Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Economics and Management
Dept. of Industrial Economics and Technology Management

Anne Aspelund Pedersen
Kristiane Lund Kallåk

New Product Development based on Environmental Sustainability

A qualitative embedded case study of two Norwegian industrial companies

Master's thesis in Industrial Economics and Technology Management
Supervisor: Alf Steinar Sætre
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Problem Description

The Norwegian industry is facing challenges due to increased focus on environmental sustainability. To respond to these challenges, the companies have an ambition to reduce their emissions and at the same time maintain sustainable economic growth. The aim of this thesis is to explore how industrial companies can achieve growth and increased competitiveness through new product development (NPD) based on environmental sustainability. Our overarching research question is: "How can Norwegian industrial companies leverage new product development (NPD) to improve their environmental sustainability performance and simultaneously increase their competitiveness?"

Preface

This Master's thesis is written by two students from the Department of Industrial Economics and Technology Management (IØT) at the Norwegian University of Science and Technology (NTNU) during the spring of 2020. The thesis takes form as a case study and is based on a literature review written by the same students during the fall of 2019. It is written within the field of Strategy, Innovation, and International Business Development.

We would like to thank the following for their contributions to our research: Our academic supervisor, Alf Steinar Sætre, for sharing his knowledge, experiences, and giving us feedback. The interviewees from Borregaard and Hydro for taking time to speak with us. Thomas Kristiansen and Hans Erik Vatne for being our contacts from their respective companies. The participants of the expert group in product development from Prosess21, for giving us valuable insight into innovation, new product development, and sustainability challenges in the Norwegian industry.

Trondheim, July 20th, 2020.

Kristiane Lund Kallåk & Anne Aspelund Pedersen

Abstract

The recent years have shown a growing concern about environmental challenges. This is reflected in the literature, in consumers' buying intentions, and in companies' new product development processes.

This thesis investigates how Norwegian industrial companies can leverage new product development (NPD) to improve their environmental sustainability performance. Based on a literature review that investigated how environmental sustainability orientation (ESO) impacted consumers' jobs-to-be-done (JTBD) and companies' new product development (NPD), we developed a conceptual framework and conducted an embedded case-study of two companies. The empirical data consists of qualitative data collected through 19 interviews, in addition to company and plant visits including demonstrations and discussions on the topics of this thesis.

Finally, this thesis contributes to theory by enhancing the knowledge about how environmental sustainability orientation can affect consumers and companies' behavior. First, our findings show that environmental sustainability aspects are becoming increasingly important for consumers' purchasing decisions. Second, we found that the use of life cycle assessment (LCA) and environmental product declarations (EPD) have a positive effect on the profitability of industry products. Third, new product development (NPD) can be an effective way to develop and educate the market about environmental sustainability. Lastly, we found that NPD based on environmental sustainability can strengthen the corporate reputation and create competitive advantage for companies.

Sammendrag

De seneste årene har vist en økende interesse og bekymring rundt utfordringer knyttet til klima. Dette er reflektert i litteraturen, gjennom konsumenters intensjoner om handling, og gjennom bedrifters prosesser for produktutvikling.

Denne oppgaven undersøker hvordan norske industribedrifter kan utnytte produktutvikling for å bedre deres prestasjoner knyttet til klima og bærekraft. Basert på en litteraturstudie som undersøkte hvordan miljømessig bærekraftsorientering påvirker konsumenters *jobs-to-be-done* og bedrifters prosesser for produktutvikling, konstruerte vi et konseptuelt rammeverk og gjennomførte en integrert casestudie av to bedrifter. Det empiriske datamaterialet består av kvalitativ data innhentet gjennom 19 intervjuer, i tillegg til bedrifts- og fabrikkbesøk som inneholdt demonstrasjoner og diskusjoner rundt temaene for denne oppgaven.

Denne oppgaven bidrar til teori ved å øke kunnskapen om hvordan miljømessig bærekraftsorientering kan påvirke konsumenters og bedrifters oppførsel. Først viser funnene våre at miljømessige bærekraftsaspekter øker i viktighetsgrad når det gjelder konsumenters kjøpsabeslutninger. Deretter viser det seg at bruken av livssyklusanalyse (LCA) og miljødeklarasjoner (EPD) har en positiv effekt på profitabiliteten til industriprodukter. Det viser seg også at produktutvikling kan være en effektiv måte å utvikle og utdanne markedet på når det gjelder miljømessig bærekraft. Til slutt viser det seg at produktutvikling basert på miljømessig bærekraft kan styrke bedrifters rykte utad og videre skape konkurransekraft for bedriftene.

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Abbreviations

- ESO: Environmental Sustainability Orientation
- JTBD: Jobs To Be Done
- NPD: New Product Development
- TBL: Triple Bottom Line
- SBU: Strategic Business Unit
- R&D: Research & Development
- EPD : Environmental Product Declaration
- LCA : Life Cycle Assessment
- CCU: Carbon Capture and Utilization

1. Introduction

Environmental challenges are gaining increased attention throughout the world. This influences the behavior of a growing number of consumers and companies. Consumers demonstrate their concern for the environment by making more environmentally sustainable choices in daily life—such as eating more plant-based, driving their car less, and buying more eco-friendly products (Gilg, Barr, & Ford, 2005). Companies express their climate awareness by integrating environmental sustainability into their business operations—such as employee training, supply chain management, and new product development (Du, Yalcinkaya, & Bstieler, 2016). In this way, consumers and companies increase their levels of environmental sustainability orientation (ESO)—and demonstrate that they take responsibility for their environmental impact.

Environmental sustainability, as a political concept, was put on the global agenda by the Brundtland Report in 1987. The term *sustainable development* is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987, p. 8). The Brundtland Report emphasizes that the environmental, economic, and social development are closely linked. Therefore, all three dimensions must be taken into account when solving the big world challenges. Moving towards sustainability is a social challenge that entails changes in attitudes, habits, and strategies. Companies that have previously focused on economic sustainability, i.e. "maintenance of capital", need to create strategies that also prioritize the social and environmental dimension. That is, to integrate maintenance of "moral capital" and "natural capital" into their business (Goodland, 1995, p. 3). In this thesis, we focus on the environmental dimension. We believe that environmental sustainability is of particular interest, as the negative environmental development has significantly started to affect the business reality (Maxwell & van der Vorst, 2003).

We use the following definition of environmental sustainability orientation (ESO): "[A] construct comprising three dimensions: knowledge of environmental issues, sustainable practices

and commitment toward environmental sustainability" (Roxas & Coetzer, 2012, p. 461). ESO can be interpreted at consumer and company level, which both have been popular research topics in recent years. Much of the research at consumer level focuses on how ESO influences buying behavior. Consumers are becoming increasingly concerned with the environmental performance and consequences of their purchases and product usage (Paparoidamis, Tran, Leonidou, & Zeriti, 2019). At the company level, current literature seems to focus on how ESO is related to financial performance (e.g. Chan, He, Chan, & Wang, 2012; Dixon-Fowler, Slater, Johnson, Ellstrand, & Romi, 2013) and how ESO impacts new product development (NPD) success (de Medeiros, Ribeiro, & Cortimiglia, 2014).

We explore how companies can use NPD to improve both their environmental performance and competitiveness. As NPD success is highly related to consumers' buying decisions (de Medeiros et al., 2014), it is interesting to investigate how consumers' buying behavior is influenced by their ESO—and what companies can do to benefit from this. What climate challenges a company faces—and what steps can be taken to overcome them—are largely dependent on the company's industry. Also, the company's nationality will have an impact on its strategic opportunities. To our knowledge, there is little research today that explores the topic in the context of Norwegian industrial companies. Norway has greater prosperity and a better economy than many other countries. This means that the authorities can set stricter requirements for companies' environmental responsibility, in addition to being able to provide financial support for climate measures. The business culture in Norway also differs from many other countries in terms of how companies are managed and what values are emphasized. Some important values in Norwegian companies are equality, trust, and empowerment of employees (Levin, Nilssen, Ravn & Øyum, 2012). These can affect the way Norwegian companies work with NPD.

Industrial companies have long been an important part of the Norwegian economy. Especially at the beginning of the 20th century, many Norwegian industrial companies were established. Several of these still exist and constitute some of the country's largest and most profitable firms today (Næss, 2020). However, the companies' growth is based on increasing utilization of natural

resources, which has resulted in significant environmental impacts. Over the years, incremental improvements have been made to reduce emissions and energy consumption caused by their processes. Nevertheless, there is still great potential for improving these companies' environmental performance—for example, through development of new products. This is an understudied area which we believe deserves more attention.

We aim to enhance the knowledge about NPD as a contributor to better environmental performance of Norwegian industrial companies. Through qualitative case analyses, we investigate how two Norwegian industrial companies strategically use NPD to respond to the increased demand for environmental sustainability. Collection of empirical data in the form of qualitative in-depth interviews and visits to several process plants and office locations, has provided us with valuable insights into our case topic of research. The thesis is based on a literature review conducted during the fall of 2019, where we investigated the relationship between environmental sustainability orientation (ESO), consumers' jobs-to-be-done (JTBD) and firms' new product development (NPD). We hope that our findings will be of interest to practitioners who are curious about NPD based on environmental sustainability. Furthermore, we hope that the insights from our study will contribute to the literature, by providing empirical data that can help substantiate theories.

1.1. Research Question

One overarching research question is developed to explore the opportunities for Norwegian industrial companies to gain benefits from becoming more environmentally sustainable. The research question is based on literature that argues that environmental NPD can be an effective way for companies to adapt to the environmental sustainability challenges they face (Paparoidamis, Tran, Leonidou, & Zeriti, 2019; Pujari, 2006; Pujari, Wright, & Peattie, 2003).

Research question: *How can Norwegian industrial companies leverage new product development (NPD) to improve their environmental sustainability performance and simultaneously increase their competitiveness?*

1.2. Review of the Content

The thesis consists of eight chapters, of which this introduction is the first. Chapter 2 presents a literature review of the topics environmental sustainability orientation (ESO), consumers' jobs-to-be-done (JTBD) and companies' new product development (NPD). This review will serve as the theoretical framework for the further analyses. Chapter 3 describes our research methodology for the literature review and case studies. Next, chapter 4 presents our case analyses which are structured in three levels: within-case analysis, cross-case analysis and cross-company analysis. Chapter 5 suggests some implications for theory and practice, while chapter 6 discusses limitations of our study. Finally, an overall conclusion is given in chapter 7.

2. Theoretical Framework

The purpose of this review is to present central research that has been done within the three topics outlined in figure 1: environmental sustainability orientation (ESO), consumers' jobs-to-be-done (JTBD) and companies' new product development (NPD). The overarching objective is to investigate how ESO impacts consumers' JTBD and companies' NPD. This study will serve as the theoretical framework for this master's thesis as the topics we have visited will be analyzed further through an embedded case study. Section 2.1 contains a review of the topics separately. Next, section 2.2 connects the different topics and highlights some findings we consider as particularly interesting.

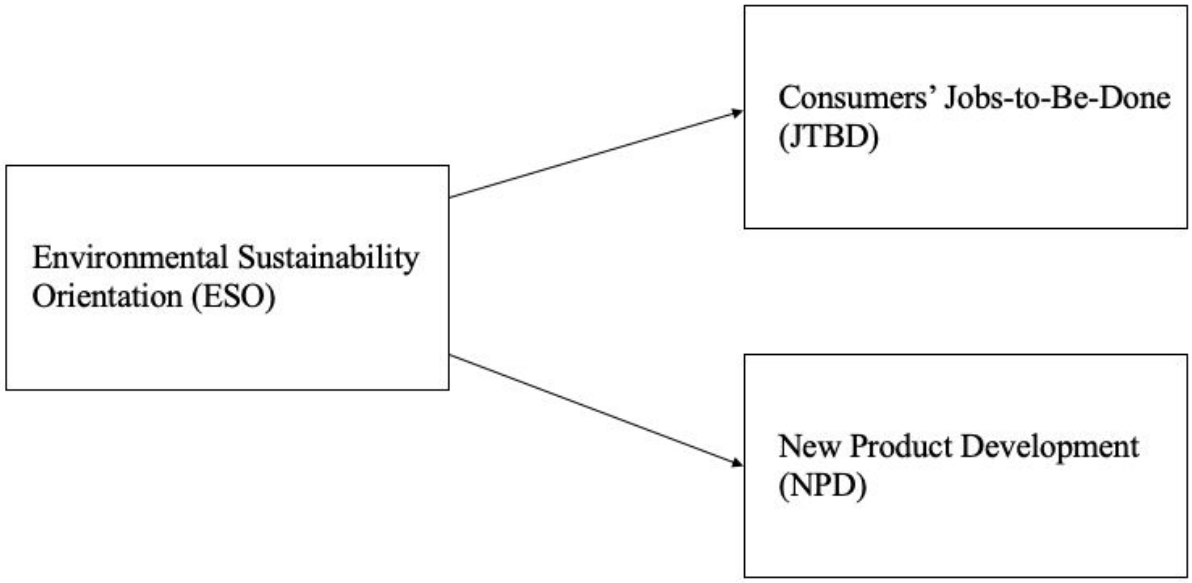

Figure 1: Conceptual framework for literature review

2.1. Literature Review of Topics

2.1.1. Sustainability Terminology

The use of sustainability terminology has increased significantly over the past decades, as sustainability has gained prominence as a research topic. Literature searches show that there are many different terms used to explain almost the same concepts, and that "the number of terms continues to increase along with the rapid increase in awareness of sustainability" (Glavič & Lukman, 2007, p. 1875). As the sustainability challenge applies to everyone, the terminology is needed in many different contexts, such as in scientific papers, annual reports, textbooks, governmental policy and media. Since most of the terms are multiword units, it can be difficult to find their definitions in dictionaries (Glavič & Lukman, 2007). Consequently, the terms are often used imprecisely, which can lead to misunderstandings and inefficient communication. This can be particularly challenging when companies try to communicate their sustainability efforts to consumers. A common misconception among consumers is for example that *sustainable* and *environmentally friendly* are synonyms, which is not correct.

From a holistic perspective, ambiguous terminology creates challenges that can delay the desired development towards a more sustainable future. By clarifying sustainability terminology, the communication within the scientific community, organizations, agencies, and stakeholders can be improved. Efficient communication is crucial in the process of moving our societies toward sustainable development (Glavič & Lukman, 2007). With this as an argument, we wish to devote the remainder of section 2.1.1 to define and discuss the sustainability terminology that will be used throughout this thesis.

