improved human health, thereby positively impacting social sustainability.

Respondent A also mentioned that emphasizing bioeconomy is not only important for the environment but also supports diversity and safety-related problems, which shall also be focused on. Respondent A goes on by stating that the company’s use of biomass and renewable energy works as a good example for others and hopes that these actions for a better future will at some point generate outcomes of great importance for the future.

5.2 Economic and competitive strategies

Sustainability and investments related to sustainability can in many situations strengthen the economic success of a company as it can help to build the company's reputation and potentially develop new growth-supporting opportunities (see Chapter One). The economic opportunities and possible competitive advantage-enhancing strategies related to bioeconomy and biomass utilization were also mentioned in the interviews. Especially

visible topics were economic benefits gained from biomass, flexibility creating competitive advantage, low costs steering businesses and customers, and the importance of efficiency in business.

5.2.1 Economic benefits from biomass

Two interviewees explained that biomass utilization reduces emission-related costs. According to both interviewees, this is largely due to the higher emission costs of fossil fuels when compared to biomass. As this research demonstrates in Chapter 2.2.1, the burning of biomass does not create new CO2 emissions, such as the use of fossil fuels, which is why biomass is seen as carbon-neutral. Respondent C also added that due to its carbon neutrality, biomass does not create CO2 expenses in the European Union's emission trading system (ETS). Respondent B mentioned that the overall cost of biofuels has gone up significantly within the last few years, which again favours the use of biofuel. Respondent C further stated that the cost incentives by the EU and the government steering towards decarbonization have significantly reduced the burning of coal and other fossil fuels in Finland. Respondent B also mentioned the importance of joint ventures and people working together. Respondent B believed that when several parties work together for goals, such as contributing to decarbonization, there are possibilities to create new economic opportunities.

> *''... these kinds of joint ventures and thinking about new business opportunities, about how to decarbonize. I think it does create a lot of New economic opportunities.''* **Respondent B, June 2023**

The competition within the Finnish paper industry is tough. Respondent C reminds that to succeed in the tough competition, the company must operate cost-efficiently. Both respondents A and B expressed the belief that the current utilization of bioeconomy and bioenergy is a secure option for the company. So far, this approach has allowed the company to maintain competitiveness by offering lower raw material costs and operational costs. The trend of emphasizing sustainability and decarbonization is believed to continue also in the future, which is why the respondents felt that emphasizing bioeconomy will remain the preferred option for the company.

> *''...in terms of cost as well, it (biomass) has been considered the best combination here, at least for us. Especially when looking ahead.''* **Respondent C, June 2023**

Respondent A remarked that the company always calculates a payback period for every investment, emphasizing that the only exceptions are cases involving laws and regulations. It is important to acknowledge the economic advantages for the surrounding environment as well. Respondent D reminded that biomass not only brings economic benefits to the company but also contributes to the economic well-being of the surrounding area and the entire country.

5.2.2 Flexibility bringing competitive advantage

Two interviewees from the case company mentioned that the company's investments in multi-fuel boilers give the company flexibility to operate with many different fuel options. Respondent A explained that by being able to choose between different fuel options, the company is capable of using the most efficient alternatives when considering supply, demand, price, and the environmentally most beneficial alternatives.

> *''...so that you can then switch from one (fuel option) to the other depending on consumption, demand, price, environmental alternatives, and many other factors, so you kind of have flexibility in the process.''* **Respondent A, May 2023**

Respondent B also stressed the significance of flexibility in the forest and paper manufacturing sector. They noted that in recent times, various consultants and industry insiders have highlighted the importance of flexibility in energy consumption alternatives. Given the uncertainty about future directions, whether driven by regulations, scientific advancements, or alternative options, Respondent B stated that having more than one option available is the optimal solution for a mill or energy system. Respondent E reminded that flexibility is not only about the use of renewable energy sources. As per

Respondent E, paper manufacturers in Finland have maintained competitiveness and efficiency by integrating both paper and pulp production within the same mill. This flexible approach enables mills to lower their fibre costs by producing the fibre internally within the mills.

5.2.3 Pricing steering business

Pricing is steering business operations in many ways. As mentioned in Chapter 5.2.1, a business must create revenue and be competitive for the business to survive and grow. Respondent A mentions that the price of the concepts being used naturally affects the company's choices to a degree. Due to its significance in the company's costs and profitability, a company must consider what energy sources are the most favourable from an economic perspective.

> *''...I think historically those kinds of decisions have always followed the cash book. So also, which is more favourable from an economic perspective, just because energy is such a vital share of our costs, but also such an influencer on our profitability.''* **Respondent B, June 2023**

Respondent D mentions that in the current state, many legislations are aimed at sustainability-related matters, which also affects the shift toward sustainable operations. Respondent C complemented this opinion by saying that the emission trading within the EU favours the use of biofuels by creating additional cost burdens for the use of fossil fuels that do not apply to biofuel usage.

Respondent B emphasized that considering biomass as carbon-neutral creates opportunities for business expansion by lowering costs. The respondent continued stating that transitioning mills primarily to renewable energy sources opens up greater long-term possibilities and contributes to a more stable future for a company. This strategic shift supports the current focus on reducing CO2 emissions, which Respondent B considers as one of the policymakers' ultimate goals. Respondent A mentioned that low costs do not just steer the company's decision-making but also that of the customers. The respondent highlighted that

meeting customers' requirements is the initial priority for the company, but following this, a significant factor influencing the customers' decision-making is the price.

5.2.4 Importance of efficiency

A key focal point highlighted by the expert in the field of paper production, particularly concerning the Finnish paper industry, is efficiency. Respondent E emphasized that the average quality of paper machines in Finland and Sweden surpasses that of other European countries. This was identified as a distinct competitive advantage for both the Finnish and Swedish paper industries. Respondent E continued by saying that the reason Finland and Sweden have machines of such high quality (meaning effective, quick, and large machines), is due to both countries investing in the development of machinery from early on.

> *''...many of these mills are very productive due to the large and fast machines and there we have an advantage over the competition in Europe. There are also mills of good quality within Europe but if you look at the number, Finland and Sweden are in a strong position.''* **Respondent E, June 2023**

Respondent B also mentioned the importance of efficiency within business operations and thought that there will always be pressure on how to use wood resources most effectively. Respondent E was confident that biomass can serve as a foundation for achieving efficient production capacity in Finland. The respondent supported this argument by explaining how biomass, when utilized for pulp production, enhances the competitiveness of the Finnish paper industry.

Due to the importance of energy efficiency, respondent B thought that it would be of high importance to investigate how energy efficiency could be improved in the future. The respondent mentioned that the industry is grappling with questions regarding the utilization of alternative energy sources, strategies for minimizing energy consumption with existing sources and exploring new technologies to detect ways of reducing overall energy. Respondent E suggested that even with the high level of energy efficiency in the Finnish mills, there still is space to improve the efficiency that is derived from fibre usage.

Respondent E emphasized that developing processes in a manner that minimizes energy consumption, especially when correlated with the product's properties, is of the utmost importance.

5.3 Future-forward planning

Understanding the impact of various concepts and methods on operations is crucial, as it has the potential to shape future business models. This, in turn, can enhance a company's comprehension of how to generate increased value (see Chapter 3.1). During the interviews, considerable discussion revolved around various subjects, including the comparison between bioenergy utilization and fossil fuels, the sensible and justifiable use of biomass within both the case company and the industry in general, and the exploration of different strategies to potentially enhance the future success of both the company and the industry.