The definition of *sustainability* is formulated in various ways. However, most of them emphasize that the concept consists of an economic, environmental, and social dimension (e.g. Cooper et al., 2004; Eccles & Krzus, 2010; Elkington, 1998). This is in line with the Sustainable Development Goals (SDGs) that was adopted by the United Nations in 2015 with the aim of

seeing the environmental, economic, and social development in context (UN General Assembly, 2015). The 17 main goals are interconnected, which means "they recognize that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability" (United Nations Development Programme, 2020). Although the concepts of *sustainability* and *sustainable development* are closely related, they must be interpreted differently. While *sustainability* should be viewed as humanity's target goal of human-ecosystem equilibrium (homeostasis), *sustainable development* refers to the holistic approach and temporal process that lead us to the end point of sustainability (Shaker, 2015).

Environmental sustainability, often referred to as "maintenance of natural capital", seeks to "sustain global life-support systems indefinitely" (Goodland, 1995, p. 6). More specifically, environmental sustainability can be defined as:

> A condition of balance, resilience, and interconnectedness that allows human society to satisfy its needs while neither exceeding the capacity of its supporting ecosystems to continue to regenerate the services necessary to meet those needs nor by our actions diminishing biological diversity. (Morelli, 2011, p. 5)

While environmental sustainability can be understood as a condition, the term *environmental sustainability orientation* (ESO) refers to individuals' and organizations' commitment to the environment, in terms of knowledge of environmental issues and implementation of environmentally sustainable practices (Roxas & Coetzer, 2012).

At consumer level, environmental sustainability orientation (ESO) can be more specifically defined as "purchase, use, and disposition of products in the desire to minimize or eliminate any harmful effects and maximize the long-run beneficial impact on society" (Mohr et al., 2001, p. 47). Since this literature review will study how ESO influences the purchase and development of new products, we choose this definition as it focuses on product consumption. The level of ESO can thus be interpreted as the degree to which the consumer emphasizes environmental aspects in

the context of product purchases. The concept of ESO at consumer level will be discussed in more detail in section 2.1.2 and 2.1.3.

At company level, environmental sustainability orientation (ESO) can be defined as "the overall proactive strategic stance of firms towards the integration of environmental concerns and practices into their strategic, tactical and operational activities" (Roxas & Coetzer, 2012, p. 464). In this thesis, we emphasize the company's environmentally sustainable practices, and how environmental sustainability is expressed in its practices for new product development. With the term *environmentally sustainable products*, we refer to products with a low environmental impact (Pickett-Baker & Ozaki, 2008). Such products are also often called *eco-friendly*, *low-carbon*, or *green*. The terminology containing the word green or greener can sometimes be incorrectly associated with *greenwashing*, which is understood as the act of misleading consumers regarding the environmental practices of a company or the environmental benefits of a product or service (Parguel, Benoît-Moreau, & Larceneux, 2011). The terminology related to ESO at company level and new product development will be discussed further in section 2.1.4 and 2.1.5.

2.1.2. Environmental Sustainability Orientation at Consumer Level

Consumers' environmental sustainability orientation (ESO) is typically expressed through their eating habits, transportation methods, and buying behavior. As this literature review seeks to answer how ESO is affecting consumers' perception of value in the form of their jobs-to-be-done (JTBD) and firms' new product development (NPD), we will investigate consumers' consumption and buying behavior related to physical products.

There has long been an increasing interest towards environmentally sustainable products. Studies show that there is also an increasing willingness to pay a small premium for these products (Cherian & Jacob, 2012). Though there is an increasing will, there is often a gap between what consumers' value and how they behave, which is referred to as the *intention-action gap* (White,

Hardisty, & Habib, 2019). There exists a similar concept concerning companies known as the *knowing-doing gap*, which looks at companies and organizations and how different obstacles hinder them to act on their knowledge (Pfeiffer & Sutton, 2000). For the sake of this literature review we will use the term *intention-action gap* to highlight that we refer to consumers. According to a large multi-country survey by McKinsey:

> 87% of consumers are concerned about the environmental and social impact of the products they buy, 33% say they are willing to pay a premium for sustainable products, and another 54% care about the environment, and want to help tackle climate change. (Bonini & Oppenheim, 2008)

These results serve as a good example of the gap that shows the difference between what consumers value and how they behave, and we can see that while there is a strong concern for the environment, there is a significant gap between intention and action. There can be different reasons for this gap, e.g. habits, costs, poor information, and accessibility.

Poor information sharing about the environmentally sustainable benefits of products can be a challenge. Products often lack information regarding how environmentally friendly they are, "a problem is that the social and environmental sustainability is not easy to assess from the tangible product, and would thus require augmenting the total product with appropriate information" (Toppinen, Toivonen, Valkeapää, & Rämö, 2013, p. 777). Connecting information to the product will make it easier for consumers to understand the actual quality, and what has gone into making that particular product (Kirchler, Fischer, & Hölzl, 2010). This is something that will make the decision process easier for consumers when choosing between different alternatives.

For consumers to have the best starting point to make a buying decision, it would be beneficial to increase the availability of product information. By doing this, consumers will get the information they need about environmental sustainability in the production process of the product, as well as the use and possible recycling. Though information can be a good thing, it is

important to be aware of the trap of greenwashing. Transparency about company behavior, manufacturing processes and product attributes is important to gain the trust of consumers. Mohr & Webb (2005) argue that consumers learning about responsible product properties is a process that takes time. It is also argued that the intention-action gap will decrease with time (Carrington, Neville, & Whitwell. 2010).

2.1.3. Consumers' Jobs to Be Done

The core of the JTBD-theory is that consumers do not buy products or services, they pull them into their lives to make progress. This progress is what the authors define as the *job*, which is the "progress that a person is trying to make in a particular circumstance" (Christensen, Hall, Dillon, & Duncan, 2016, p. 27). This definition gives a new way of categorizing consumers or their problems and focuses on why they make the choices they make.

> When we buy a product, we essentially "hire" it to help us do a job. If it does the job well, the next time we are confronted with the same job, we tend to hire that product again. And if it does a crummy job, we "fire" it and look for an alternative. (Christensen, Hall et al., 2016, p. 56)

The theory is an alternative way of expressing consumer value and how they make their buying decisions. It challenges traditional marketing theory that connects consumers' characteristics with their purchasing decisions. Ulwick has a different way of explaining the jobs-to-be-done (JTBD) theory (Ulwick, 2016), where he looks at jobs as activities rather than progress, but for the sake of this report we find Christensen's definition more appropriate.

Traditional marketing theory often uses segmentation to categorize consumers into groups based on their age, gender, location, interests and other variables (Kotler & Keller, 2012). It then utilizes this information to find correlations with other buyer segments to create a consumer profile. The JTBD-theory criticizes such traditional marketing theory for focusing too much on

consumer profiles and on correlations drawn from data (Christensen, Dillon, Hall, & Duncan, 2016). It can be misleading to assume that consumers with the same characteristics, e.g. age, gender, or height, have the same reasons for procuring a product or service. This theory transformed the understanding of consumer choice, as it seeks to capture the causal driver behind a buying decision.

The JTBD-theory can be divided into four key principles (Christensen, Hall et al., 2016). Number one says that a *job* is a shorthand for what an individual really seeks to accomplish in a given circumstance. It emphasizes the complexity of the experience consumers are trying to create. The more specific the job, the more specific solution is required for it to succeed. This is especially relevant with consumers increasing environmental sustainability orientation, which can affect product attributes, usage, recycling, and other product aspects.

The second principle considers circumstances to be more important than traditional consumer characteristics or trends. To achieve a good match for an innovation, it is important to understand the consumers' circumstances and what they need in that given circumstance. Consumers cannot be categorized based on gender, age, or location, but rather on what specific progress they are trying to make in a specific situation. E.g. a person who is looking to purchase a product that is produced in a more environmentally sustainable manner in addition to being recyclable, does not necessarily fit into a specific consumer category. People can have the same causal drivers behind their purchasing decisions without having similar characteristics.

The third principle says that "Good innovations solve problems that have only inadequate solutions—or no solution" (Christensen, Hall et al., 2016, p. 59). This is tightly connected to the job, which is a complex and specific process to give the consumer exactly the solution they are looking for. There are several examples of consumers creating their own solutions if the existing solutions are not considered to be adequate. In the context of environmental sustainability, an example can be related to personal hygiene, e.g. the use of disposable cosmetics products, such as cotton pads. Disposable one-time-products that cannot be recycled are not very

environmentally sustainable. Therefore, consumers with a high level of environmental sustainability orientation might consider it as a better solution to cut small pieces from a sheet or a t-shirt and use them as an alternative. This is a more environmentally sustainable alternative than the disposable cotton pads that you can buy at the grocery store because you can wash and reuse them. This solves the environmental sustainability oriented consumer's job in a better way as the solution has a lower environmental impact than the conventional alternative.

The last principle states that "Jobs are never simply about function - they have powerful social and emotional dimensions" (Christensen, Hall et al., 2016, p. 59). This indicates that the consumers' JTBD includes some sort of emotional dimension in addition to the physical job. Environmental sustainability orientation is about protecting the environment, which is often connected to both social and emotional dimensions (White et al., 2019).

Now that the different principles for this theory are presented, we will investigate how to uncover which jobs the consumers need help with. The JTBD-theory provides five questions that can help with uncovering this (Christensen, Hall et al., 2016). Referring to our research question, we will now use these questions to exemplify how the consumers' environmental sustainability orientation might impact their job specifications. Number one; *"Do you have a job that needs to be done?"* When you want to go to your cabin for a weekend get-away, you need something to transport you from home to the cabin. With the increasing environmental sustainability orientation amongst consumers, the job that needs to be done includes more than the physical transportation. The job is no longer just about transportation, it is about transportation that is also environmentally sustainable. Examples can be carpooling, bus, or electric vehicles.

"Where do you see non-consumption?" To answer this question, we will look to the food industry. As environmental sustainability becomes more important for consumers, the focus on reducing or avoiding eating meat has been a popular topic (Tosun & Yanar, 2018). Increasing non-consumption of meat has led to substitution-products that meet the demand for consumers with a high level of environmental sustainability orientation. Vegan and vegetarian options are

becoming increasingly popular, and the increase in demand has led to more choices when going grocery shopping.

"What work-arounds have people invented?" One example provided by our academic supervisor stood out for this question. In the case of heavy snow, if you do not have snowshoes available, strap on some tennis rackets. This is a good example of a solution-oriented consumer who uses what they have available in that given moment.

"What tasks do people want to avoid?" There has been an increased focus on reducing product packaging the past years. Especially in the food industry. This can be seen by the "non-packaging-food-stores" that have started to emerge. These types of stores require you to bring your own containers for the food that you purchase.

"What surprising uses have customers invented for existing products?" Sometimes, consumers utilize products for other purposes than the given one. Here we can look back at the example above with the reusable cotton pads. People can cut off small pieces from a t-shirt or other fabric and use it for removing makeup etc., which is far off what a t-shirt is meant to be used for.

There are many ways of approaching the job process, and the more specific the job description, the better. We will now look at how the change in consumers' jobs will affect companies. Companies that are able to understand the jobs consumers need done, often have more success with their innovation processes (Christensen, Dillon et al., 2016).

2.1.4. Environmental Sustainability Orientation at Company Level

It is important for businesses to adhere to market requests and governmental policies. "Businesses around the world face increasing pressure to reconfigure their strategic orientations and capabilities in response to calls for sustainable development" (Roxas & Coetzer, 2012, p. 461). In other words, companies must increase their environmental sustainability orientation

(ESO) in order to meet political climate requirements and to remain competitive in the market. In recent years, researchers have given much attention to explore how companies can develop and demonstrate their ESO (e.g. Banerjee, 2002; Linnenluecke & Griffiths, 2010; Zwetsloot & van Marrewijk, 2004). Moreover, many recent studies focus on how ESO affects the company's performance in different ways (e.g. Artiach, Lee, Nelson, & Walker, 2010; Eccles, Ioannou, & Serafeim, 2014; Schrettle, Hinz, Scherrer-Rathje, & Friedli, 2014).

A company's environmental sustainability orientation (ESO) can be developed and demonstrated through integration of environmental concerns into culture, decision-making, strategy and business operations and through its interactions with stakeholders (Linnenluecke & Griffiths, 2010; Zwetsloot & van Marrewijk, 2004). As a business orientation, ESO broadens the scope of business goals "to include those goals that minimize the negative natural environmental impacts of firms" (Roxas & Coetzer, 2012, p. 464). The concept of ESO can be analyzed in two levels; the cultural level and the practical level (Claudy, Peterson, & Pagell, 2016). Environmental sustainability culture is the integration of environmentally sustainable values and ideas in the organizational culture (Banerjee, 2002), which includes norms, values, ideologies and beliefs (Howard, 1998). This implies that the degree to which environmental sustainability is embedded as a strategic norm in the company's culture will be reflected in its level of ESO (Adams, Lee, Nelson, & Walker, 2016; Linnenluecke & Griffiths, 2010).

Environmentally sustainable practices refer to the integration of environmental sustainability concerns into internal operation plans, programs, and practices (Crittenden, Crittenden, Ferrel, Ferrel, & Pinney, 2011; van Hemel & Cramer, 2002). This dimension indicates that "ESO does not only measure firm's tendency, proclivity or inclination toward environmental sustainability, but also the actual behavior of the firm" (Roxas & Coetzer, 2012, p. 473). Consequently, a company can increase its level of ESO by implementing more environmentally sustainable business activities. Typical initiatives that will increase the company's level of ESO are concerned with dematerialization, reduction of waste and emissions leading to improved environmental performance and/or reduced environmental impact (Pujari, 2006). In chapter

2.1.5, we will discuss such initiatives in the context of environmentally sustainable new product development (NPD).

Companies may also demonstrate their commitment to the environment using the *triple bottom line (TBL)* framework, coined by Elkington (Elkington, 1998). The TBL is an accounting framework that aims to measure companies' performance in a broader perspective, by emphasizing the social and environmental performance as much as the financial. In addition to being an accounting tool, the intention is to provoke deeper thinking and encourage corporate managers to prioritize their people and planet targets as much as their profit targets (Elkington, 2018).

As a continuation of the triple bottom line concept, Eccles and Krzus coined the term *One Report* (Eccles & Krzus, 2010) as a reference to the concept of *integrated reporting*. Integrated reporting is about representing the financial and non-financial performance of a company in one single report (International Integrated Reporting Council, 2020). Eccles and Krzus argue that the meaning of One Report is twofold (Eccles & Krzus, 2010). First, One Report means a single document that allows the company to communicate to all stakeholders that it is taking a holistic view of their interests. Secondly, One Report means that financial and nonfinancial information are reported in such a way that shows their impact on each other. They argue that such reporting will result in greater transparency about the company's performance and how it is being achieved, and that "This function of reporting will change behavior; it is as important as providing information on achieved performance in financial, environmental, social and governance terms" (Eccles & Krzus, 2010, p. 23). This literature thus indicates that adoption of One Report can be an effective way to increase companies' levels of environmental sustainability orientation (ESO), as it will influence both culture and practices in a more environmentally sustainable direction.

2.1.5. Companies' New Product Development

New product development (NPD) can often be visualized as an innovation process which follows a series of stages known as a *stage-gate process* (Cooper, 2008). This has become a popular system for driving new products to market, and Cooper argues that the benefits of this model is to improve effectiveness and efficiency. The process maps how NPD projects move from the idea stage to launch and beyond, where each stage has clear goals and purposes and are designed to reduce uncertainties and risks associated with the project. Another way to look at the innovation process is provided by the book *The innovation journey* which presents empirical evidence that the innovation journey consists of a nonlinear cycle of activities, both divergent and convergent, which repeats over time in unpredictable ways (Van de Ven, Polley, Garud, & Venkataraman, 2008). With this empirical evidence they show that the innovation journey is a chaotic process, with multiple iterations, and that the linear stage-gate process is inadequate for managing such a process.

Environmental new product development is defined as "product development into which environmental issues are explicitly integrated in order to create one of the least environmentally harmful products a firm has recently produced" (Pujari et al., 2003, p. 658). This definition also includes the redesign of existing products so that their environmental impact in terms of materials, manufacture, use, or disposal is reduced. Environmental NPD is thus a similar process to conventional NPD, including an additional level of complexity regarding environmental sustainability. The process will continue to solve the core job for consumers, while also addressing their needs for improved environmental performance. An efficient way for companies to strategically align themselves with consumers' growing environmental concerns is to develop *environmentally sustainable products* (Paparoidamis et al., 2019). In a strict sense, environmentally sustainable products do not really exist, "as all products we buy, own, use and discard in our everyday lives will have a negative impact at some stage in their life cycles" (Pickett-Baker & Ozaki, 2008, p. 283). Despite this, there seems to be acceptance in the literature to refer to products with low environmental impact as environmentally sustainable.

Environmental NPD is a good alternative to NPD for companies that seek to increase their environmental sustainability orientation (ESO). It is argued that "commercial success of ENPD [environmental new product development] in the market place is crucial in helping move companies and society towards environmental sustainability" (Pujari, 2006, p. 78). Pujari also states that in order for environmental technologies and products to actually make a contribution to a future world of sustainability, they need to provide a viable environmentally sustainable product choice and thus gain market shares from the conventional (non-environmentally sustainable) products. This emphasizes the importance of successful environmental NPD, with viable solutions that consumers are willing to purchase. In order for the environmentally sustainable products to sustain long-term success, they need to demonstrate their environmental performance in addition to upholding the functional benefits of the product, also known as the core of the job to be done (Maxwell & van der Vorst, 2003; Fuller & Ottman, 2004). This should be the focus for firms' when developing new products to meet the requirements of consumers with high levels of ESO.

2.2. Key findings from Literature Review

We have now discussed important terminology within the field of sustainability, as well as explored how consumer and company behavior is affected by their level of environmental sustainability orientation (ESO). This section connects the different concepts from the literature review and highlights some findings we consider as particularly interesting. Figure 2 is a modified version of figure 1 and illustrates how the research question of the literature review have been answered.

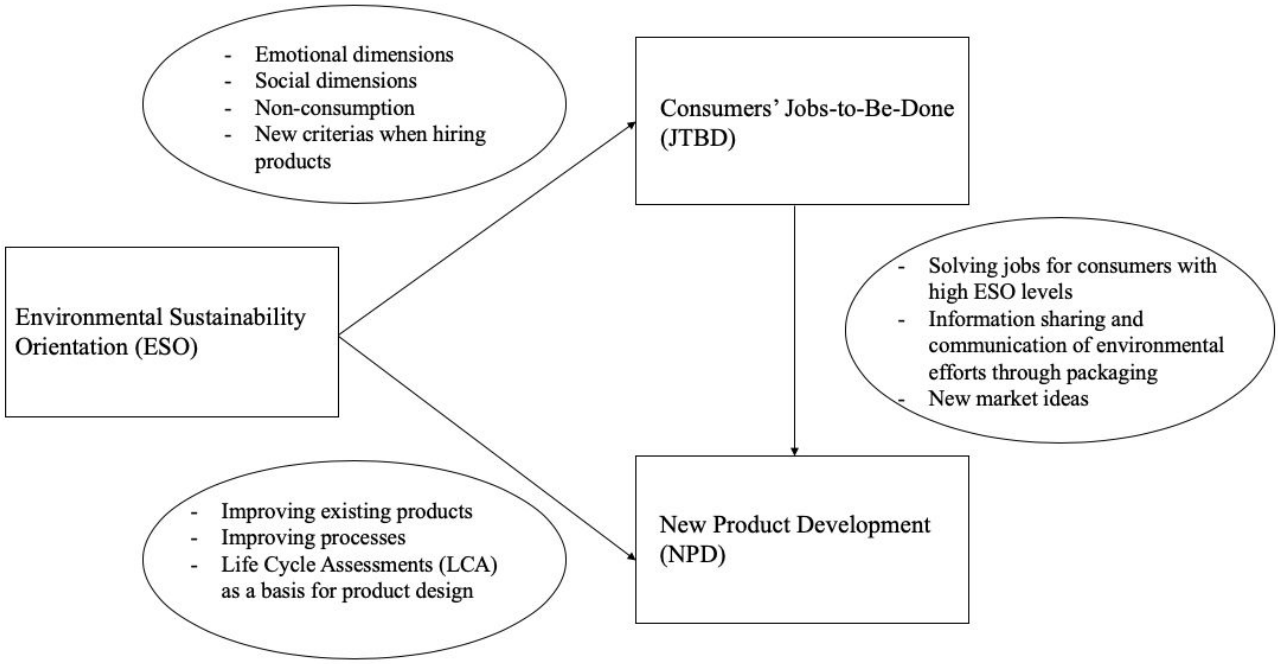

Figure 2: Visualization of key findings of literature review

2.2.1. New Dimensions to Consumers' Job Specifications

The literature shows that consumers are becoming increasingly concerned about environmental sustainability. Specifically, it is shown that there is an increase in consumers who value the environmentally sustainable aspects of the products they purchase (e.g Bonini & Oppenheim, 2008; Cherian & Jacob, 2012; Gilg et al., 2005). Expressed through JTBD-terminology, we can say that the environmental specifications of the consumers' jobs are becoming more dominant than before in their purchasing situations. Returning to the four key principles of the JTBT-theory (Christensen, Hall et al., 2016), the visited literature suggests that increasing levels of ESO will have significant influence on principle 2 (circumstances), principle 3 (inadequate solutions or no solution) and principle 4 (social and emotional aspects of the job).

Principle 2 states that circumstances are considered to be more important than traditional consumer characteristics or trends (Christensen, Hall et al., 2016). For consumers with high levels of ESO, these circumstances will be affected in various ways. Returning to the example in 2.1.3 with the week-end trip to a cabin, the consumer's circumstances are now affected by ESO,

and also possibly environmental sustainability practices. They want transportation that will affect the environment in the least negative way. The world is becoming increasingly aware and concerned about the negative environmental impact of product production, purchasing and usage. There is also an increased interest regarding recycling and reuse of products.

The third principle says that "Good innovations solve problems that have only inadequate solutions—or no solution" (Christensen, Hall et al., 2016, p. 59). Connecting this to consumers' ESO will yield several possibilities for new solutions. Looking at reduction of waste, there are numerous possibilities for new environmentally sustainable solutions. Returning to the example from chapter 2.1.3 about disposable cotton pads, consumers with high levels of ESO will likely intend to reduce disposable one-time products. A good substitution will be similar products or solutions that still gets the job done in a satisfactory manner, while being reusable and/or recyclable. This will clearly give a new dimension to the job specification, as it will include stricter requirements regarding packaging, reuse, and recycling of products.

Principle 4 expresses the importance of social and emotional dimensions connected to jobs. Environmental sustainability culture, including values and beliefs, can be connected to social and emotional dimensions for consumers. Studies have shown that humans have a strong desire to fit in and will conform to the behavior of those around them (White et al., 2019). Social influence is therefore powerful when encouraging pro-environmental buying decisions. For example, a recent study shows that telling online shoppers that other people were buying environmentally sustainable products resulted in a 65% increase in making at least one sustainable consumption (Demarque, Charalambides, Hilton, & Waroquier, 2015). Also, the emotional dimension is closely linked to ESO, as research has shown that hope and pride are particularly useful in driving sustainable consumption. For example, a study regarding energy conservation in the workplace showed that people who were publicly praised for their energy-efficiency efforts, thus engendering pride, saved more energy than the group of people that were given small financial rewards (Handgraaf, Van Lidth de Jeude, & Appelt, 2013).

2.2.2. The Intention-Action Gap

Although environmental aspects are becoming increasingly important for consumers when they "hire" products to solve their jobs, research shows that these intentions are not always reflected in practice. "Few consumers who report positive attitudes toward eco-friendly products and services follow through with their wallets" (White et al., 2019, p. 124). This *intention-action gap* makes sense when analyzed with the JTBD-theory, which points out that coincidences that occur in the specific buying situation often are far more important than the consumer's basic values when making a purchase decision (Christensen, Hall et al., 2016). For example, a consumer with a high level of ESO can visit the supermarket on the way to the gym with the intention of buying an organic banana to get some healthy and fast energy. At the store, the consumer sees that the organic bananas are only sold in multipacks, which is not so convenient to bring to the gym. Therefore, the consumer chooses to buy a conventional banana, despite the intention of choosing the more environmentally sustainable alternative.

Thus, it can be concluded that ESO influences the consumers' intentions to buy environmentally sustainable products much more than their actual buying decisions. Although the environmental dimension of the consumers' job specification is more important than before, it is not more important than the functional dimension. The multipack of organic bananas was "fired" because it could not solve the consumer's job, which was to have a healthy and simple snack to bring to the gym.

From the firms' perspective, "there has seemingly never been a better time to launch a sustainable offering" (White et al., 2019, p. 124). It can therefore be frustrating to understand and deal with this intention-action gap. However, this emphasizes the importance of taking a JTBD-approach to their NPD practices. Analyzing the specific jobs the firm can solve for consumers increases the likelihood to succeed with innovation (Christensen, Dillon, et al., 2016). This strategy also applies when solving jobs for consumers with high levels of ESO. Looking at the banana example, there was clearly a need to offer single organic bananas. In this case, a small

change in the packaging of the product will potentially lead to increased sales because it better solves the consumer's specific job. In this way, the company can arrange for consumers to act in line with their intentions to choose environmentally sustainable products.

2.2.3. Growing Potential for Environmental New Product Development

Companies are clearly facing challenges connected to the calls for environmentally sustainable development. Increasing companies' ESO thus becomes necessary to remain competitive in the market. As environmental sustainability can be integrated in both culture and practices (Claudy et al., 2016), increased levels of ESO can be achieved through both integration of more environmentally sustainable values and ideas in the organizational culture and implementation of more environmentally sustainable business activities. In any case, increased environmental sustainability initiatives will often lead to increased costs. Therefore, companies should be interested in exploiting the calls for change to increase their value creation. Environmental NPD, as discussed in chapter 2.1.5, can be an efficient way to achieve growth and increased market share (e.g. Pujari, 2006; Pujari et al., 2004). There are many opportunities for market growth for companies that choose to increase their level of ESO through their NPD practices. Consumers' increased levels of ESO creates potential for new product ideas, which the company can exploit.

First, companies can succeed with new product ideas by helping consumers with high levels of ESO solve their jobs. Although such consumers seek to live as environmentally sustainable as possible, they still have needs that must be satisfied. For example, everyone must brush their teeth and eat food. By offering environmentally sustainable product alternatives to solve these jobs, companies can gain new market shares. Such market ideas would probably not have had as much commercial success if they were launched 10 years ago.

Second, companies can succeed with environmental NPD by taking their existing products and making them more environmentally sustainable. For example, using more environmentally sustainable materials or reducing the amount of materials in packaging can be effective.

Packaging can potentially be an effective way of demonstrating to consumers what actions the company is taking for the environment. For example TINE SA, Norway's largest supplier of dairy products, has used the packaging of its products (cream cups, milk cartons etc.) to show consumers its sustainability efforts (TINE, 2020). Offering milk cartons made of 100% renewable materials allows the consumers to "touch and feel" the actions TINE is taking in the direction of becoming more environmentally sustainable. Such explicit and visual communication of environmental sustainability efforts may also have a positive impact on the company's reputation, as the company name can be associated with environmental sustainability.

Finally, changes in the companies' production processes can contribute to market success. Making improvements in the production, such as reducing waste, emissions, and material consumption will result in products with reduced environmental impact (Pujari, 2006). Such efforts can be particularly powerful if the products are assessed from a life cycle perspective. Using standardized tools—such as life cycle assessments (LCAs)—to evaluate the environmental costs of products are becoming more common in various industries (Schau & Fet, 2008). When performing a LCA of a product, input factors, output factors, and the potential environmental impacts are evaluated throughout the product life cycle (Digitaliseringsdirektoratet, 2018). The results can indicate which environmental impacts are greatest, what is the source of these, and which lifetime phase is most important in relation to different environmental impacts. Based on the LCA results, an Environmental Product Declaration (EPD) is created, which is a documentation of the product's environmental impact that is open to the public. Such assessments and declarations can result in greater transparency and make it more profitable for companies to invest in more environmentally sustainable production processes.

2.2.4. Conclusion

Returning to our starting point for this literature study (figure 1), our review indicates that ESO at both consumer and company level can have a significant impact on JTBD and NPD. At consumer level, it influences the way consumers think when procuring products and services.

However, it is important to highlight that their intentions are more affected than their actual buying behavior. At company level it is indicated that having a high level of ESO is critical to remain competitive. ESO can be increased through integration of environmental sustainability into NPD practices, both through environmental NPD and through exploiting consumers' ESO by offering environmentally sustainable products. These theoretical findings are summarized in figure 2.

3. Methodology

This chapter describes and discusses our research method for the literature review (section 3.1) and case study (section 3.2). The choice of topics for the thesis has been inspired by our collaboration with the Norwegian process industry over the past year. During the summer and fall of 2019 we participated in the expert group for product and service development in *Prosess21*. *Prosess21* is a forum that was established to enhance the cooperation between the different fields of expertise in and around the Norwegian process industry. Its aim is to give strategic advice to how the Norwegian process industry can reduce emissions while simultaneously maintaining sustainable economic growth (Prosess21, 2020). In addition, we had a 9-week internship in Norsk Hydro ASA during the summer. Our internship was in the company's Technology Office, where we spent time analyzing mega trends and becoming better acquainted with the Norwegian process industry. We also got the opportunity to make several plant visits and conduct in-depth interviews with employees from the participating companies.