5.3.1 Bioenergy utilization and the advantages of fossil fuels

The interviews showed that even though the utilization of biomass comes with many benefits, it is not without its flaws. On the contrary, also fossil fuels come with certain advantages. Four of the interviewees mentioned the increased number of transports caused by switching from fossil fuels to biomass. Respondent C clarified that coal, which the company used to utilize, is an exceptionally energy-intensive raw material, whereas raw materials, such as biomass, having lower burning temperatures and being less energy-intensive, require more material, leading to an increased need for transportation. Respondent A recalled that the utilization of biomass increased the number of transports by around 20-30 trucks per day in comparison to earlier needs. Respondent D added that even though the number of transports has increased, it now mostly comes from nearby, and wondered, whether this would be more cost-effective and environmentally friendly in comparison to earlier when coal was transported from overseas.

Respondent B mentioned that the benefit of using coal was its ability to dispose of the sludge and waste generated at the mill. However, when shifted to bioenergy, the mill faces the challenge of disposing of the sludge since biomass-fired boilers are not able to handle

sludge disposal. Additionally, Respondent B noted that natural gas holds an advantage over both biomass and coal, as it does not produce waste, whereas both biomass and coal generate ash when burned. Respondent C added that aside from being less waste-generating, fossil fuels were also easier to handle, and burn compared to biomass.

> *''… from a technical point of view, it must be said that fossil fuels are easier to process and burn. So, there is a good side to them.''* **Respondent C, June 2023**

Two respondents explained that certain fossil fuels used to be much cheaper than biomass, thus, affecting the choice of not investing in bioenergy earlier. Respondent C clarified that high investment costs were the biggest reason for the mill not applying earlier the investment enabling the switch from fossil fuels to bioenergy. However, as mentioned earlier, today, the regulations and emission tariffs have made biomass the favourable option from an economic point of view.

Respondent B explained that companies are not solely responsible for choosing their energy sources, as the industry often aligns with the discussions and directives set by the government based on current preferences. The respondents felt that a clear, and homogenous understanding of bioeconomy and its implementation is missing. According to Respondent B, ongoing debates about forest management, including discussions on conservation create the issue of building a coherent understanding of the concept even greater. The respondent emphasized that stable and reliable access to resources is crucial for bioeconomy, stressing that without it, there cannot be an effective practice of bioeconomy.

5.3.2 Sensible utilization of biomass

As the above chapters have described, the use of biomass comes with many advantages but also disadvantages both environmentally and economically. However, according to the interviews, several attributions are justifying the utilization of biomass. Three respondents explained that today, burning biomass for energy is sensible as there currently is not much else that biomass products, such as sawdust, chips, and bark could be used for. Respondent A felt that the utilization was justified, as the forest residues used for bioenergy production

would otherwise often go to waste and rot if they were left in the forests. Particularly the utilization of black liquor was seen as sensible due to its lack of other utilization purposes. Respondent D felt that burning biomass for energy production is sensible until new, more efficient alternatives emerge. Many respondents also believed that, due to the country's strong forest volume and extensive biomass availability, utilizing biomass in Finland is sensible.

Respondent B said that switching from fossil fuels to renewable energy sources enables the company to stay competitive and to be able to operate in general. The respondent continued by saying that not only can the company show what improvements the switch to renewable energy sources has brought, but this also enables the company to keep up with the legislative requirements related to sustainability and emissions set by the EU. Additionally, respondent B emphasized that forests and forest-based resources must contribute to achieving various climate objectives, such as sustainable development goals. The respondent highlighted that certain societal debates regarding forest utilization must be resolved in order to move forward.

> *''...I think if we want to reach the sustainable development goals and all of the climate goals, we have to find a way to make sure that forests are part of it and we have to move on from some of our societal debates...''* **Respondent B, June 2023**

Respondent B emphasized the significance of biomass for mills without pulp production capabilities, particularly those unable to generate energy through by-products like black liquor. In the case company, where the mills' energy production is relatively low, the company must actively study different alternative energy sources and currently, biomass is considered the most favourable option. Respondent C argued that biomass is a natural choice for paper production companies, given that residues, and by-products from paper production materials, are efficiently used for in-mill energy production, due to the high energy demand. Respondent C also highlighted that Finland stands out in the efficient utilization of biomass and biofuels compared to most European countries. Additionally, the respondent mentioned that many European countries primarily rely on alternatives like natural gas for energy production, which is considered a fossil fuel.

5.3.3 Keys for future success

The interviews revealed that there still is potential for improvement within the paper manufacturing industry. Respondent E noted that Finland consistently leads in paper production technology, with Finnish paper quality, machinery, and products earning admiration from the industry around the world. According to the respondent, the early investments in technological innovation and development have created the base for the knowledge and experience that the Finnish paper industry has today. However, the respondent still believed there to be room for improving the efficiency of current products. By a more efficient product, respondent E was referring to using fewer raw materials for certain functions, such as the durability of the product, which has been one of the core functions for packaging materials. The respondent continued by stating that by combining various fibres and chemicals, it is possible to modify the functions of the products. They felt that there could be opportunities to discover ways of reducing raw material use during the production processes while still preserving the functions of the product and ensuring the sustainability of the production process.

> *''There we are talking about products that use less raw material for a certain function. So, there is room to manufacture products that have good packaging properties. And there you end up combining a lot of fibre, different chemicals and forming products in such a way that you have products that have certain properties.''* **Respondent E, June 2023**

The answers gained from the interviews also showed that bioeconomy provides many possibilities for the future of the forest and paper industry. Respondent B believed that for companies within the forest industry, highly connected to operating with biomaterial and renewable resources, using bioeconomy as a conducive framework could create an enabling environment and a strong future. Respondent A believed that the importance of biomass will grow in the future as long as it is seen as the optimal renewable energy source and if the price stays competitive. However, the respondent hesitated that it would ever become a remarkable factor affecting the energy business. Respondent B also believed that biomass would play a critical role as an energy source for the near future but felt that to

achieve the set climate targets, new alternative sources with lower emission levels must emerge.

Both respondents B and D felt that all biomass utilization drives technical progression. Respondent D explained how, for example, the popularity of black liquor utilization has created interest in innovating new purposes for the material. Respondent A also believed trends to affect the level of biomass utilization. The respondent highlighted that the level of paper consumption both in Europe and the world has decreased constantly. According to the respondent, as the consumption and production of paper reduces, various forest residues will become unused, meaning that they cannot be used for much more than energy production. Respondent C said that the company is following the trends, but nothing ‘‘game-changing’’ has yet come up. Both respondents B and C also believed electrification and its utilization to become one of the central trends of the future. With electrification, the respondents refer to technologies replacing fossil fuel technologies by using electricity as an energy source (Cleary, 2022). Respondent C continued to say that electrification has taken major steps forward within Finnish energy production and mentioned that ten years ago nobody would have thought that Finland would be producing energy by wind, or solar power at the level it is today. Respondent B also mentioned that some of the company’s mills outside Finland have been looking into electrification and its possibilities to merge into the mill’s energy production.

Another ‘‘megatrend’’ mentioned in the interviews was the so-called hydrogen economy. Respondent C clarified that hydrogen economy aims to capture carbon dioxide from combustion gases, combine it with hydrogen, and in such a way, create green methane and other products, such as methanol, thus, replacing other fuel options, such as natural gas. Respondent C continued by saying that depending on the development of the hydrogen economy, the energy industry and technology could develop rapidly. Respondent B mentioned, however, that it is still difficult to say how long it will take before the hydrogen economy becomes more available.

Respondent B extensively discussed the technology known as BECCS (see Chapter 2.1.2), and its potential impact on the future of the forest and paper industry. The respondent mentioned that the technology has been studied within the company and is considered to

have potential. However, at present, the implementation of the technology still is challenging, particularly in Europe, where, according to the respondent, the industry environment is not as enabling as, for example, in the United States. Due to the implementation difficulties and high costs, the respondent felt that adopting the technology more widely within paper production remains difficult. The respondent mentioned, however, that for now, the company, even if interested, is solely a follower and could consider implementing the technology at the time it makes more sense. The respondent concluded by suggesting that BECCS is a technology worth considering if the use of biomass is expanded in the future.