Our experiences from *Prosess21* and Hydro have provided us with rich insights into the Norwegian process industry and the challenges they face. We took interest in how the companies' environmental sustainability orientation (ESO) influences their new product development (NPD) practices. That is how we were motivated to choose the topics and research question for our thesis.

3.1. Methodology for Literature Review

The purpose of our literature review is to explore and map the existing academic research on environmental sustainability orientation (ESO), consumers' jobs-to-be-done (JTBD) and companies' new product development (NPD). This research was used to answer our research question: *How does environmental sustainability orientation (ESO) influence consumers'*

jobs-to-be-done (JTBD) and companies' new product development (NPD)? In this section we describe our method for the literature study.

3.1.1. Search Process

As knowledge production within the field of sustainability is accelerating, our initial keyword searches gave us a substantial number of hits. It was difficult to find an appropriate starting point for our literature review based on this type of literature search. We continued the process by asking our supervisor, Professor Alf Steinar Sætre for relevant authors and publications. Based on his research experience, he has great accessibility and knowledge within the fields of NPD and JTBD and could provide us with valuable guidance. The literature he suggested proved to be a good basis for identifying other relevant sources. Through our participation in the expert group in *Prosess21*, we gained insights and knowledge about how environmental sustainability affects the industry. This knowledge formed a basis for our research on environmental sustainability.

Within the field of NPD, we were recommended two authors in particular: Cooper and Van de Ven. Within JTBD-theory, we were recommended to explore publications by Christensen and Ulwick. In addition, our supervisor suggested reading publications from Eccles and Elkington. With this starting point, we conducted several searches including these authors and topics, and used the snowball effect to gain more knowledge. In the field of sustainability, we used keyword searches with keywords such as "green", "product innovation" and "review" and found an article named "Success factors for environmentally sustainable product innovation: a systematic literature review" (de Medeiros et al., 2014). We could see that this article had utilized some of the literature that we had been given by our academic supervisor. We therefore used its reference list as a starting point for chain-referral sampling, i.e. using one article as the basis to find other relevant articles to review (Biernacki and Waldorf, 1981).

We used keyword searches on various databases, mainly “Oria”, “Scopus”, “ResearchGate”, “ScienceDirect” and “Google Scholar”. Oria is NTNU’s internal database for literature, whereas the other four are external databases.

3.1.2. Selection Process

Several selection criteria were used to find the appropriate literature. To determine which articles to choose from the chain-referral method, the articles had to concern environmental sustainability at consumer or company level and/or environmental sustainability in new product development. We also put restrictions on the validity of the articles, as they should bear academic weight. To determine whether the article had significant academic weight, we looked at the impact factor for most of the articles, in addition to checking how many citations they had. Number of citations were assessed relative to the year of publication. We put no restrictions on the publishing journal or the year it was published. However, we ensured to include several new publications on ESO to reflect some of the newest findings within this field.

3.1.3. Limitations of Method for Literature Review

One of the main limitations of this method is that it could have been more structured to capture and assess the most relevant and important literature. As our selection process was based on recommended literature and chain-referral sampling, this may have led to us missing out on some important publications. For this particular research topic, a complete literature review would require a systematic review of all critical appraising relevant research (Snyder, 2019). We found that the chain-referral method based on the recommended authors would give us the best possible overview of our research topics given the strict time frame. In addition, we only looked at environmental sustainability, which is only one of three aspects of sustainability. This restriction was necessary due to the time constraints and might have led to us missing some important aspects of the holistic concept of sustainability.

3.2. Methodology for Case Study

This section will describe our research design for the qualitative part of our thesis, namely the case study. In addition, we will discuss our data collection, data analysis, and the quality of the research design.

3.2.1. Research Design

3.2.1.1. Research question

A field study contributes to the literature and obtains methodological fit when its associated research question and research design is coinciding with the current state of relevant theory at the time of the research design and execution (Edmondson & McManus, 2007). Our literature review revealed a lack of literature on our topic within the Norwegian industry. We therefore argue that the literature exploring new product development based on environmental sustainability is immature in the Norwegian context. The less known about a specific topic, the more open-ended the research question should be (Edmondson & McManus, 2007). This is consistent with our research question which is an open-ended question of "how", in addition to our choice of using an exploratory qualitative research design.

3.2.1.2. Case Study

To explore and strengthen our findings from the literature review, we chose to conduct a case study during the spring of 2020. " … [A] case study allows investigators to focus on a "case" and retain a holistic and real-world perspective ... " (Yin, 2014, p. 4). This is appropriate when further exploring the theories from the literature review. Edmondson and McManus (2007) states that "[F]it is achieved by logical pairings between methods and the state of theory development when a study is conducted" (Edmondson and McManus, 2007, p. 1177). Based on the formulation of our research question, and Yin stating that a case study is appropriate when the

research question is posed as a "how" or "why" question (Yin, 2014), we have a good fit with our chosen method.

3.2.1.3. Selection of cases

From our participation in *Prosess21*, and our summer internships in Hydro, we gained knowledge and insights that we could use when conducting our case study. We chose Hydro as one of the two case companies, as we have gained insight into the company through the summer internship and conducted interviews with several employees from the company. These interviews focused mainly on new product development and innovation, and megatrends in the Norwegian process industry. The second company we chose was Borregaard, who also participated in the same expert group in *Prosess21*. During the summer of 2019, we visited Borregaard's facilities in Sarpsborg and were given a guided tour which included different demonstrations in their laboratories. In addition, we conducted one interview concerning new product development and innovation, and megatrends in the Norwegian process industry. Based on this, we chose two cases within each of the two case companies. We used theoretical sampling when choosing the four specific cases, which means that the cases were selected because they are particularly suitable to offer theoretical insights. We will conduct what is called an embedded case study, which in our case includes a within-case analysis, cross-case analysis, and within-company analyses. Multiple case-studies provide a stronger base for theory building, and the resulting theory will be better grounded, more accurate, and more generalizable than for a single case-study (Yin, 2014). Yin argues that theory developed from multi-case designs is more robust. We chose an embedded case-design including four specific cases from two case companies, as it will provide more analytical benefits when building theories from our case-study.

3.2.1.4. Units of analysis

Case study design should describe the research question, indicate what data are to be collected, and describe its units of analysis (Yin 2014). To choose what information should be collected and focused on during the interviews, we used our research question as a basis. We chose to

focus on how the companies respond to the increased focus on environmental sustainability from different stakeholders, specifically their customers. This also includes how they utilize the benefits from having an environmentally sustainable production or product, compared to their competitors. This can be understood as an embedded case study, rather than a holistic case study (Yin, 2014). An embedded case study gives us the possibility to involve analysis at more than one level, which is coinciding with our embedded case design.

Borregaard and Hydro are two very different companies regarding size, technology, and structure. To have a comparable case-study, we chose the unit of analysis to be a product or products from the two companies in the cross-case analysis. In Borregaard, the units of analysis are EuroVanillin Supreme, and Exilva, which are two products in the company's portfolio that come from different business units. For Hydro, we chose Reduxa and Circal, and IKEA Delaktig. These products also come from different business units. This was a conscious choice, with the aim of getting a better and more thorough overview of the companies when analyzing and answering our RQ.

3.2.2. Data Collection

3.2.2.1. Data Sources

In case studies, Yin (2014) recommends using multiple case-designs over single case-designs (Yin, 2014). The purpose being to strengthen the findings by having multiple sources supporting the same information and concepts (Miles, Hubermann, & Saldana, 2014). Due to the sharply defined timeframe of this project, we decided that four cases would be appropriate. Planning the number of cases in advance, is common for researchers due to time and money considerations (Eisenhardt, 1989). According to Eisenhardt & Graebner (2007) "Theory-building cases usually rely extensively on qualitative data from interviews and other sources, such as observations, historical books, archives, and so forth" (Eisenhardt & Graebner, 2007, p. 28). Our main data sources are the interviews we conducted during the summer of 2019 and the spring of 2020. In addition, we used documents provided by the companies as well as online documents and

archival data. We also have some data material from plant visits and meetings with representatives from the two case companies from the summer and autumn of 2019. Eisenhardt (1989) argues that "[T]he triangulation made possible by multiple data collection methods provides stronger substantiation of constructs and hypotheses" (Eisenhardt, 1989). Jick (1979, p. 603) argues that "[T]he use of multiple measures may also uncover some unique variance which otherwise may have been neglected by single methods".

During the summer of 2019 and spring of 2020 we interviewed numerous, knowledgeable people from different parts of the organizations in the two companies. When dealing with interview data, it is important to limit bias. One way to mitigate this, is to use multiple and highly knowledgeable informants from different parts of an organization, who can provide different perspectives on the same topics (Eisenhardt & Graebner, 2007). We argue that we have managed to limit informant bias. Eisenhardt (1989) claims that multiple investigators enhance confidence in findings (Eisenhardt, 1989). Eisenhardt and Bourgeois (1988) propose conducting the interviews in a two-person team. One researcher handles the interview questions, while the other records notes and observations (Eisenhardt & Bourgeois, 1988). This is exactly what we did when conducting our interviews. We found this to be particularly fruitful, as it enabled each of us to focus fully on the task at hand. One of us had the interviewing role for Hydro, and then we switched the roles for Borregaard. By having both of us participating in the conduction of the interviews in addition to the analysis and interpretation of our findings, we argue that we achieved triangulation by researchers.

3.2.2.2. Interview Process

Before conducting the interviews, we created a semi-structured interview guide with open-ended questions (see Appendix A and B). Qualitative methods are useful when the aim is to discover how the respondent sees the world. To obtain this, it is essential that the questions asked are as nondirective as possible (McCracken, 1988). Having a semi-structured interview guide with open-ended questions enables this. The goal with open-ended questions is for the informant to

speak freely. To obtain this, it is important as an interviewer to be unobtrusive. Also, to listen for what the informant has to say without trying "to "read" the hidden meaning of speech and gesture" (McCracken, 1988, p. 21). The interviewer should listen with great care, and "one must let the respondent talk on for a moment. For what appears to be an abrupt change of topic may be a simple and important piece of clarification" (McCracken, 1988, p.21). Having a semi-structured interview allows us to follow the informant, and possibly discover new and important pieces of information. Although, it is important to return to the topic of interest if the conversation drifts too far away from the topic.

Based on our literature review we chose some topics that became the categories for the interview guide. The interview guide was revised along with the interview process, and we adjusted it to the specific informants and their knowledge competence. The goal was to get as much insight into the different categories as possible, from sources with different perspectives on the topics.

The goal for an interview process is to have enough data to reach saturation. On the other hand, there are resources and time constraints that must be considered. Together with our supervisor, we decided that six to eight respondents from each company was sufficient for this thesis. This coincides with what McCracken considers to be sufficient for many research projects (McCracken, 1988). The interviewees were chosen based on their expertise and competence about the chosen case studies. Together with one contact person from each company, we discussed what products and topics would be relevant for our thesis, and then we found the most qualified people within those business units. An overview of the informants and their contribution to the case studies are shown in Table 1 for Hydro and Table 2 for Borregaard. Borregaard is a smaller organization than Hydro, and wanted more anonymized titles for the informants. We chose titles that are anonymous while still being sufficiently descriptive. All interviews were performed with one informant at a time, except for one. In Borregaard, we interviewed the Marketing and Sustainability Coordinator together with the EHS and Sustainability Manager.

All interviews during the summer of 2019 were conducted face-to-face, including plant visits to both Hydro and Borregaard's facilities in Vækerø, Holmestrand and Sarpsborg. During the plant visits we also visited the laboratories and production facilities, which included presentations from key personnel at both Hydro and Borregaard. All the interviews during the spring were conducted over Skype or Teams, and one via regular phone call. Most interviewees we already knew from the summer, so it was unproblematic to conduct the interviews over Skype and Teams. The one phone call was with our leader in Hydro, who we know well from our summer internship there during the summer of 2019. The interviews lasted up to one hour. This was a choice we made to limit the amount of data to be processed, and to focus the conversation onto relevant topics. We started with the interview guide and the open-ended questions and followed the natural flow of the conversation. Sometimes the informant led the conversation elsewhere, which enabled us to gain insight in other important aspects of the topics to be researched. After each interview we discussed the findings, evaluated the interview results, and adjusted the interview guide.

Table 1: Overview of conducted interviews with Hydro

Title	**Date**	**Interview form**	**Duration (min)**
Head of Technology Primary Metal Commercial	03.07.19 + 06.03.20	In person + Video call	55:04 + 58:38
Director of Innovation Primary Metal Commercial	04.07.19 + 02.03.20	In person + Video call	46:26 + 46:44
VP Strategic Projects, Extruded Solutions, Strategy and Innovation	31.07.19 + 03.03.20	In person + Video call	1:16:19 + 1:05:12
Chief Technology Officer (CTO)	03.03.20	Phone Call	40:24
Director Corporate Business Development	04.03.20	Video call	44:07

Head of Brand and Marketing	04.03.20	Video call	41:39
Head of Strategy Primary Metal Recycling	26.03.20	Video call	36:50

Table 2: Overview of conducted interviews with Borregaard

Title	**Date**	**Interview form**	**Duration (min)**
Innovation Manager	24.06.19 + 30.03.20	In person + Video call	43:44 + 43:52
Sales Director	17.03.20	Video call	45:02
Technology Manager 1	17.03.20	Phone call	45:34
Technology Manager 2	18.03.20	Video call	44:33
Marketing & Sustainability Coordinator	18.03.20	Video call	43:13
EHS and Sustainability Manager	18.03.20	Video call	43:13
Team Manager Research	23.03.20	Video call	44:16
Process Manager	27.03.20	Video call	41:36

3.2.3. Data Analysis

Our analysis process consisted of the following steps: Pre-establishing categories based on the literature study; transcribing and coding the interviews; creating new categories; within-case analyses, cross-case analysis, and cross-company analysis.

The interviews were manually transcribed by both of us ad verbatim. Although, such transcripts will never be flawless, nor include the same level of complexity as the initial interview conversation (Sandelowski, 1994). Conducting and transcribing the interviews gave us enhanced insight and deeper understanding of the data. The transcription was conducted in parallel to the interviews, which provided the possibility to adjust the interview guide if necessary. The most used method for data analysis is to code interview statements (Brinkmann & Kvale, 2017). "The goal is to develop categories that capture the studied experiences and actions in full" (Brinkmann & Kvale, 2017, p. 226). We started by coding the interviews using our literature-based categories from the literature review, which is defined by Brinkmann & Kvale (2017) as concept-driven coding. When reviewing the data, we also created some new categories within the literature-based categories, to capture more detailed information that revealed itself.