6 Discussions

This chapter will discuss the central findings gained from the interview results presented in Chapter Five. The findings being analyzed will relate to the theoretical framework presented in Chapters Two and Three as well as the results from earlier research mentioned in Chapter Two. The chapter begins by summarizing the key findings, whereafter, the next sub-chapter analyses these findings deeper with the help of the theoretical framework and earlier research results.

6.1 Summary of the findings

The first part of the findings discusses sustainability and its connection to business practices. Based on the results, a clear increase in customer interest and awareness regarding sustainability can be seen. The results emphasize the increased concern of carbon footprint amongst the customers, which according to the findings, is believed to continue to rise in the future. The adoption of sustainable measures, such as transitioning from fossil fuels to renewable energy sources, has garnered positive responses from customers and has been observed to enhance the company's image. There has also been a noticeable increase in customers' requests and demands related to sustainability, influencing their purchasing decisions. Respondents believe that to remain competitive, the company must effectively address these demands. The first part of the findings also emphasizes the positive impact that biomass utilization has on environmental and social sustainability. The results highlight impacts, such as a rise in employment opportunities in the surrounding areas, heightened environmental awareness among people, and an increased value in forests leading to improved forest management. The respondents also felt that biomass plays an important role in achieving the ambitious climate goals set by the UN and mentioned that the development of technologies will affect its part in achieving the goals in the future. The results also revealed that the paper manufacturing industry is a strong supporter of circularity as the raw materials are utilized efficiently and the recycling level of materials and products is high.

The second part of the findings discusses the different ways companies can utilize biomass and bioeconomy to create economic, and competitive advantage. The answers from the

respondents show that bioenergy utilization creates economic value for the company by being a cheaper raw material, and due to its carbon neutrality, does not create additional expenses, unlike fossil fuels. The respondents also mention that for now, biomass utilization is calculated to be the most profitable solution economically. Respondents also mentioned that the ability to be flexible with raw material alternatives in energy production brings competitive advantage, as it is difficult to predict what methods will be favoured in the future. According to the findings, flexibility within the mill operations also enabled creating competitive advantage. The second part of the findings underscores the significance of efficiency, highlighting that both the Finnish and Swedish paper manufacturing industries are widely recognized for their high level of production efficiency and paper quality. The findings also show that energy efficiency can significantly enhance a company's economic stability, given its substantial role in the overall cost structure of the company.

The third and final part of the findings discusses the future possibilities of utilizing bioeconomy and mentions, what benefits, and disadvantages the utilization of bioenergy has brought when compared to the earlier emphasis on fossil fuel utilization. Even though biomass does not require long transports, the number of transports has multiplied when compared to coal use. Biomass, compared to coal, also demands a greater volume of raw material to generate an equal amount of energy due to its lower energy intensity. The findings show that using bioenergy complicates waste management as waste, such as sludge, cannot be burned together with biomass as was possible with coal. The answers also indicate that politics heavily affect the energy industry, and the respondents feel that a consensus around the concept of bioeconomy is needed. The third part of the findings also highlights that today, burning biomass for energy is sensible, as there still are not many other options to utilize the material. The answers also indicate that the material is circularly and efficiently utilized within the industry and, thus, is also a natural choice for an energy source. Biomass is also seen to be vital for energy-intensive industries, as the economic policies heavily favour the use of renewable energy sources. According to the respondents, the future success of the industry is greatly affected by technological developments and trends related to the hydrogen economy and electrification. Other emerging technologies, such as BECCS, are also seen to possibly affect the future, as the industry must find ways of improving efficiency while also lowering operating costs.

6.2 Analysis of the results

This chapter involves an analysis of the results presented in chapter five. The analysis involves a comparison between the results obtained from the conducted interviews and the information presented in the theoretical framework.

Rising sustainability awareness affecting company profitability

The findings indicate that customers' awareness and interest in sustainability have grown significantly and are believed to keep growing in the future. This increased interest and awareness has led to a growing number of sustainability-related requests and demands and has, according to the respondents, even affected customer buying behaviour. The findings revealed that addressing customer demands related to sustainability is considered crucial for maintaining competitiveness. This finding supports the evidence from previous observations by Peppers and Rogers (2016) mentioning that answering the customer's needs is a key factor in determining whether the customer will do business with the company in the future. It is also clear that the case company's change toward sustainability has been well received by the customers, as the feedback, according to the findings, has been positive. This correlation between sustainability and customer satisfaction agrees with earlier observations by Valls Giménez (2018) who mentioned that today when sustainability is greatly emphasized, businesses must put more effort into strengthening their relationship with the customer, society, and the environment as this is a necessity of succeeding in the future. Due to the increased environmental awareness, customers are also less accepting concerning irresponsible climate-related actions (Vesal et al., 2021). As described by Vesal et al. (2021), by neglecting sustainable responsibilities, businesses are at risk of damaging the company's reputation and losing important customer relationships ultimately causing harm to a company's economic stability.

The research indicates a positive correlation between bioeconomy initiatives and environmental actions, contributing to a stronger company image. According to the findings, emphasizing bioeconomy not only strengthens the company's image but also enables it to meet legislative sustainability requirements and emission standards, ensuring its viability

for future operations. These findings are consistent with those of Putri et al. (2020), who explain that green management is not only about improving the company image but also a necessity for companies to be able to function in the future. This increase in customer interest and the company's openness toward the customer can also strengthen the relationship between the company and customers, which, according to Joyce and Paquin (2016), is an important factor affecting business success. By interacting openly and actively with the customer, not only can the company strengthen its customer relationships, but it can according to Ngo and O´Cass (2013) also create more profitable and longer-lasting customer relationships as the customers' demands are more precisely answered. These statements further support the idea of Angelini (2018) suggesting that a well-executed management of customer relationships is an important factor in attaining and sustaining competitive advantage.

Biomass's environmental and social effect

The findings emphasize that while biomass is considered carbon-neutral, it does generate CO2 emissions roughly equivalent to those produced by fossil fuels. The difference is that no new fossil emissions are created. As Pang (2019) describes, burning fossil fuels releases new carbon emissions in the atmosphere, whereas the burning of biomass only releases the same amount of carbon dioxide that has been absorbed during the growth of the tree and, thus, does not increase the total carbon emissions in the atmosphere. However, as Speight (2022) describes, also carbon emissions created during the processing of biomass should be considered.

The findings also suggest that bioeconomy and bioenergy utilization strengthen social sustainability. Not only did the respondents mention that utilizing biomass for energy production generates more jobs locally than using fossil fuels such as coal, but it was also believed to enhance sustainable awareness. According to the findings, efficient utilization of forest residues for bioenergy enhances the economic value of forests, potentially leading to improved forest management. This approach not only generates positive impacts on the forests but also benefits to surrounding communities. Respondents felt that such positive effects could also favour the performance of the business. This corresponds with the findings of Laszlo and Zhexembayeva (2017) who mention that for a company to stay competitive,

it must create sustainable value for the customer and employees, as well as for other stakeholders affecting the business, such as local communities or surroundings.

According to the findings, biomass utilization within the Finnish forest industry is seen sensible due to its strong availability in the country. The findings indicate that the strong availability is a result of excellent forest management by, for example, the sensible use of raw materials, which has led to increased forest volumes. This finding was also reported by Anttila and Verkerk (2022) who have mentioned that due to decreased logging volumes and improved forest management, the forest stock levels have increased in all European countries except for Albania, between the years 1990 and 2015.

Circularity, efficiency, and flexibility steering the Finnish forest industry

The interviews with the respondents revealed that emphasis on circularity is strong within the industry. The findings suggest that the forest industry, particularly the pulp and paper sector in Finland, has successfully optimized its operations for high energy efficiency when compared to other European countries. This achievement is believed to strongly rely on early investments in technological development. This supports the findings by Fisher (2019), mentioning that the Finnish market pulp production in 2019 was the most energy-efficient of all the EU countries, despite the tough geographical location. According to the findings, biomass utilization is also the cheaper, and more optimal solution from an economic point of view, in comparison to fossil fuels. This is partly due to the tariffs on fossil fuel utilization defined by the EU's emission trading system (ETS) (Black et al., 2023). The respondents also mentioned that the benefit of having comprehensive forest resources leads to stable biomass availability and shortens transportation distances. Lipiäinen et al. (2022) suggest that large domestic forest biomass resources create great conditions for the production of bioenergy in countries, such as Finland and Sweden, and support the possibility of improving the industry's energy efficiency.

The findings explain that the efficient, and thorough use of wood-based raw material, and the raw material's effortless implementation through the existing biorefineries, as well as the recyclability of wood, makes biomass a natural choice of raw material, and create competitive advantage to the operators within the forest industry. These findings support

the evidence from previous observations made by Hämäläinen et al. (2011), who confirmed that the existing infrastructure in the biorefinery business creates competitive advantage for the actors within the forest industry in Finland in comparison to other countries. The results indicate that the exceptional recyclability of paper products is considered a crucial factor supporting circularity and circular bioeconomy. Respondents emphasized that paper ranks among the most recycled products globally. This also accords with earlier observations by D'Amato et al. (2020), mentioning that in a circular bioeconomy concept, the focus lies on biological efficient use of biological resources, recycling, and waste management. The interview findings indicate that there is potential for enhancing the product by reducing the quantity of raw materials used in specific functions, such as improving the durability of the product. Enhancing raw material efficiency not only has the potential to create competitive advantage but also strengthen the circularity of the company. This aligns with the concept of a circular business model, as described by Nußholz (2017), which aims to create value for the company by improving the efficiency of the resources being utilized.

According to the findings, flexible raw material use was seen vital for future success, as the development of the energy industry and preferred raw materials are impossible to predict. The possibility of using various raw materials in the multi-fuel boilers that the case company has invested in also supports Achillas and Bochtis (2020) view on circularity and circular business models, which according to them aim at utilizing raw materials at maximum efficiency while also creating benefit for as long as possible. Such circular implementations and the efficient utilization of raw materials are crucial considering the rapid growth of the human population that has led to an overuse of natural resources that poses harm to both humankind and nature (D'Amato et al., 2020). Not only do the boilers enable the company to work with various fuel alternatives, but they also allow the company to use the most efficient alternatives when considering the availability, legislative preferences, price, and environmental effects. This flexibility also provides the company with the opportunity to generate long-term profits, which is a crucial aspect not only for ensuring business profitability but also when pursuing sustainable development (Valls Giménez, 2018).

Issues around biomass utilization and the integration of bioeconomy

As the findings indicate, biomass utilization comes also with certain disadvantages when compared to the earlier utilization of fossil fuels. The findings show that due to the relatively low energy density of biomass, bioenergy production requires noticeably more raw material to produce the same amount of energy when compared to fossil fuel utilization, such as coal. The increased demand for raw materials also requires more transportation, contributing to a rise in traffic volume. As noted by Krigstin et al. (2012), the escalation in traffic creates challenges such as heightened air pollution and disruptions that require recognition if the goal is to achieve environmental benefits through renewable energy source utilization. However, the findings also emphasize the positive outcomes of biomass for the surrounding areas and people. This includes a rise in employment opportunities associated with the biomass utilization and transportation value chain, along with shorter transportation distances. The influence of forest bioeconomy in job creation is significant. This statement is in line with the study by Hetemäki and Kangas (2022), who wrote that the bio-industries related to the forest industry were responsible for around 2.5 million jobs within the European Union in the year 2017, equalling around 14% of the total bioeconomy related employment. As biomass utilization and the availability of raw materials in Finland is strong, it is fair to assume that it also plays a significant role in creating jobs in Finland.

The findings also indicate that biomass utilization creates problems in the waste management sector, as boilers would need fossil-based fuels to burn the sludge created as a by-product on the sites. This can be seen as a disadvantage that battles against the principles of circular business models that according to both Achillas and Bochtis (2020) and D'Amato et al. (2020) among others, aim to minimize waste production. However, solutions for this exact problem have been studied before. For instance, in 2019, the Finnish paper manufacturing company Stora Enso invested in an industrial scale pilot plant that used a technology patented by a Swedish company called C-Green Technology AB, which dries the sludge in an energy-efficient manner using heat and pressure. This process results in clean and scentless biofuel that can be burned without any additional fossil-based fuels. (Stora Enso, 2019) This type of implementation gives also other companies struggling with similar problems the opportunity to find solutions to tackle the problems. Even with the drawbacks that biomass utilization generates, its utilization is seen as sensible as the respondents felt that many components of biomass have limited application possibilities beyond

energy production. However, although the previous statement is true for specific biomass components, as emphasized by Cambero and Sowlati (2014), it is worth noting that biomass can be utilized for various purposes, including the production of bioproducts, such as various chemicals and materials.

One issue around businesses integrating bioeconomy lies in the lack of definition of the concept. According to the findings, bioeconomy lacks a consensus around the concept, leading people to comprehend, and understand the concept differently and, thus, complicates the creation of a coherent path for companies and countries to follow. This statement strengthens the one by Hetemäki and Kangas (2022), mentioning that the concept of bioeconomy can be difficult to understand, as it has many definitions. According to Baranano et al. (2021), the paradigm that most definitions of the concept follow is one, where the economy is based on the sustainable utilization of natural resources. The difficulty occurs in the lack of a mutual understanding of the utilization of raw materials. The findings show that there are conflicts and disagreements regarding the utilization of forests and whether or not to preserve them or manage them in a certain way. According to the respondents, bioeconomy needs stable access to resources, and thus, a consensus around the raw material utilization is needed. This statement supports evidence from previous observations from Wan et al. (2012), mentioning that the erratic policy changes regarding bioenergy are a major factor causing uncertainty for future predictions regarding business development and could endanger many future investments.

Technological development and future trends guiding the industry

The findings suggest that technological development within the hydrogen economy and electrification can be major factors affecting the future of energy production practices. This verdict further supports the statement by Göss (2023) suggesting that the significance of biomass's role in the energy mix in the future relies on the development of electrification technology and other renewable energy sources. The findings suggest that the electrification technology implementations including solar, and wind power have taken major steps forward and are today widely utilized in Finland. As mentioned above, the technological developments will set the ground for the future of energy production as well as new technological implementations for the forest industry. However, the results indicate that, given

the uncertainties surrounding future preferences and technological advancements, biomass is presently considered the preferred option. These findings align with the research by Lipiäinen et al. (2022), suggesting that due to the challenge of predicting the pace of technological development, transitioning from conventional energy sources to bio-based alternatives like biomass, is seen as a primary action for decarbonizing the forest industry, particularly in countries, such as Finland and Sweden.

The findings also show that the industry is well aware of the fact that biomass is not emission-free, but many feel that it is currently the best option for reducing emissions for the industry. Not only is it seen to benefit the community by creating jobs and utilizing domestic resources from nearby locations, but it also lowers the level of fossil CO2 emissions and other emissions such as nitrogen oxide, and sulfur dioxide. However, to achieve the ambitious sustainability goals regarding decarbonization, it is important to constantly study alternative sustainability-supporting options. The findings show that the case company has been studying the technology introduced in Chapter 2.1.2 called BECCS, where the purpose is to capture the CO2 generated from burning biomass and storing it in geological formations underground thus enabling even carbon-negative results (Fragkos and Siskos, 2022). The challenge in integrating the technology into the industry lies in its high cost and the substantial construction needed on existing installations and is thus not currently seen as a solution for the near future. The comments about the difficulty of implementing the technology are consistent with those of The Ministry of Economic Affairs and Employment (2023) confirming that even if the concept is being analyzed, BECCS is not currently being tested in Finland due to the lack of geological storage sites required to store the captured CO2. However, according to Lipiäinen et al. (2022), the technology has the potential to explain that the Swedish forest industry believes BECCS to play a significant role in achieving the country's carbon balance in 2050 and would be largely implemented in the pulp and paper industry.