Before writing the case study, we had to translate the transcribed interviews from Norwegian to English. Davidson (2009) argues that "transcription that encompasses translation from one language to another presents an especially complex and challenging situation" (p. 38). This translation was an important part of our analysis, so we devoted sufficient time to do this translation. We divided the interviews between us and made sure to cross-check each other's work before using it in the analysis.

We started with within-case analyses of the four cases and divided the cases between us based on company affiliation. The overall idea with a within-case analysis is to become intimately familiar with each case (Eisenhardt, 1989). Eisenhardt also argues that this familiarity "accelerates cross-case comparison" (Eisenhardt, 1989, p. 540). Writing the within-cases provided us with

deep insight into the four cases, which revealed unique patterns of each case. To increase the quality of the analyses, we regularly checked each other's work, and discussed the continuing work to be done.

After the within-case analyses, we conducted a cross-case analysis between the two cases within each company. There are different ways to start when conducting a cross-case analysis. Eisenhardt (1989) argues for several tactics, where one "is to select pairs of cases and then to list the similarities and differences between each pair" (p. 540). As we only had two cases in each company, it was evident which cases should be paired. "The juxtaposing of seemingly similar cases by a researcher looking for differences can break simplistic frames. In the same way, the search for similarity in a seemingly different pair also can lead to more sophisticated understanding" (Eisenhardt, 1989, p. 540). By looking for differences and similarities across the two cases, our aim was to understand better how the two companies utilize new product development to increase their environmental sustainability orientation, and how it can lead to increased competitive advantage for the companies.

Lastly, we conducted a cross-company analysis, comparing the two companies. Before conducting the cross-company analysis, we created categories based on our research question. Our goal was to look for similarities and differences within the established categories.

3.2.4. Quality of Research Design

3.2.4.1. Internal Validity

Internal validity is defined by Yin (2014) as "the strength of a cause-effect link made by a case study, in part determined by showing the absence of spurious relationships and the rejection of rival hypotheses" (Yin, 2014, p. 239). To obtain internal validity, it is important to discover the underlying theoretical reasons for why the relationship exists (Eisenhardt, 1989), and whether the results can be interpreted as correct or not (Jacobsen, 2015). Our data is mainly based on the interviewees' description of reality. Our job as researchers is to consider whether the informants

are giving us a true description of the situation, and that they are not withholding important information (Jacobsen, 2015). By interviewing informants from different parts of the organizations, and on different levels in the organizations, we had the opportunity to check if we were given divergent or inconsistent answers to our questions. After analyzing the transcribed interviews, we did not see any divergent answers from either of the companies. Another challenge is for us as researchers to interpret and analyze the data in a correct way. To avoid this situation, we both analyzed the data separately, and then cross-checked each other's work to ensure that we had the same interpretation of the data. The last challenge is for us to present and draw correct conclusions from our analysis, so that it reflects the reality of the situation. Before finalizing our thesis, we sent a draft to the informants to get feedback and validation on our findings. By doing this, we ensure that the data is handled correctly, in addition to enhancing the validity of the data (Jacobsen, 2015).

3.2.4.2. External Validity

External validity concerns to which degree the results can be generalized. The strength of a qualitative study is to uncover phenomena, establish causal mechanisms, and uncover special prerequisites for something to have an effect (Jacobsen, 2015). The question becomes whether the results from these particular cases can be generalized as to hold for other types of cases. Yin (2014) argues that the form of the research question can help or hinder external validity. Research questions that include “how” or “why” are congruent with case studies and can help strengthen the external validity of the method. It is also mentioned that one should think of the case as “the opportunity to shed empirical light about some theoretical concepts or principles” (Yin, 2014, p. 40), which implies the importance of having some theory or theoretical propositions before conducting a case study. Carrying out the theoretical review and examining which theory exists set a solid ground work for our case study.

We chose two relatively large Norwegian industrial companies. Both of the companies have a strong focus on innovation and environmental sustainability, and we consider them to be suitable

to give us the insight we need to answer the research question. One limitation for generalizability for our case-study stems from limitations for generalizability of the Norwegian industry. Another comes from the fact that our case-companies are both well-established, large, industry firms in the Norwegian process industry. This limits the generalizability of the findings for companies that are of a smaller size or in a slightly different industry.

Lastly, there are possible limitations regarding the selection of informants. To mitigate this, we included informants of different age groups, different business units, and with varying tenure with the companies. By doing this, we argue that we got a holistic overview over the companies, and that we also got some new insights from the most recent employees.

3.2.4.3. Reliability

The goal of reliability is to minimize errors and biases in a case study (Yin, 2014). "If a later researcher follows the same procedures as described by an earlier researcher and conducts the same case study over again, the later investigator should arrive at the same findings and conclusions" (Yin, 2014, p. 48). To obtain this, it is important to document the procedures followed when conducting the case study. Through the spring of 2019, and every step of this process, we thoroughly documented what we did and what results we got from different procedures. First, all interviews were audio recorded, and we took detailed notes during the interviews. The interviews were transcribed by us ad verbatim, in addition to noting down the time, place, and circumstances around them. Second, the coding and categorization of the collected data was divided between us and checked regularly for accordance. Lastly, the interviewees' preparedness for the interviews varied. A few had prepared presentations in advance to answer our questions, some had read through the interview guide, and others were conducted without any preparation. Different levels of preparedness with the informants can according to Jacobsen (2016) influence their answers. However, the topics of our thesis are not considered to be sensitive, so the bias is hopefully washed-out across informants.

4. Case Analysis

This chapter presents the case analyses we have carried out in order to answer our research question. First, section 4.1. provides a thorough insight into each of the case companies. This is followed by case analyses at three levels. Section 4.2 presents four within-case analyses. Section 4.3 presents two cross-case analyses. Section 4.4 presents a cross-company analysis.

4.1. About the Companies

This section presents our two case companies, Hydro (4.1.1) and Borregaard (4.1.2). The presentation of each company follows the same thematic structure. First, we give an introduction to the company's core business and organizational structure. Then we provide a brief insight into the company's history and culture. After this, we turn our focus to two of the main topics from the literature review, namely environmental sustainability orientation (ESO) and new product development (NPD). We will here describe how both ESO and NPD are important priorities in Hydro's and Borregaard's corporate strategy.

4.1.1. Hydro

4.1.1.1. Introduction to Hydro

Hydro is a fully integrated aluminum[1] company founded in Norway in 1905. The company has 36,000 employees and is present in 40 countries worldwide (Hydro, 2020c). With its five business areas—Bauxite & Alumina, Energy, Primary Metal, Rolled Products and Extruded Solutions—Hydro is the only global aluminum company that covers the entire value chain. The company serves more than 30,000 customers within all market segments of aluminum (Hydro, 2020c). Hydro is a public limited company organized under Norwegian law. The company's

[1] Spelling of *aluminum*: This thesis is written in American English, and will therefore use the AE spelling—*aluminum.* However, when using direct text quotes from Hydro, we will write *aluminium* as Hydro itself uses this spelling consistently. Oral quotes from the interviews have been translated from Norwegian and will therefore use *aluminum*.

primary listing is on the Oslo stock exchange and subject to Norwegian securities legislation (Hydro, 2019b). The largest shareholder is the Norwegian State represented by the Ministry of Trade, Industry and Fisheries (Nærings- og fiskeridepartementet, 2020). As of July 2020, the Norwegian State owns 34,26% of the total shares.

Hydro's governance system is based on delegation of responsibility to the five business areas and to corporate functions that manage finance, tax, accounting and other common areas (Hydro, 2019b). The organizational structure is illustrated in figure 3.

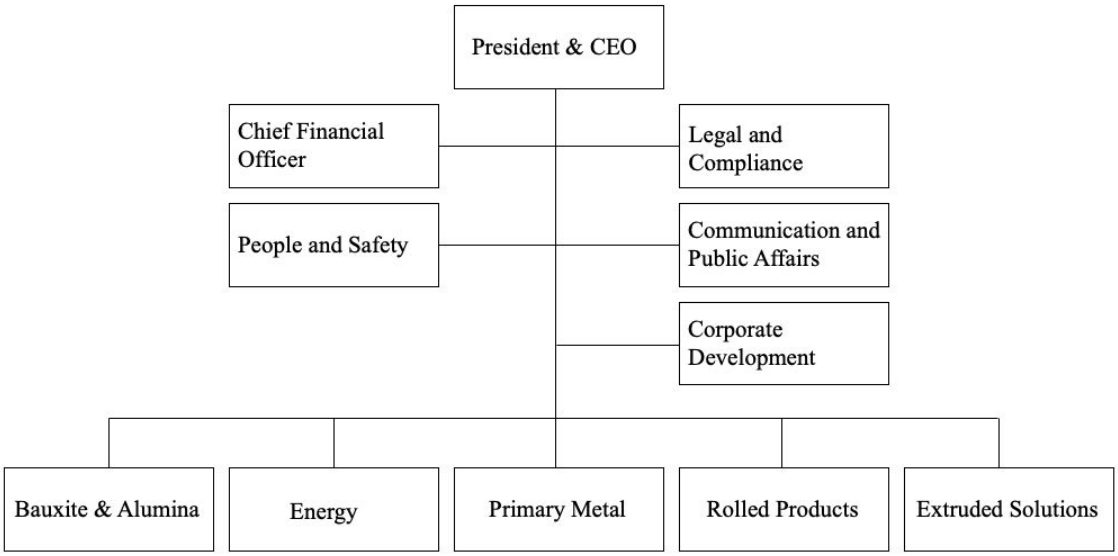

Figure 3: Organizational chart of Hydro (Hydro, 2019g, "Organizational chart") modified by authors

In this thesis we will mainly focus on two of the business areas—Primary Metal and Extruded Solutions—as well as the corporate level of the organization. Primary Metal and Extruded Solutions are chosen because they together represent both upstream and downstream parts of Hydro's business. In addition, they can shed light on interesting—but different—opportunities for new product development (NPD) based on environmental sustainability. At the corporate level, our interviewees represent Hydro's Corporate Technology Office, Corporate Business

Development, and Brand and Marketing. The Corporate Technology Office is responsible for the overall technology strategy in the company across the business areas. It is headed by the Chief Technology Officer (CTO). Although our case analyses are limited to two of the business areas, we will provide a brief introduction to each of the five units. We argue that it is important to have knowledge about all the business areas to understand Hydro's challenges and opportunities related to environmental performance and NPD. Table 3 provides an overview of the size of each SBU.

Table 3: Size of Hydro's strategic business units (SBUs)

SBU	**Employees**	**Revenue**
Bauxite & Alumina	3,476	28,548 (MNOK)
Energy	193	2,267 (MNOK)
Primary Metal	4,858	9,196 (MNOK)
Rolled Products	4,109	2,711 (EUR)
Extruded Solutions	22,236	15,218 (MNOK)

The aluminum value chain starts with extraction of bauxite and continues with production of alumina. Hydro's bauxite and alumina facilities—Paragominas bauxite mine and Alunorte alumina refinery—are located in the Parà state in the northern part of Brazil (Hydro, 2019a). The bauxite business includes one of the world's largest bauxite mines, and the bauxite is sold to other companies in addition to being further processed in Hydro's own alumina plant. Similarly, the alumina business includes direct sales to other companies as well as use in Hydro's own aluminum production (Hydro, 2019a).

Energy has the lowest number of employees, but still generates significant revenue. Hydro operates 20 hydropower plants, which together have an annual production of 10TWh. This

makes Hydro the third largest power producer in Norway (Rosvold, 2019). The hydropower is mainly used to support the company's own production of primary metal (Hydro, 2019c).

The Primary Metal unit includes facilities in 17 locations in Europe, Canada, Australia, Brazil, Qatar and the US (Hydro, 2019i). Two-thirds of the production of primary metal is based on renewable energy. In addition, the business unit operates recycling facilities that enable Hydro to offer aluminum with a high amount (>75%) of post-consumer scrap (Hydro, 2019i). This reduces the material's carbon footprint significantly.

Rolled Products consists of 7 production locations that together supply the market with around 1 million tons annually (Hydro, 2020e). The business unit serves a variety of industries, such as transportation, automotive, building and construction, electronics, and packaging.

Extruded Solutions is Hydro's most downstream business unit and ensures the company's presence closer to consumers. The unit does not sell products directly to the end users, but delivers extruded aluminum products to well-known brands within thousands of product areas—e.g. electronics, transportation, furniture, windows and doors. Its product offerings include both customized extrusions and fully fabricated components (Hydro, 2019d). The business area was established in 2017 when Hydro acquired Sapa—the world's largest extrusion company. Sapa was originally formed as a 50/50 joint venture between Orkla and Hydro in 2013. Hydro's acquisition was strategically motivated, as it allowed the company to grow in the most attractive areas in aluminum, increasing its global presence and making Hydro the world's leading integrated aluminum company (Bulai, 2017; Hydro 2017). The business unit counts for 100 production facilities in more than 40 countries (Hydro, 2019d).

4.1.1.2. History and Culture

Since the establishment of Hydro in 1905, the company has undergone significant development, across several industries and continents (Hydro, n.d.c.). The company is based on the

"Birkeland-Eyde process", which is a patent by entrepreneur Sam Eyde and professor Kristian Birkeland for using electricity to capture nitrogen from the atmosphere. Their method made it possible to use Norway's vast potential for hydroelectric power to create nitrogen-based industrial fertilizers at a reasonable cost relatively easily (Andersen & Yttri, 1997).

When the company was officially established, Hydro's share capital was mostly French, some Swedish and only to a small degree Norwegian (Hydro, n.d.c.). In the years that followed, Hydro quickly became one of Norway's largest industrial companies. After a turbulent period during the Second World War, Hydro evolved into a modern post-war industrial conglomerate, with business within plastics, petroleum, and light metals (Hydro, n.d.c.). Hydro's international expansion began in the 1970s, and in the 1980s and 1990s its petroleum and aluminum activities were expanded further. Two important milestones in Hydro's recent history took place in 2004 and 2007. First, the fertilizer and industrial gas businesses were established as an independent company, named Yara International. Three years later, Hydro merged its oil and gas operations with Statoil (now Equinor). The "new Hydro" that remained was a global, integrated aluminum company (Hydro, n.d.c.).

Despite major changes taking place between 1905 and today, Hydro claims that three characteristics of the company have been preserved: "the spirit of entrepreneurship, a dedication to innovation and careful nurturing of a system of values" (Hydro, n.d.c.). Hydro's current purpose is "to create a more viable society by developing natural resources into products and solutions in innovative and efficient ways" (Hydro, n.d.g.). After Hydro's new CEO was appointed in 2019, the company launched a new strategy with "sustainability" and "profitability" as key priorities (Vosgraff, 2019). This involves having units with competitive costs based on efficient operations, solid market positions based on innovation and differentiation through sustainable products and processes. The CEO stated that the aim is "to position Hydro as a robust and profitable industry leader, based on innovation and sustainability" (Hydro, 2020a).