7 Conclusions

The concluding chapter of the research will offer reflections on the established research questions by providing conclusive results for each research question. The chapter introduces the theoretical contributions and practical implications emerging from the research findings, specifically considering their significance for the case company being studied but also the Finnish forest, and pulp and paper industry. Finally, the chapter will address the limitations of the study and introduce suggestions for future research.

7.1 Research questions

The first sub-chapter will return to the research questions presented in the introduction chapter. Each research question will be answered through the findings gained earlier.

RQ 1: What are the advantages and drawbacks of bioeconomy for industrial companies?

To understand the possible advantages and drawbacks of bioeconomy for industrial companies, we must first establish, what we mean by bioeconomy. In this context, the concept is defined according to the definition by Baranano et al. (2021), who define bioeconomy to be an economy that is based on sustainably utilizing natural resources, and the one by Ympäristöministeriö (2014), who describe bioeconomy as a form of economy, where the aim is to be less dependent of fossil sources while minimizing loss of biodiversity and creating economic growth and jobs that support sustainable development.

Bioeconomy as a concept supports the efficient use of raw materials. Following bioeconomic principles can enable industrial companies to develop new, and more efficient technologies regarding raw material utilization and production efficiency. This, in turn, can significantly improve the company's economic strength and create competitive advantage. In the pulp and paper mills emphasizing bioeconomy, the efficient use of raw materials is visible, for example, through the multi-fuel boilers, enabling both efficient and flexible use of different raw materials. By emphasizing bioeconomy, the industrial companies also support environmental responsibility as the use of environmentally friendlier raw materials helps to reduce emissions and enhances decarbonization goals. The increasing emphasis

on sustainability also affects customer relationships and customer behaviour. Thus, emphasizing sustainability also strengthens the company image and creates stronger, and longer-lasting customer relationships.

The emphasis on bioeconomy also enables industrial companies to stay competitive by being able to answer legislative requirements related to sustainable development and emission levels. Not only does it help the companies to operate according to the regulations, but it can also improve employee satisfaction, as employees are happier working for a company that is embracing and respecting sustainability.

However, emphasizing bioeconomy comes also with certain disadvantages. Strict environmental policies make bioeconomy implementation difficult and costly. A lack of a coherent understanding of bioeconomy as a concept and mutual understating of raw material utilization creates difficulties in implementing the concept. Unclear policies and lack of a clear path and regulations to follow make it difficult to operate according to the principles of the concept and also create problems in creating long-term plans and future investments. Due to the uncertainty of future preferences and technological developments, investments related to environmental development could bring companies high costs.

By using renewable raw materials instead of fossil fuels, industrial companies face problems of increased transportation, causing both economic and environmental issues. The utilization of renewable raw materials also poses challenges for waste management, particularly in dealing with the disposal of sludge and ash generated from the operations. These challenges also go against the principles of a circular business model, which according to Achilas and Bochtis (2020) inter alia aims at waste minimization. To be competitive, industrial companies must also be able to answer the customer demand. Due to the high emphasis on sustainability, customer demands could require costly new investments for companies.

RQ 2: What are the economic and environmental benefits of using biomass for the Finnish forest industry?

Even if not emission-free, biomass utilization comes with many environmental benefits for the Finnish forest industry. As mentioned earlier (see Chapter 2.2.1), biomass utilization reduces the carbon footprint by not releasing new fossil emissions into the atmosphere. Also, the forest that biomass is harvested from is during its growth able to absorb roughly the same amount of biomass that is released when the raw material is burned. Not only does the utilization of biomass instead of fossil fuels, such as coal, reduce the carbon footprint, but it also reduces the level of other emissions. according to the interviews, due to biomass being burned at a lower temperature and the fact that it contains almost no sulfur, its utilization has enabled the reduction of nitrogen oxide, and sulfur dioxide.

Due to its wide availability in Finland, using biomass is not only sensible for the forest industry, but it also shortens transportation distances thus not only benefitting the environment but also decreases transportation costs. Utilizing biomass also creates additional value for the Finnish forests. Therefore, its utilization can also strengthen forest management, leading to healthier and denser forests. By utilizing biomass for energy production, the forest industry efficiently utilizes wooden raw materials, ensuring that the material is used as thoroughly as possible. It is essential that emphasis is put on sustainable forest management and efficient use of raw materials as these are according to UNECE (2021) the key steps in being able to benefit from bioeconomy.

Besides strengthening the forest residue utilization, using biomass for energy production is efficient especially for pulp and paper manufacturers, as they create biomass from their own side streams. On top of strengthening the circularity and efficiency, using biomass from one's own side streams also lowers the operational costs and, thus, improves the profitability of the company. Due to its wide domestic availability, shorter transportation distances, and different environmental policies affecting raw material prices, using biomass is also the cheaper option when compared to fossil fuels such as coal.

The high level of domestic raw material utilization caused by biomass utilization also generates numerous jobs within the Finnish forest industry and the surrounding areas. The higher number of jobs also correlates to stronger economic performance of a company, and strengthens the company's image, as the use of the raw material supports sustainability. As sustainability policies drive companies towards emphasizing bioeconomy and

utilizing bioenergy, the money previously allocated to mostly foreign fossil fuel sources is now directed towards the Finnish forest industry instead, strengthening the economic balance of the industry.

RQ 3: What business models should the forest industry use in the future for efficient use of biomass?

As this research shows, sustainability in its entirety has become a major topic both amongst the government and the customers. Thus, when planning out new business models, companies within the forest industry should step away from the traditional business model canvases that focus on creating only economic value and instead use canvases, such as the sustainable business model canvas by Alexander Joyce and Raymond Paquin, which focuses on creating value on all three pillars of sustainability. The three layers on this canvas are the economic layer (presented in Figure 6), the social layer (presented in Figure 7), and the environmental layer (presented in Figure 8). (Ensign et al., 2021 Geldres-Weiss et al., 2021) In the future, sustainability-driven business models used by companies within the forest industry should be circularity-driven with an emphasis on maximizing resource utilization and waste minimization. On top of emphasizing waste management and resource utilization, circular business models should aim at creating long-lasting benefits for the company. (Achillas and Bochtis, 2020) As circular business models focus on renewable raw material utilization; they also support the reduction of emissions. Due to bioenergy being one of the key factors in achieving decarbonization (Lipiäinen et al., 2022), utilizing biomass can be seen to be important both from an environmental, and economic point of view. Thus, in the future, companies that do not utilize bioenergy are at risk of facing considerable additional raw material-related charges, as well as endangering current, and future customer relationships.

Due to the uncertainties of future developments as well as customers' rising sustainability awareness and demands, business models used within the forest industry should emphasize flexibility. The findings indicate that it is difficult to see the direction that the energy production will take in the future making it important to be able to produce energy with many different options. Flexibility also creates competitive advantage, as the company is more adaptive to changes while also being able to minimize risks of not being able to compete

due to changes in policies and regulations. Not only does flexibility relate to being flexible in energy production options. It is also important to be able to flexibly answer customer demands as it can greatly affect customer buying behaviour. Thus, companies should openly collaborate with customers and by understanding their needs, offer more personalized services. The importance of customer-centricity enhancing business models is strengthened by Joyce and Paquin (2016), who argue that the topic central in all business model canvases is the relationship between the business and its stakeholders. Joyce and Paquin highlight that by combining the layers in the business model canvases one can clearly notice the positive correlation between strong customer relationships and business success.

To maximize profitability, companies must operate efficiently. Thus, future business models for companies within the forest industry and especially the pulp and paper industry should focus on maximizing production, product, and raw material efficiency. According to Gebauer et al. (2011), by combining customer centricity, service differentiation, and innovativeness, companies can find solutions for better resource utilization, improve production and product efficiency, and strengthen existing customer relationships. Circular business models emphasizing renewable raw material utilization, efficiency, and waste management should also study technological innovations, such as the one called BECCS, which could improve the company's waste management and emission levels and, thus, also improve the company's profitability by lowering emission, and waste-related costs. It is crucial for companies to focus on technological development, as the ambitious sustainability goals will according to the Confederation of Finnish Industries (2021), with high probability, require sectors with high emission levels, such as the pulp and paper industry, of drastic operational changes and substantial technology investments.

7.2 Theoretical contributions and practical implications

This research aimed to investigate the potential of utilizing biomass as a competitive advantage in the Finnish forest industry, particularly in the pulp and paper sector. While previous studies, such as those by Lipiäinen et al. (2022) and Kumar et al. (2020), have mainly studied the sustainability advantages of incorporating biomass into the industry, there has been limited attention to the competitive advantage that its utilization can offer. This study

offers further insights into the economic advantages of biomass utilization and explores how emphasis on sustainability influences these benefits.

Regarding customer interest in sustainability, the findings are consistent with those of Vesal et al. (2021) and Valls Giménez (2018) indicating a notable rise in interest in recent years. However, the results outlined in this study highlight a lack of awareness among companies regarding the specific factors that drive customer decisions, despite recognizing the importance of responding to these demands. This newfound insight should encourage companies to measure the impact of sustainability on customer decision-making, thereby enhancing customer relationships and strengthening overall company competitiveness.

In terms of sustainable actions affecting company image, the findings are in line with those of Putri et al. (2020) in that sustainable actions have had a positive effect on customer attitudes. However, the results of the study revealed that the forest industry, particularly the pulp and paper industry, is currently struggling with an image-related challenge. Despite the efforts to highlight sustainability, the industry has struggled to convince the public about the positive impacts it has had on sustainable development. It appears that the advantages of utilizing biomass and forest residue, such as the positive impact on forests and nearby communities through job creation and improved forest management seem to be unclear to the public. Due to the current focus on sustainability and circular business models (Jonker and Faber, 2021), emphasizing bioeconomy and sustainability can significantly enhance the company's image as well as strengthen existing, and new customer relationships. It seems that furthering a more positive perception of the industry could significantly contribute to improving its economic stability. Therefore, promoting topics, such as enhanced forest management, and optimal forest density, should be advocated more.

The findings illustrate that the most potential business models for companies within the Finnish forest industry are ones that support circularity. This finding further supports the study of Joyce and Paquin (2016) claiming that due to the increased sustainability concerns, the pressure on businesses to address these issues more actively has increased. According to the findings, a switch towards more sustainability favouring operations is seen as a must, and even with potentially costly implementations, it is seen as the way of establishing success in the future. Uncertainties of future technological developments and

preferred raw material choices are impossible to predict. industrial companies should concentrate on adaptable business models that provide the flexibility to embrace new preferences and regulatory changes. The findings also suggested that companies within the paper manufacturing industry should enhance the level of raw material utilization while simultaneously improving product features for more sustainability-supporting outcomes.

One major issue associated with biomass utilization is the generated emissions. Thus, companies engaged in biomass utilization should explore alternative solutions for more efficient raw material transportation and technologies that minimize emissions and waste. The case company has acknowledged studying the technology known as BECCS but has not invested in it yet due to current implementation challenges and high costs. However, as highlighted by Lipiäinen et al. (2022), the Swedish forest industry believes that BECCS will play a significant role in achieving the country's decarbonization goals by 2050, particularly impacting the pulp and paper industry. Given the similarity in sustainability targets between the two countries, the Finnish forest and paper industry should closely monitor the development of the technology, as its implementation could potentially affect economic strength and create competitive advantage within the industry. Despite the challenges in implementation, there are opportunities to explore the technology through collaboration with entities, such as the Finnish Ministry of Economic Affairs and Employment (2023), which is involved in executing projects related to the technology in Finland. Additionally, other technologies aimed at reducing CO2 emissions, such as creating synthetic methane by combining CO2 with clean hydrogen have been studied and should also be investigated by actors within the industry (The Finnish Ministry of Economic Affairs and Employment, 2023).

As mentioned in the findings, another challenge encountered by the case company in biomass utilization is related to waste management, specifically the disposal of sludge. The findings mention that the case company is actively working on resolving this issue to prevent an increase in waste levels. However, as discussed in Chapter 6.2, a similar issue was addressed by another Finnish paper manufacturer, Stora Enso, which implemented a solution enabling the creation of biofuel from sludge without the use of additional fossil fuels (Stora Enso, 2019). The case company should consider studying and adopting a similar approach as a potential solution. The implementation by Stora Enso also highlights the

possibility of selling sludge to entities like Stora Enso, who already have such technologies implemented. This would not only benefit both parties involved but would also contribute to environmental conservation by minimizing waste generation.

7.3 Limitations of the study and suggestions for further research

It is important to remember that the findings are based on the answers from one expert working within the field of paper production consultation and one company's employees. All the interviews mostly discussed the situation from a Finnish perspective, though also other countries were discussed. It is thus important to keep in mind that the comments regarding biomass utilization can greatly vary between countries, as most countries do not have as extensive biomass availability as countries, such as Finland and Sweden. Many of the comments related to emission, and sustainability policies also apply to the Finnish preferences and even though many policies affect all the EU countries, some might be country-specific. Even though answers gained from the interviews could be seen as fitting for the entire industry, the opinions on the discussed matters could vary between other companies, employees, and individuals. In order to build a more comprehensive and sweeping image of the results, more companies within the industry shall be interviewed. It is also worth noting that the study results are the current views on the topic and could need to be re-considered as the future development around sustainability and emission policies can change briefly.

The studies revealed uncertainty regarding the benefits of biomass utilization compared to fossil fuels, due to increased transportation needs. Future research should investigate the correlation between the heightened transportation requirements of biomass utilization and the emissions from burning fossil fuels. This understanding would bring clarity to the actual advantages of using biomass over fossil fuels and could contribute to accelerating the development of more efficient biomass utilization practices.

One factor that keeps emerging in earlier research on bioenergy utilization is the uncertainty of predicting the future of bioenergy policies due to continuous changes (Berndes et al., 2016; Kumar et al., 2020; Wan et al., 2012). This concern is also raised in the interview findings, indicating a lack of mutual understanding of bioeconomy as a concept as well as

the utilization of raw materials. Thus, future research should focus on studying why such bifurcation around the concept exists and try to find solutions for a more homogenous approach.

All respondents acknowledged the increased awareness of sustainability among customers. However, none of the respondents had a precise understanding of the extent to which it influences customer decision-making. Therefore, further studies are needed to discover how significantly sustainability guides customers' decision-making and buying behaviour. This understanding is crucial for companies to appropriately address customer demands, as this can play a significant role in establishing sustainable, long-lasting customer relationships.

Summary in Swedish – Svensk sammanfattning

Att utnyttja biomassa som en konkurrensfördel inom skogsindustrin: En fallstudie av en massa- och papperstillverkare i Finland

Inledning

Hållbarhet spelar en allt större roll i företagsverksamhet inom olika branscher idag. Detta är särskilt betydande för industriella företag såsom pappersproducenter, där användningen av naturresurser alltid varit omfattande. En väsentlig anledning till det ökade fokuset på hållbarhet beror på strävan att förbättra den miljömässiga hållbarheten, som har lidit avsevärt de senaste årtiondena till följd av industrialisering och snabb global utveckling. Speciellt har tillgången till naturresurser påverkats av dessa faktorer. Förutom risken att utömma naturresurserna har industrialiseringen och den snabba befolkningstillväxten gett upphov till oro för den ökande mängden utsläpp som påverkar naturen på ett betydande sätt. (Portney, 2015) För att främja ekonomisk framgång inom sektorer som pappers- och skogsindustrin och samtidigt stödja hållbar utveckling är det avgörande att investera i innovationer som minskar både företagens driftskostnader och den globala miljöpåverkan. En potentiell strategi är att reducera beroendet av externa aktörer inom energiproduktion och i stället satsa på användningen av förnybara resurser, såsom skogsråvaror. I detta sammanhang kan utnyttjandet av biomassa spela en central roll.