4.1.1.3. Hydro's Environmental Sustainability Orientation

Sustainability has a key position in Hydro's current corporate strategy. The company has developed a holistic approach to sustainability, and emphasizes economic, social and environmental aspects in all strategic decisions. In other words, the *triple bottom line* (Elkington, 1998) is a key principle in decision making contexts. Due to Hydro's global presence, the company has an important responsibility to ensure proper social rights for employees and business relations. This can be challenging at times, especially when the business activities take place in third world countries.

> I have been working with business development for many years and I have looked at many companies we have considered buying. And it is clear that we have had to write off many of these deals because there are things in them that Hydro may not be familiar with. For example, to buy a factory in India where the way it was organized and operated meant that the families lived on the plant and received both education and hospital by the owner. But it was a scheme that in our situation would be seen as a form of slave trade. Combining the life of the workers with a job and making a commitment to the company. A very interesting deal, but it would not fit Hydro's reputation. We cannot work with this type of organizational model. (VP Strategic Projects, Extruded Solutions, Strategy and Innovation)

This example illustrates how Hydro's corporate social responsibility (CSR) strategy can influence decision making. The CSR strategy is based on respecting and supporting the human rights of all individuals potentially affected by the company's operations (Hydro, 2019h). According to Hydro, the agreement with the factory in India was not in line with the company's view on CSR, and therefore it was not entered into. It is important to recognize that CSR is a significant aspect of Hydro's overall strategy. However, we will not elaborate on this as it is

beyond the scope of the thesis. In line with our overarching research question, the following discussion will mainly focus on the environmental dimension of the sustainability term.

All the seven interviewees from Hydro explain that having an environmental sustainability orientation (ESO) has become increasingly important in recent years. However, it is recognized that challenges related to environmental sustainability have been present for a long time. According to the CTO, most of the challenges can be related to the fact that aluminum production is energy intensive and causes emissions of environmentally harmful gases.

> We are extremely lucky to have hydropower. But we use carbon as anode in our process, and therefore CO_2 is emitted from the electrolysis as a by-product. So that is the big challenge. And then we can talk a lot about the fact that since we have hydropower, our aluminum only represents a tenth of the CO_2 emissions compared to the coal-based aluminum in China, which puts us in a very good position. But as time moves on, this has tightened more and more. The demands are becoming tougher and the expectations from consumers are becoming much tougher. One should really have zero [emissions], and not just better than China or better than competitors. (CTO)

What the CTO indicates are another two important challenges. First of all, consumers' requirements for the company's environmental footprint have become harder to meet. Second, it is difficult to differentiate Hydro's aluminum from less environmentally sustainable aluminum without damaging the reputation of the global industry.

The majority of the informants indicate that Hydro has experienced increased pressure from both consumers and authorities to improve its environmental impact. The pressure is particularly evident in Norway and other prosperous countries where social rights are already satisfied. On the other hand, increased demand for environmental sustainability also creates opportunities for Hydro. Although aluminum comes with a significant climate footprint, Hydro believes that the

material can be a contributor to solving several climate challenges. As Hydro is present throughout the entire aluminum value chain, it has the ability to influence the production from its origin (Hydro, 2020d). This creates potential to improve the company's environmental impact in several ways.

The properties of aluminum also offer powerful opportunities for Hydro to contribute to a more environmentally sustainable society. Aluminum is light, strong, flexible, and 100% renewable. If Hydro succeeds in substituting other materials with aluminum, the company can contribute to creating a lower environmental impact from similar products and product usages. Hence, Hydro argues that aluminum can be "a key building block for the low-carbon, circular economy" (Hydro, 2020d).

> The industry emits CO_2. That is how our prosperity is built. It is built on mass production and pollution, one could say. But it also means that: when you are a part of the problem, you are also possibly a part of the solution [to the problem]—which is necessary for us to become a low carbon society ... You actually need materials to build the electric cars and the wind turbines and all that is needed for us to become a low-carbon society. (Head of Brand and Marketing)

Hydro recognizes that climate change is one of the most important challenges of our time, and that the company's future profitability will depend on its environmental sustainability efforts (Hydro, 2020d). When the new strategic direction was presented in 2019, a new climate strategy was also launched. The strategy—*30 by 2030*—aims at reducing the company's gross CO_2 emissions by 30 % throughout the value chain by 2030 (Hydro, n.d.d.). This long-term ambition is approached in two ways: (1) Through greener sourcing and production and (2) through helping customers reduce their emissions through greener products. Hydro's shorter-term ambition is to be carbon neutral in a life-cycle perspective by the end of 2020, which involves "to save at least as much carbon emissions as we generate" (Hydro, n.d.d.). The most important measures to

achieve this are to increase the recycling capacity, lowering emissions in its own production processes, and delivering aluminum to segments where it has the greatest benefits from a climate perspective.

4.1.1.4. New Product Development in Hydro

In line with Hydro's framework for leadership, organization and culture, each strategic business unit (SBU) is responsible for its own innovation activities. Due to the variation in the SBU's products, there are natural differences in how they work with NPD and what they describe as new products. However, there are some common characteristics of NPD in the company. First of all, the majority of new products can be described as *continuous* or *incremental improvements* rather than *radical innovations*. The CTO explains that this is typical for large industrial companies. Radical changes require large financial investments and take time. Improvements to products that the company already has, on the other hand, are necessary to stay competitive, and is less time demanding. However, the increased strategic focus on environmental sustainability has necessitated greater investments.

> There is no doubt that some of these big things, like getting rid of CO_2 from electrolysis, will require significant investments both in the development and upgrading of old factories. So, there will certainly be large challenges ahead—because this becomes very expensive to change—switching technology to something that has lower CO_2 emissions ... This is a challenge that all industrial companies will face. (CTO)

Another characteristic of NPD in Hydro is that there must be a demand for the product when it enters the market. "An innovation begins with a need in the market. At least in our industry, it is almost always like this" (Head of Technology, Primary Metal, Commercial). That is, there must be a *market pull*. New product ideas must be thoroughly analyzed and go through several decision gates before the company will invest significantly in them. We will not elaborate on

Hydro's stage-gate processes in this thesis, as it goes beyond the scope of our research question. What is relevant to point out is that profitability will always be a critical criterion when product ideas are considered. Although environmental sustainability has become increasingly important in recent years, there will always be an economic bottom line to satisfy. This is in line with Hydro's triple bottom line approach to decision making.

In Primary Metal, what is referred to as *a product* is simply the aluminum that is to be further processed by the customer. In other words, the opportunities for developing *radical* new products are quite limited. The CTO explains that improvements of products, processes and technology always have been key priorities in the company. The innovation focus in Primary Metal is mostly about improving processes that can lead to improvements in the carbon footprint of the products. This can provide competitive advantages for Hydro based on environmental sustainability as life cycle assessments (LCA) have become a widely used method for assessing the footprint of products.

In a LCA, all forms of environmental impact that take place throughout the life of the product are considered. This means that material selection becomes very important, since it affects, among other things, maintenance needs and how much energy the product requires in the usage phase. For example, the use of aluminum in car components will result in weight savings, which is advantageous because lower weight means lower fuel consumption. In addition, an LCA will consider the carbon footprint of the energy used to produce the materials for the product. This can lead to a competitive advantage for Primary Metal, in that they are able to show low carbon numbers. In the first within-case analysis (section 4.2.1) we will explore these opportunities by looking at Hydro's new market offerings—*Circal and Reduxa.*

Extruded Solutions has a large product range and close collaboration with the customer is important. The business unit supplies products to a variety of industries and applications, e.g. windows, furniture, building and construction, and automotive. This provides a variety of opportunities when it comes to NPD. Compared to Primary Metal, Extruded Solutions develops

products for customers that the end consumer is more familiar with, e.g. IKEA, Audi and BMW. Increased pressure from consumers for environmentally sustainable solutions can create several opportunities for NPD.

> Some of the largest markets for aluminum are automotive, building and construction. Working to get closer to the "voice of the" consumer through for example closer cooperation with manufacturers, product developers and/or designers further down in the value chain and within other segments would be important going forward in order to increase market pull for greener products. Creating "cool" and at the same time environmentally friendly designs which attracts the consumers could be a competitive advantage for Hydro as an integrated aluminum company with presence throughout the value chain. (Director of Corporate Business Development)

The Director of Corporate Business Development claims that this proximity to the end customer is a great benefit for Hydro to build competitive advantage based on environmental sustainability. This is based on the fact that consumers are becoming more environmentally conscious (see section 2.2.1), and are expected to be willing to pay more for environmentally sustainable products in the future. Making Hydro more visible to end consumers can thus be an efficient way to build competitive advantage. In the second within-case analysis (section 4.2.2) we will explore this further by looking at *IKEA DELAKTIG*—a furniture collection that uses Hydro's aluminum to increase the products' lifetime and making it more environmentally sustainable.

4.1.2. Borregaard

4.1.2.1. Introduction to Borregaard

Borregaard is one of Norway's largest actors within the wood processing industry and operates one of the world's most advanced bio-refineries (e.g. Oslo Børs, n.d.; Prang, 2013). The company uses natural, sustainable raw materials to produce advanced and environmentally sustainable

products that can replace oil-based alternatives. By utilizing all the different parts of the timber, it produces specialty cellulose, biovanillin, bioethanol and microfibrillated cellulose for a number of different purposes and applications. The company operates within several markets, including agriculture and fishing, building industry, pharmaceuticals and cosmetics, nutrients, batteries, and biofuel.

The Borregaard Group has 1100 employees in 16 countries (Borregaard, n.d.g.). The company is organized into three business units: BioSolutions, BioMaterials and Fine Chemicals. BioSolutions develop, produce, and sell biopolymers and biovanillin from lignin. BioMaterials develop, produce, and sell specialty cellulose. Fine Chemicals consists of pharmaceutical products and bioethanol (Borregaard, n.d.g.). These three business units are further divided into five product groups: Biopolymers, Speciality Cellulose, Biovanillin, Pharma Intermediates and Cellulose Fibrils (see figure 4). We will look further into Biovanillin and Cellulose Fibrils in this case study.

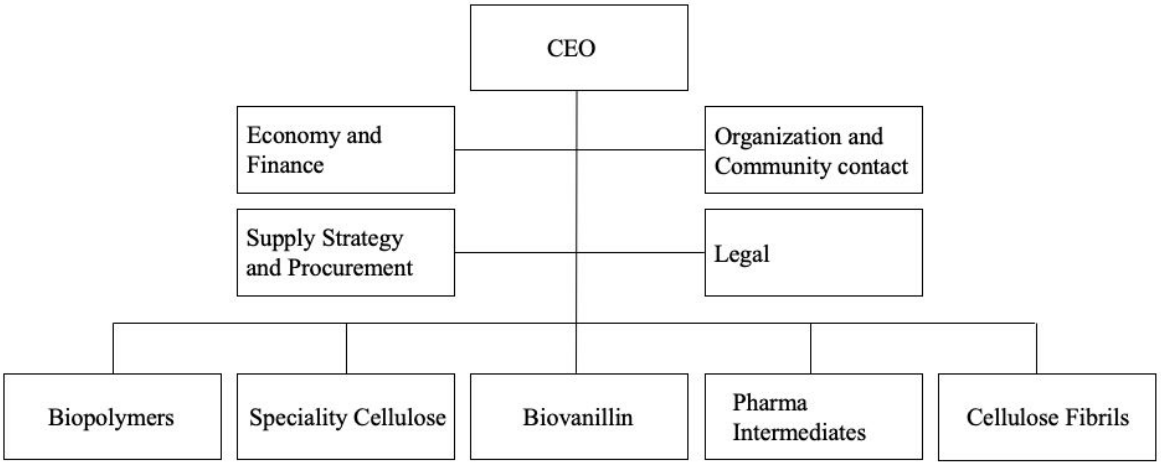

Figure 4: Organizational chart of Borregaard (made by authors)

4.1.2.2. History and Culture

Borregaard's first industry facilities were started in the 1600s, but the modern industry business took its form when Kellner Partington Paper Pulp Company Ltd became owners in 1889 (Borregaard, n.d.f.). It was later purchased by Norwegian owners in 1918, and the name was changed to Borregaard. The name derives from a historical place in Sarpsborg—the city where the facilities are currently located. The company then expanded by building a cellulose factory near Sarpsfossen. This is how one of the largest industry facilities in Norway started.

Borregaard merged with Orkla in 1986 and became one company named Orkla Borregaard. In 1992 this company merged with Nora Industries, and changed its name to Orkla. The chemical part of the company kept the name Borregaard. In 2012, Borregaard was separated from Orkla, and was listed as Borregaard ASA on the Oslo Stock Exchange (Borregaard, n.d.f.). Borregaard ASA is a public limited company organized in accordance to Norwegian law. In June 2020 Borregaard had 6360 shareholders, of which 56.9% of the capital was held by foreign investors (Borregaard, 2020b).

Until the Second World War, Borregaards main products were cellulose and paper. After this, its production expanded into several chemical products, in addition to engaging in larger businesses within other industries.

4.1.2.3. Environmental Sustainability in Borregaard

Borregaard claims that one of its main goals is to "deliver sustainable solutions based on renewable raw materials and unique competence" (Borregaard, n.d.h.). In line with this goal, the company has three core values: *Sustainability*, *Long-term perspective* and *Integrity* (Borregaard, n.d.h.). We will elaborate on the first value in the following paragraphs.

Since the beginning, Borregaard's business model has been centered around sustainability (Borregaard, 2020a). The interviewees explain that environmental sustainability is an integral

part of all of the company's operations—and has had a significant impact on the company's business development. The most important raw material for Borregaard is wood, more specifically Norwegian spruce harvested from certified woods (Borregaard, 2020a). There are two certifications for forestry in Norway: Norwegian Programme for the Endorsement of Forest Certification (PEFC), and Forest Stewardship Council (FSC) (Tomter, 2018). Borregaard uses both FSC and PEFC certified wood sources from sustainable forestry (Borregaard, 2020a). For every tree harvested by Borregaard, new ones are planted. Since the 1920's, the Norwegian forest has been constantly growing, which has contributed to an increase in CO_2-capture by the forest (Tomter, 2018).

The Norwegian forest is claimed to be one of the world's most sustainable forestries (Borregaard, 2020a). Wood is an everlasting resource if it is being monitored and kept sustainable. Trees can reduce emissions in multiple ways. While they grow, CO_2 is captured and stored from the atmosphere. As they grow old, they have less capacity to capture and store CO_2. By harvesting the old trees and using them as biomass for sustainable products that can replace oil-based alternatives, Borregaard can contribute to emission reductions in addition to utilizing the photosynthesis as a natural carbon capture and utilization (CCU). Borregaard's business model is unique in the way that it utilizes every part of the raw material, and turns it into valuable specialty products (Borregaard, n.d.h.). This is a way of reducing waste, while simultaneously increasing the value creation of its processes.

What is interesting to discuss, is the possibility for environmental sustainability to have a negative effect on economic profitability. Normally, environmental sustainability initiatives require significant investments in equipment, raw materials, and technical know-how. When discussing this with the employees from Borregaard, several of the informants respond in the same manner.

> We see that other companies are required to make large investments, but for us, utilizing 100% of the timber has always had a value. So instead of releasing the

> waste, we either try to burn it or—if there is a possibility to get a higher value than burn value—we have a potential product. The fact that we have a timber that we have been processing all these years, has made it an integrated part of our business model—it is the core of Borregaard's business model. And this has just as much to do with emissions as it does dividend. If we were to utilize only the cellulose part, that would account for only 40% of the timber, which would have been very bad business. (Innovation Manager)

The combination of having an integrated business model and a focus on incremental innovation and environmental sustainability, has made Borregaard competitive through the years. During the interviews it is highlighted that it is important to ensure environmental sustainability throughout the entire value chain when developing new products. "We also need to try to develop cohering processes to make these products, which are also environmentally sustainable, or at least as environmentally sustainable as possible" (Team Manager Research). In other words, Borregaard emphasizes sustainability throughout the entire value chain—not only the output product.

EHS and Sustainability Manager explains that Borregaard initiated its first life cycle assessment (LCA) for its products in 2008. This was based on an internal drive to confirm what the company already knew about its environmentally sustainable products. In later years, there has also been an increased demand from customers to have access to this kind of information. This coincides with our findings from the theoretical review (chapter 2).

> We started running LCA analysis on our products, and we have done a lot of that for a long time. It has long been a "nice-to-have". Now in the later years, we see that this is becoming more "need-to-have", as customers are starting to demand it. It is very rewarding to see that we started early with a lot of the things that today are getting a lot of attention. (Innovation Manager)

Borregaard has collaborated closely with Østfold Research through many years when conducting LCAs. To gain confidence with customers and investors, it is advantageous to have a third party conducting these types of analysis. As described in the theoretical review, an LCA assesses the environmental impact of a product throughout its entire life cycle, and is used to create an Environmental Product Declaration (EPD). This allows the customer to make their purchasing decisions based on environmental performance criteria. In addition to EPDs, Borregaard has conducted a competitor analysis where it compares its own products to those of its competitors, with regard to greenhouse emission through a LCA perspective (Borregaard, n.d.d.). CO_2 emission from Borregaard's EuroVanillin Supreme is 90% lower than emissions from vanillin based on guaiacol, which is a petrochemical raw material. The emissions from Borregaard's bioethanol are 80% lower than those of diesel.

Compared to products made from oil, Borregaard's products have a significantly lower environmental sustainability footprint. "Borregaard's origin is that it competes with companies that make a lot of the same products based on oil. This gives us a better starting point when it comes to environmental sustainability, simply because our raw material is renewable" (Sales Director). However, the company's production is based on energy demanding processes. Borregaard is a part of the process industry, which is known for its large energy consumption. In addition to the processes demanding a lot of energy, it also has emissions from the processes to take into consideration. The Sales Director considers the energy intensiveness to be its largest challenge. Several of the interviewees point out that heavy oil was an environmental challenge for a long time—and gradually led to change.

> What we have done, is that we have become independent of heavy oil, which was a project that started around the year 2000. The last oil heating was gone around 2014-2015. After this, Liquefied Natural Gas (LNG) came in and took the peak load. In addition to this, we burn garbage and waste from our own processes, and the biogas from the treatment plants are made by us, and then [we use] LNG for

> power. So, it has been a long-term project with the goal of becoming heavy oil independent. (Innovation Manager)

Communication with different stakeholders around environmental sustainability is becoming increasingly important. Even though Borregaard has always had an environmentally sustainable profile, it has become more important the past couple of years to emphasize this.

> The fact that we have recently hired people that work only with sustainability, communicates that we believe there is a value—a pretty significant value—in the years to come. And you can see it in the control rooms, on the stock market, investors are starting to make selections based on environmental sustainability. And if you do not fulfill the demands for the three elements in ESG [Environmental, Social, and Governance], and if you were to fall outside of this, it is not certain that they [the investors] will invest money in your company. This is also important economic drivers, for a control room, for a top manager. … [T]here are a few changes that have emerged after all the talk about the green shift and the environmental sustainability trend. It has led to a large focus on cash flow. … [B]orregaard has been working with this [environmental sustainability] for the past 10 years, but not much has gone out of it. What we see now though, is that we are a couple of years ahead of some competitors, and this is something that we must try to uphold, in addition to becoming even better and gaining value from it. (Innovation Manager)

Borregaard has committed to several climate goals for the future. One of them concerns the transportation of its products, which is approved by the climate initiative Science Based Targets (SBT) (Becker, 2020). SBT is a common initiative from CDP, UN Global Compact, World Resources Institute (WRI) and WWF. The initiative has a goal to increase companies' ambitions for climate influence by reducing greenhouse gas emissions. In a press release in January 2020, Borregaard's CEO explained that the company has set ambitious goals for its long-term

greenhouse gas reductions—and will approach this through several new climate actions. "We will further an environmentally sustainable development through minimizing the negative environmental effect from our production, in addition to maximizing the positive environmental impact through the products we produce" (Borregaard, n.d.a.).

Borregaard shall reduce its emissions by 53% within the year 2030, and by 100% within the year 2050, compared to the base year 2009 (Becker, 2020). Since the year 2009, the company has already decreased its direct and indirect emissions by 34%. Borregaard's future reduction plan includes reducing the energy consumption further, in addition to utilizing renewable energy. Indirect emissions are emissions that are not directly linked to production processes, e.g. transportation or handling of products.

The company has also been recognized for its global climate work and has reached the A-list two consecutive years (2018 and 2019) of the environmental organization CDP (Borregaard, n.d.c.). CDP, formerly Carbon Disclosure Project, is an international non-profit organization made up of CDP Worldwide Group and CDP North America, Inc (CDP, n.d.). It drives companies and governments to reduce their greenhouse gas emissions, safeguard water resources and protect forests (CDP, 2019). CDP has regional offices and local partners in 50 countries. Amongst 8400 companies that reported to CDP in 2019, only 179 of these, 2.1 %, reached the A-list for climate change.

4.1.2.4. New Product Development in Borregaard

The Borregaard Way is driven by "strong innovation ability and continuous improvement" (Borregaard, n.d.h.). What is often seen in industrial companies, is that the term *innovation* is used to refer to what is—according to the literature—*process management.* These two processes are in reality opposites, where one is variance reducing and the other variance seeking (Benner & Tushman, 2002). Boregaard has both of these processes, with the main focus being on process management or incremental improvement. It also has a share of more radical innovation, and its goal is that 20% of the revenue should come from products launched in the past five years. This is mentioned by several of the informants during the interviews. In the year 2018, Borregaard

managed to have 13% of the total turnover from products launched the past five years. The two within-cases from Borregaard will illustrate two different products, where one is more radical than the other. The first case, *EuroVanillin Supreme,* is an example of how Borregaard has exploited its current technology and resources—and now uses continuous incremental innovation or process management to continuously improve the product. The second within-case, *Exilva,* illustrates a more radical innovation, where Borregaard has utilized a more exploratory approach. Exploration and exploitation are two fundamentally different search modes (Benner & Tushman, 2002). Exploitation builds on a company's existing technological capabilities, while exploration involves searching for new capabilities and shifting to a different technological trajectory.

Since the establishment, the company has put a lot of resources into innovation and development. It has a large R&D-department, which contains roughly 10% of the total workforce. This is relatively big for such a small company. It has an R&D-spending of close to NOK 100 million per year, and some 20% of Borregaard's revenues comes from new products (Misund, n.d.). There is a lot of ground research being done in the laboratories, where Borregaard looks at streams going out of the factory and which molecules they include, with the aim to find out what other usage areas these outgoing streams can have. The Sales Director states that: "The main objective for Borregaard is to elevate commodities and turn them into specialty products, in order to create more value for its side streams". This shows the R&D-approach to NPD. The other approach is the one driven by market pull, where the company looks for unfulfilled demand in the marked, or future unfulfilled demand.

> There is a demand in the market, the salesperson takes that demand back to the company, which then tries to make projects that fit with the demand in the market. Ideally, there should be a pull in the market for a new product, and at the same time, R&D is continuously working to improve what we already have, but this is incremental, process management of the products and processes that we already have. … [I]t starts with a hypothesis, then we do tests, and then we send requests to customers asking if they would be interested in buying this product given the fact that we can produce it. And then the snowball starts rolling. You find

> technical possibilities in the factory, you begin testing, invest in a pilot, and then eventually launch a fullscale product. (Innovation Manager)

The Team Manager for Research also mentions market pull as an important part of Borregaard's NPD process. "This is what we work on here at the research department. We say that we are a market-oriented research department, with a large customer base—both existing customers and potential customers. We work on developing things that we know the customers need" (Team Manager Research). Several of the informants, the Team Manager for Research included, point out that they also have the other approach to NPD, namely technology push, which is also known as more traditional R&D. The Team Manager for Research defines this as starting out with an idea, and then you must figure out where in the market this idea can fit.

> Of course, we have some new product development and projects that start this way also, but most of it comes from a demand in the market. And what is important for us is that NPD and innovation in general, is not only something that happens in the R&D department, but rather something which involves the whole organization. … [I]t is important for us that we do not start a project in R&D that requires a lot of resources, only to find out that it is not realistic for us to produce. We work a lot in the crossing between research, production, and market, which we call the golden triangle. (Team Manager Research).

Through the interviews with different Borregaard employees, there have been several mentions of the *innovation triangle*—also referred to as the *golden triangle*. Many of the informants have brought this up when talking about innovation and product development across the different business areas. The triangle consists of production, R&D, and commercial, which means that all these business areas are involved in innovation projects. Technology Manager 1 mentions that: "There is a prioritization where both commercial, production, and R&D is involved. … [I]t is interdisciplinary groups that work with the development of the innovation project, and they follow a stage-gate-process." (Technology Manager 1)

Borregaard utilizes the traditional business innovation funnel in its NPD processes. Ideas are fed into the funnel, decisions and evaluations are made throughout the funnel, and there is a prioritization of which innovations will be further explored. Technology Manager 1 mentions the use of interdisciplinary groups, which are also called innovation management teams (IMT) in these types of processes. IMTs are cross functional teams of line managers and consist of people from different parts of the business unit who collaborate to find the best innovation projects. All business units have their own IMTs.

> As I mentioned about new product development—everything we do in Borregaard is controlled by the market. We ensure that the development projects we have, not only includes a researcher in the lab. This is to ensure that our R&D-processes involve interdisciplinary teams across the organization, to ensure that what we develop is relevant for market and sales as well. And that it coincides with our values, and our customer's needs. This is one of the reasons why we have IMTs. And in those meetings, there shall be line managers who have the authority to act on what is being decided. There should also be someone present at these meetings from management in that business area, so that innovation is put on the agenda. (Technology Manager 2)

Another important factor for Borregaard's success with NPD has been the collaboration with external support functions. The Innovation Manager explains that customers are reluctant to try a product before it has been through existing factory equipment. In general, they are not willing to test things that have only been tried out in the laboratory.

> This leads to requirements for investments in large budgets early to run tests. Innovasjon Norge and BiA have been two very important collaboration partners, with actually daring to take the first investments of a couple of tons, which later will become thousands of tons. … [I]t is a very challenging industry to be in, it is very cost intensive when developing something new. (Innovation Manager)

This emphasizes the importance for external support to succeed with innovations and larger investments. Had it not been for the different support functions that are available when working with innovation, it might not have been possible for Borregaard to carry out these projects.

4.2. Within-Case Analyses

This section presents our four within-case analyses. In the two first cases we explore new product development (NPD) based on environmental sustainability in Hydro. As Hydro covers the entire aluminum value chain, we find it interesting to look at the opportunities for NPD both upstream and downstream in the chain. Hydro Case 1 illustrates the opportunities in Primary Metal, through an analysis of *Hydro REDUXA 4.0 and Hydro CIRCAL 75R*. Hydro Case 2 looks at the opportunities in Extruded Solutions, through an analysis of *IKEA DELAKTIG*.

In the third and forth within-case analysis, we investigate NPD based on sustainability in Borregaard. Ever since the company was founded, Borregaard has had a strong focus on environmental sustainability and circular economy. Its raw material is timber, and it utilizes wood from sustainably sourced forests. Borregaard Case 1 analyzes a typical Borregaard-product—*EuroVanillin Supreme*—which is the result of a side stream. The product has a significantly lower carbon footprint than its competitors, which makes it appeal to customers with aspirations for more environmentally sustainable products. Borregaard Case 2 looks at a new radical product innovation from Borregaard, which is called *Exilva.* This is a new business for Borregaard, and possibly a new opportunity for growth and competitive advantage.

The four within-case analyses are structured in the same way. First, an introduction and description of the products are given. Then we will elaborate on the strategic background and how they were developed from idea to market. Finally, we will discuss some future challenges and opportunities associated with the products.

4.2.1. Hydro Case 1: REDUXA 4.0 and CIRCAL 75R

4.2.1.1. Product Description

Hydro REDUXA 4.0 and Hydro CIRCAL 75R (hereafter referred to as Reduxa and Circal) are the first two types of Hydro's certified low-carbon aluminum products (Hydro, n.d.f.). The products are designed based on the increasing demand for environmentally sustainable materials. In line with Hydro's climate strategy, Reduxa and Circal are intended to help Hydro's customers reach their sustainability goals and respond to the ever more climate-conscious consumers (Hydro, n.d.f.). Although all of Hydro's aluminum products have a significantly lower footprint than the global average, these particular products are unique in the sense that they are third-party certified and registered as trademarks. The official identity badges used in the communication of the brands are shown in figure 5 and 6.

Figure 5: Reduxa identity badge (Hydro, n.d.h)

Figure 6: Circal identity badge (Hydro, n.d.h)

Reduxa and Circal are product offerings from the Primary Metal business unit. Primary Metal produces aluminum that is further used by Hydro's downstream units or sold to external customers. The Head of Technology in Primary Metal Commercial explains that it is rare that such trademarks as Reduxa and Circal are launched so far upstream in Hydro's value chain: "It is not often that we launch this type of distinct products like Reduxa and Circal. Most of our product development is just a small adjustment of chemistry."