Syfte och forskningsfrågor

Syftet med denna avhandling är att öka förståelsen för hur skogsindustrin, särskilt massa- och pappersindustrin i Finland, använder sig av biomassa. Vidare strävar avhandlingen efter att förstå de aktuella fördelarna som industrin får genom att använda biomassa samt de potentiella fördelar som användningen kan medföra. Dessutom utforskar avhandlingen möjligheten att använda biomassa som en konkurrensfördel inom industrin. Resultaten från avhandlingen ger insikter om hur betoning på miljömässig hållbarhet kan skapa fördelar för företag inom skogsindustrin, inte bara från en ekologisk utan även ekonomisk synvinkel.

För att uppfylla syftet, har följande frågor ställts:
Huvudfråga:

- Vilka konkurrensfördelar kan papperstillverkaren eller andra företag inom skogsindustrin uppnå genom att utnyttja biomassa?

Underfrågor:

- Vilka är för- och nackdelarna med bioekonomi för industriföretag?
- Vilka är de ekonomiska och miljömässiga fördelarna med att använda biomassa för den finska skogsindustrin?
- Vilka affärsmodeller fungerar bäst för effektiv användning av biomassa inom skogsindustrin?

Denna studie avgör inte ifall biomassa är det bästa möjliga alternativet som förnybar energikälla. Dock är det relevant att öka förståelsen för användningen av biomassa i Finland, eftersom landets användning av biomassa är högst bland alla industrialiserade länder när man betraktar den totala energikonsumtionen. (Motiva, 2023) En stor del av den biomassa som används i Finland går till energiförsörjning inom skogsindustrin. Till exempel genererar massaproduktionen svartlut som en biprodukt i massaprocessen, som sedan kan användas som en energikälla. (Berndes et al., 2016)

Det är viktigt att förstå hur biomassa och bioekonomi för tillfället utnyttjas samt de ekonomiska fördelar som detta kan tillbringa. En ökad förståelse kan i bästa fall leda till en bredare tillämpning av hållbara resursalternativ inte bara inom andra länder utan även inom olika industrier och företag. Genom att öka förståelsen för hur biomassa och bioekonomi används kan företag förbättra sina nuvarande metoder och processer för att uppnå mer gynnsamma resultat både ur miljömässig och ekonomisk synvinkel. Utvecklingen av bioekonomi anses skapa många möjligheter för att lösa den stora mängden problem som världen står inför på grund av en växande befolkning, överanvändning av resurser, försämring av miljön och klimatförändringar. (Borgström och Mauerhofer, 2016) Förståelsen för bioekonomi och de möjligheter som användningen av biomassa kan ge är relevant, då vi står inför stora problem orsakade av en snabbt växande befolkning som skapar ett allt högre behov av att producera och använda resurser som inte bara kräver enorma mängder energi utan också ökar nivån av föroreningar och avfall som skadar miljön. (Jha, 2020)

Metod och material

Studien har genomförts med kvalitativ forskningsmetodik inkluderande en fallstudie samt individuella semistrukturerade intervjuer med personer som är involverade i ämnet och data som används (Khan, 2020). Avhandlingens syfte är att skapa förståelse för hur biomassa används inom skogs- och pappersindustrin i Finland. Därför beslöts studien genomföras även med en fallstudie där en pappersproducent som verkar i Finland studeras noggrant. Valet att fokusera på ett enda företag motiveras av behovet av att skapa en detaljerad och noggrann bild av hur en pappersproducent egentligen utnyttjar biomassa.

Studiets semistrukturerade intervjuer genomfördes med fem personer som arbetar inom pappersindustrin i Finland. Fyra av de intervjuade personer var anställda i olika arbetsroller på det pappersbruk som analyseras i denna studie. Intervjufrågorna fokuserade på pappersproducentens egen användning av biomassa och hur de upplevt att användningen av biomassa har bidragit eller skulle kunna bidra till företagets framgång och kundrelationer. Förutom intervjuerna med företagsanställda genomfördes även en intervju med en expert med lång erfarenhet av pappersproduktion. Målet med denna expertintervju var att tillföra kompletterande insikter till de resultat som framkom i de övriga intervjuerna samt att erbjuda ett neutralt perspektiv på de ställda frågorna. Intervjuerna genomfördes mellan maj och juni 2023 och hölls på svenska, finska eller engelska, beroende på den intervjuades språkbakgrund.

För datainsamlingen användes tematisk analys. Tematisk analys ansågs vara en lämplig datainsamlingsmetod, eftersom den ofta används för att identifiera, analysera, organisera, rapportera och beskriva teman eller mönster inom den kvalitativa data som samlats in (Nowell et al., 2017). I denna studie tillämpades tematisk analys för att hitta mönster och tematisera data från de transkriberade intervjuerna samt kapitlen i det teoretiska ramverket. Genom att definiera teman kunde författaren skapa meningsfulla mönster som stöder de centrala koncepten i studien. (Clarke och Braun, 2016)

Undersökningens resultat

Resultaten tyder på att medvetenheten om hållbarhet har ökat bland kunder och allmänheten som en följd av dagens fokus på hållbarhet. Därav påverkar handlingar relaterade till hållbarhet i allt högre grad kundens beslut och krav. Följaktligen är det avgörande för företag att vara medvetna om krav och preferenser angående hållbarhet, då detta kan bidra till att skapa längre och mer hållbara kundrelationer. Särskilt är kunderna bekymrade över koldioxidavtrycket, och enligt resultaten förväntas denna oro öka i framtiden. Dock är det ännu oklart i vilken utsträckning hållbarhet slutligen påverkar beslutsfattandet.

Studien bevisar att skogsindustrin idag lider av en hållbarhetsrelaterad imageproblem eftersom branschen inte har lyckats effektivt kommunicera till allmänheten de åtgärder som vidtagits för att säkerställa hållbarhet och de positiva effekter dessa åtgärder har haft på hållbarheten. Trots detta indikerar resultaten att det analyserade företaget i fallstudien har lyckats förbättra sin image genom att betona bioekonomi och hållbarhet samt genom övergången till att använda biobränslen istället för fossila bränslen och dessutom samt fått positiva respons från kunderna. För att förstärka lönsamheten och företagets konkurrensposition, ansåg respondenterna, att företagen måste vara både flexibla och effektiva. Flexibiliteten innebär möjligheten att använda olika typer av råvaror i energiproduktionen, medan effektiviteten hänvisar till både produktionsprocessens effektivitet och förbättringar av produktens egenskaper.

Resultaten antyder att för närvarande betraktas användningen av biomassa som det föredragna alternativet för energiproduktion inom den finska massa- och pappersindustrin, både ur ekonomisk och miljömässig synvinkel. Ekonomiskt sett är användningen av biomassa mer kostnadseffektiv jämfört med fossila bränslen, främst på grund av högre priser och extra kostnader relaterade till utsläpp för fossila bränslen. Miljömässigt sett anses biomassa vara ett optimalt alternativ, eftersom en hållbar och genomtänkt användning av biomassa anses vara i stort sett koldioxidneutral och även bidrar till minskade utsläpp av andra skadliga ämnen. Dessutom främjar användningen av biomassa social hållbarhet genom att skapa nya arbetsplatser inom industrin och närliggande områden samt kan bidra till förbättrad skogsskötsel genom att höja värdet på skogsresurserna.

Resultaten bevisar också, att implementeringen av bioekonomi och bioenergi inom den finska skogs- och massa- och pappersindustrin medför dock vissa utmaningar. Eftersom

biomassa inte har samma energitäthet som fossila bränslen, ökar behovet av transporter avsevärt. Detta resulterar i både högre transportkostnader och en negativ påverkan på miljön. De snabbt utvecklande hållbarhetsriktlinjer och osäkerheter om framtida preferenser och teknologiska framsteg hindrar företagen för att göra långvariga hållbarhetsrelaterade investeringar Dessutom kan förändringar och framtida preferenser relaterade till råvaror leda till mycket kostsamma nya implementeringar som för närvarande är svåra att förutse. En brist på en enhetlig förståelse av bioekonomi som koncept komplicerar verksamheten inom industrin på många sätt, eftersom det saknas tydliga regler och direktiv att följa. Trots detta betraktas användningen av bioekonomi och biomassa som det mest pålitliga alternativet för företag inom skogsindustrin. Bioekonomi och utnyttjande av biomassa kan skapa en konkurrensfördel för aktörer inom industrin, då de anses spela en viktig roll i att uppnå de ambitiösa klimatmålen satta av FN. Aktörer som inte kan anpassa sig till de fastställda riktlinjerna kommer med stor sannolikhet att stöta på höga kostnader i framtiden.

Avslutning

Studien ger aktörer inom skogs, och massa och pappersindustrin en mer omfattande förståelse av fördelarna och nackdelarna med att använda bioekonomi och biomassa inom industrin. ör att utnyttja biomassa och bioekonomi som en konkurrensfördel måste aktörer kunna svara på kunders krav och frågor samtidigt som de hittar effektiva lösningar för att driva verksamheten och minska kostnaderna för att säkerställa lönsamheten. Dessutom stärker studien aktörernas förståelse för hur hållbarhet påverkar kunder och deras beslutsfattande. Resultaten visar att företag bör i framtiden fokusera på affärsmodeller som betonar cirkulär ekonomi, eftersom regler från regeringar, trender och kundernas åsikter i allt högre grad har roterat kring ämnen relaterade till hållbarhet och miljövänlighet. Studiens resultat visar också att betoningen på hållbarhet i företagsverksamheten är avgörande för framtida framgång, även då man beaktar de höga kostnadsriskerna för dess implementering.

Det är viktigt att komma ihåg att resultaten från denna studie är begränsade till åsikter från anställda inom ett företag samt en expert inom branschen. Av denna anledning bör det beaktas att åsikter och tankar kan variera både inom branschen och mellan enskilda individer och aktörer. För en mer heltäckande bedömning, bör resultaten jämföras med andra företag inom samma bransch. Resultaten från studien visar också att det i framtiden skulle

vara väsentligt att undersöka hur mycket hållbarhetsrelaterade faktorer verkligen styr kunders beslutsfattande, hur den ökade behovet på transporter på grund av biomassan påverkar dess nytta jämfört med fossila bränslen, samt orsakerna till varför definitionen av bioekonomi är så otydlig och hur man kunde skapa en mer enhetlig definition av konceptet.

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Appendices

Appendix 1: Interview guide for the case company

Interview Questions:

- Could you shortly describe, how the newest decarbonization related investment works and what concrete changes this has brought to the mill?
- Has the use of biomass or new investments/implementations such as the recent one led to any changes in customer attitudes or behaviour?
    - What are these attitude/behaviour changes?
- Does the usage of biomass bring local communities any benefits?
    - What are these benefits?
- Does biomass utilization bring any social benefits or impacts?
    - What are the benefits?
- How does the utilization of biomass strengthen the company economically?
- How does biomass utilization affect customer relationships?
- Do you see that by choosing greener alternatives such as changing from fossil fuels to biomass can bring the company competitive advantage within the industry and the competitors?
- Can emphasizing sustainability and greener resource alternatives lead to a more stable/secure future for the company?
    - If yes, how?
- How much of the produced biomass goes to own use and how much is being sold?
    - Is this the case with the pulp and paper industry in general? (the proportion of biomass being sold versus used by the mills themselves)
    - If there would be a surplus, would you consider selling it, and what benefits could it bring?
    - Would there be any barriers to selling it elsewhere?
- How do the emissions originating from the burning of biomass compare to the emission levels caused by the burning of fossil fuels?
- Both fossil fuels and biomass create CO2 emissions. In what ways does the company feel that biomass is the better fuel choice compared to fossil fuels?

- How does the company see Biomass's importance in the future as a sustainable resource, as it has faced controversies such as wood creating carbon dioxide when burnt for energy and wood being a limited resource?
    - Does it look like there are some other resources trending in the near future within the industry?
- Has there been any discussions about implementing technologies such as Bioenergy with carbon capture and storage (BECCS) to reduce carbon dioxide emissions being created during the burning of biomass?
- Can you see the environmental sustainability targets/emphasis influencing customer relationships or affecting the reaching of new customers?
    - If yes, how and in what ways?
- Does using biomass bring economic benefits to the company versus using fossil fuels?
    - How/what economic benefits does it bring?
    - Are there any economic disadvantages?
    - Does it also affect social sustainability in any way?
- How does the company's biomass utilization differ from the competition globally?
- What are the ways that the company desires to benefit from using biomass as an energy source on top of environmental benefits?
    - Strengthening customer relationships?
    - Economic benefits?
    - Answering customer demand?
- How has emphasizing bioeconomy affected the business?
    - What are the advantages?
    - Are there some disadvantages?
- Do you feel that using forest-based resources is going play a significant role in replacing fossil fuels and achieving the UN's sustainability goals also in the future?
    - If yes, why?

Appendix 2: Interview guide for the expert interview
Interview Questions

- På vilket sätt anses den finska pappersindustrin och papperstillverkaren vara moderna och effektiva jämfört med andra fabrik inom EU?

- Hur ser ni på finska pappers/skogsindustrins framtid?
- Hur ser ni på Biomassas betydelse i framtiden som en hållbar resurs efter att den har mött kontroverser som till exempel att trä skapar koldioxid när det förbränns för energi och att träd i sig är en begränsad resurs?
- Kan man se att miljömässiga hållbarhetsmål/betoning har effekt på kundrelationer eller förbättrar chansen att nå nya kunder? Alltså finns det en korrelation mellan dem två?
- Har miljömässighetens/hållbarhetens betydelse inom den finska skogs- och pappersindustrin vuxit under de senaste åren?
- Hur anser ni att hållbarhet kunde användas som konkurrensfördel inom skogs- och pappersindustrin i Finland?
- Finns det några svårigheter med att implementera bioekonomi och cirkulär bioekonomi i massa- och pappersföretag?
- vilka är de positiva resultaten av att betona bioekonomi och cirkuläritet inom den finska skogs- och pappersindustrin?
- Finns det andra sätt som skogs- och pappersindustrin i Finland kunde utnyttja hållbarhet för att förstärka effektiviteten eller lönsamheten?
- Finns det några hållbarhetsrelaterade trender i världen/Finland som också skogs- och pappersindustrin i Finland kunde utnyttja för att förstärka deras position eller lönsamhet?
- Anser ni att innovation och utveckling spelar en viktig roll inom den finska skogs- och pappersindustrin och dess operatörer?
    - På vilket sätt?
- Har hållbarhetsdiskussionen och krav för förminskning av utsläpp varit synliga i utvecklingsbehov och förfrågor från aktörer inom branschen?
- Upplever ni att det finns betydande skillnader mellan värderingar och arbetssätt mellan företagen inom branschen i Finland?
    - Hur?
- Har ni märkt att kundens krav för inkludering av hållbar utveckling och hållbarhet i processutveckling och förstärkning av effektivitet har vuxit under senaste åren?
- Finns det något annat sätt ni anser, att den finska skogsindustrin borde/kunde göra för att stärka sin position bland konkurrensen i Europa eller världen?