Hydro REDUXA 4.0 is the dedicated brand of low-carbon, sustainably produced aluminum. It has a carbon footprint guarantee of maximum 4.0 kg CO_2 per kg of aluminum, which corresponds to less than a quarter of the global average. The low footprint is achieved through lowering the emissions from all the process steps. That includes minimizing direct emissions from electrolysis and fuel combustion unit processes, emissions from the electricity production, and emissions from other sources—like transportation and cold metal. Reduxa is supplied from Norwegian smelters, in which all are based on electricity from renewable sources—hydropower, solar and wind (Hydro, n.d.e.).

As Hydro controls every aspect of the aluminum value chain, the company can ensure that the production process uses the cleanest possible energy from Hydro's own sources. Reduxa is available in low-carbon extrusion ingots, low-carbon foundry alloys, low-carbon sheet ingots, and low-carbon wire rods. It is verified according to ISO 14064 by DNV GL, including all carbon emissions from bauxite mining and alumina refining to the production of aluminum in electrolysis and casting (Hydro, n.d.e.). The footprint is confirmed by an Environmental Product Declaration (EPD). The Director of Innovation in Primary Metal explains that there has been no significant investment costs associated with the production of Reduxa. In addition, the extra costs of producing Reduxa compared to ordinary aluminum are negligible. Details of the pricing strategy could not be disclosed in public, other than that there is a variable upcharge.

Hydro CIRCAL 75R is Hydro's range of products made with a minimum of 75% recycled, post-consumer scrap aluminum. This corresponds to a CO_2 footprint below 2.3 kg per kg of

aluminum. Similarly, Circal is verified by DNV GL based on traceability and quality principles developed by Hydro, which is confirmed by an EPD (Kallevig, 2020). The Head of Technology in Primary Metal Commercial explains that a recycling content of 75% is high compared to the global industry. “The industry average is 10% in remelting” (Head of Technology Primary Metal Commercial). The most unique feature of Circal is that the aluminum that is recycled and used in these products are post-consumer scrap. What is referred to as *post-consumer scrap* is exclusively “aluminium that has reached its end of life as a product in use and brought back into the loop” (Hydro, n.d.b.). The term excludes process scrap, which is scrap that has never been a product. In contrast to Reduxa, it has required large investments to facilitate the production of Circal. Therefore, the pricing strategy is based on a significantly higher upcharge.

4.2.1.2. Strategic Background

The idea of developing products like Reduxa and Circal was first mentioned several years ago. The Head of Innovation in Primary Metal Commercial summarizes the development process as follows:

> Already approximately 10 years ago, someone suggested a wild idea like: "let's say we can scrap buildings and turn them into new products sometime in the future." Then it became a small vision in Hydro that one should do this. Then they invested in scrap sorting. And they did some R&D and looked at how to get a surface quality that makes this possible. It was very difficult for a very long time, and eventually we bought into the sorting industry and the latest equipment tested there. And then we also invested in new equipment in our furnace smelter ... and then, suddenly we had a value chain that did what we needed—and a patent that allowed us to have the technology for alloys that gave a nice enough surface to new products. Then we launched it. (Head of Innovation Primary Metal Commercial)

In other words, the idea behind Reduxa and Circal has been matured in the company for several years. In 2017, Primary Metal launched the two products *Hydro 75R* and *Hydro 4.0*. As the name implies, Hydro 75R is aluminum that guarantees a recycling content of at least 75%. Hydro 4.0 guarantees an environmental impact below 4.0 kg CO_2 per kg aluminum. The products corresponded to today's Reduxa and Circal but had not yet received their respective trademarks.

A key reason why it took so long to realize the product ideas is that changing production processes is technically challenging. However, the Head of Innovation Primary Metal Commercial claims that it only took three or four months from the time they decided to make the product until it was out in the market. The most important reason for waiting to materialize these low-carbon products was not the technical challenges—but the fact that the market was not considered mature enough. There must be a *market pull* for Hydro to invest in a new product idea (see section 4.1.1). At the time it was decided that the products would be launched, it was because the company had experienced increasing customer interest.

> In principle, Hydro Primary Metal is a raw material or commodity producer. Our customers are processing plants, for example Hydro Extruded Solutions. They might sell to a new customer who makes some semi-finished products, and then there may be more such customers, and then the end user comes—e.g. BMW, Apple, IKEA ... Global well-known brands that consumers encounter. This type of end user began to carry out environmental impact assessments of their products. Then they ask their supplier if they could reduce the environmental impact on their product, and then it goes further back in the value chain. Some direct inquiries too. BMW for example. They directly asked what Hydro Primary Metal could do to make aluminum with smaller footprints. More of that kind. (Head of Technology Primary Metal Commercial)

The Head of Brand and Marketing points out that the typical companies that demand low-carbon products are those that are most exposed to consumers. That is, products sold in stores, such as

vacuum cleaners, play stands, and electronics. “Not necessarily ships and cars and oil platforms” (Head of Brand and Marketing). However, it is important to note that this increase in demand is a recent development. Even though climate has been an important focus in the industry for several years, it has taken some time for it to be reflected in customer behavior, e.g. their willingness to pay.

> Until very recently, there has been very little demand for what I would call “greener materials” and questions like: Where does this material come from? How is it produced? What is the CO_2-footprint? There has been very—until very recently—very little interest in this. (Head of Brand and Marketing)

Although Hydro perceived the market to be more mature for low-carbon solutions in 2017, it proved to be challenging to succeed with 75R and 4.0. The company eventually realized that Hydro itself had to contribute to create a market.

> What comes first? The chicken or the egg? Was it the demand that came first or was it the products? And I would actually say that the products came before the demand. Fortunately. Because we would not have had the time now to develop these products now that the demand is coming. So first we made the products, and now we have worked quite intensively over the past years to start communicating around these products. (Head of Brand and Marketing)

The understanding that Hydro itself had to contribute to create the market was the starting point for the development of the brands—Circal and Reduxa. Hydro understood that the company had to create a common strategy around how to communicate the products to the market. When 75R and 4.0 were launched, Hydro did not have a mindset based on the importance of the end consumer. “These were not products that reasoned or in any way spoke to the end consumer. We needed a product that spoke to the end consumer.” (Head of Brand and Marketing)

Historically, marketing has had a low priority in Hydro's strategy. "This is one of the big challenges for the Norwegian industry in general. We are very good at product development and we are very good at technology, but we are not as good at commercialization and marketing" (Head of Brand and Marketing). However, Hydro has now acted—which is clearly reflected in the way Reduxa and Circal are communicated to customers.

> We do not say in our communication that we are the best in the world, even though we probably have the greenest products in the world. But very consciously I have told the marketing organization and the sales organization that this is not what we should rest our brand on. (Head of Brand and Marketing)

To develop the brand strategy for Circal and Reduxa, Hydro drew inspiration from other famous brands—such as GoreTex and Intel. The company decided to create two product families—two low-carbon product families with the names Hydro REDUXA and Hydro CIRCAL. Currently, there is only one product in each of the product families. But the argument for creating families is to allow Hydro to easily communicate new updated products within the family. "So in the communication we mainly talk about either high quality recycled aluminum [Circal] or low carbon aluminum based on mainly primary metal [Reduxa]" (Head of Brand and Marketing).

The identity badges (figure 5 and 6) are important parts of the brand strategy. The diamond shape is based on the concept of a product hangtag. A physical hangtag gives Hydro the opportunity "to tell the story behind our efforts and create a closer connection to consumers" (Hydro, 2019e).

4.2.1.3. Future Challenges and Opportunities

Reduxa and Circal have only been available for sale for approximately one year. The brands were officially launched in August 2019. Currently, Extruded Solution is buying the entire

production volume of Circal, as well as significant quantities of Reduxa. Using Reduxa and Circal in the production makes the business unit highly competitive when it comes to offering low-carbon extrusion products. Circal is particularly well suited for aluminum building systems, and in 2019 Circal was sold to more than 60 building projects in 16 countries. The total sales volume was around 10,000 metric tons in 2019, and resulted in full capacity utilization (Hydro, 2020b, p. 75). Reduxa has almost unlimited capacity, as the production does not depend on recycling facilities and access to scrap.

The initial customer feedback and subsequent orders have underlined the potential for these types of low-carbon products. According to the Head of Innovation in Primary Metal, both products are profitable products today. Hydro is experiencing an increased interest in the market, despite the somewhat higher prices for these products compared to standard aluminum. In the annual report of 2019, the CEO claims that "this is a small, but promising illustration that there is a willingness to make greener choices in the marketplace when alternatives are offered" (Hydro, 2020b, p. 75). As Reduxa and Circal are relatively new to the market, our interviewees cannot say with certainty whether the products will help to increase Hydro's competitiveness. However—based on the initial market response and preliminary analyses—they could point to a number of interesting challenges and opportunities that are worth a discussion.

Challenges

Challenges related to the reputation of industrial companies. The Head of Brand and Marketing explains that communication of *greener* products is challenging when being an industrial company. The fact that Hydro—for more than 100 years—has impacted the environment in the form of large emissions and energy consumption affects how the outside world views the company. Hence, it can be difficult to convey to customers and end users that Hydro's products are in fact an environmentally friendly alternative to many other materials. Furthermore, communication becomes difficult because many customers and consumers lack knowledge of the industry and the way in which environmental impact is measured. Consumers might think that all of Hydro's products are in the category "bad for the environment" because

they hear that aluminum production is an energy intensive process. Important factors are omitted from the judgement, such as material life, maintenance requirements, and recycling properties.

> We are an industrial company that pollutes. But the whole world does. The most environmentally friendly would have been if everyone was sitting in a cave and chewing on a stick. But that is not the goal. After all, the goal is prosperity for a growing part of the population. (Head of Brand and Marketing)

To deal with the communication challenges, Hydro launched a common way to go to the market around their more *environmentally sustainable* offerings. This is a brand strategy created with the end consumer in mind (see section 4.2.1.2) (Hogna & Kallevig, 2019). The aim is to communicate the company's low-carbon products—more specifically Reduxa and Circal—coherently to the market and avoid greenwashing. In addition, such a conscious communication strategy will help to create the market Reduxa and Circal are aimed at, through raising awareness for more sustainable materials and create a pull in the market for low-carbon aluminum.

Challenges related to differentiation from the global aluminum industry. Another significant challenge is differentiating Reduxa and Circal from the global average aluminum. Reduxa and Circal has a carbon footprint of maximum 4.0 and 2.3 kg CO_2 per kg aluminum respectively. Hydro's average footprint, including all aluminum production, is approximately 5.6 kg CO_2 per kg aluminum. In comparison, the European average is around 7.0 kg, while the global average is around 16 kg. In particular, the Chinese aluminum is contributing to the high global average because their production is mainly based on coal. The high global average is unfortunate for the industry because statistics that compare materials often use global averages. This can cause Hydro to be put in a bad light because people generalize and think that all aluminum production has the same footprint. It can be risky for Hydro to build its aluminum marketing on figures that compare Hydro's footprint to the global average. Such marketing could cause the entire aluminum industry to get a bad reputation and be outperformed by other materials that have

lower global average footprints. “We have seen that aluminum can be at risk of being out-competed, due to the high [global average] footprint” (Head of Brand and Marketing). Also, this challenge can be related to communication and lack of knowledge and should be handled with caution and conscious communication.

Challenges related to the interpretation of “post-consumer scrap”. The interpretation of the *post-consumer scrap* term has proved to be a challenge in the marketing of Circal. As mentioned earlier, *post-consumer scrap* refers to scrap that has been used in products before. It is important to distinguish this term from *process scrap*—scrap that has never been a product. It is the high content of recycled post-consumer scrap that makes Circal innovative and causes its low CO_2 footprint. Higher content of recycled post-consumer scrap implies lower carbon footprint.

> If you are talking about recycled aluminum from an [environmental] sustainability perspective, you can only refer to scrap that has been in use ... The [process] waste you have—it is great to melt it and use it again. But when you do, you will in theory get a higher carbon footprint, because it should, in theory, never have been produced in the first place. Then you actually add 5%—or some percentage—so that it actually ends up having a higher footprint than aluminum that is primary aluminum. (Head of Brand and Marketing)

Recycling of process scrap does not have the positive environmental effects that one might think. The significant environmental benefit is obtained when the carbon footprint is reduced, which is not the case with process scrap. “Speaking for the industry, process scrap is something we should minimize. We should make sure that we have the least possible amount of process scrap. It is just a loss.” (Head of Strategy Primary Metal Recycling).

The largest problem is that there is no common standard for how the aluminum suppliers should communicate the recycling content of their products. This is exploited by some suppliers who actively use their high recycling contents in their product promotions. “Some of our competitors

say that “but we offer 90% recycled aluminum. Do you only have 75%?" But then there is often a mix of these two [process scrap and post-consumer scrap]” (Head of Brand and Marketing). This is, once again, a challenge that can be related to a lack of customer knowledge. Hydro's way of dealing with this issue is to have a strategy that involves “increasing the awareness and understanding of post-consumer versus pre-consumer scrap to customers as well as end users of products—you and me” (Hogna & Kallevig, 2019).

Opportunities

Hydro’s brand strategy for Circal and Reduxa is based on the establishment of two product families. The intention with the families is that new product launches can be easily communicated—by assigning new members to the families. For example, it may be realistic to launch members like *Circal 65R, Circal 85R*, *Reduxa 2.0*, *Reduxa Automotive* and so on (Kallevig, 2020). In other words, the brand strategy is designed with a growth ambition in mind. Whether Hydro decides to develop new products will depend on several factors, like capacity, technology, profitability, and the market response. However, given today’s market trends and the preliminary customer response, there are several opportunities for the product families to grow. In the following discussion, we will present some of the opportunities for Circal and Reduxa to increase Hydro's competitiveness.

Growth opportunities related to LCAs. Recent years have shown an increased use of Life Cycle Assessments (LCAs) for measuring and documenting the environmental impact of products. Performing an LCA of a product involves evaluating input factors such as energy, output factors such as greenhouse gas emissions, and the potential environmental impacts of the product throughout its life cycle. In other words, demands are made on the entire product value chain. This can be advantageous for suppliers who can offer products and services with low carbon footprint. In comparison, it has in the past been common to base environmental assessments on less comprehensive methods. This could often result in suppliers of low-carbon products missing out on potential competitive advantages.

Using LCAs, material selection becomes more important because it affects the product's environmental footprint throughout the life cycle. The LCA results can provide information on what factors cause the largest environmental impact. Additionally, the results can indicate which measures will have the greatest positive effect on the footprint. A typical example is performing an LCA of a car. The materials used to make the components will namely affect the car's energy consumption and emissions in all its stages of life. In this case, aluminum can be favorable due to its properties. Aluminum is light, strong, 100 percent recyclable and has good energy absorption properties (Hydro, n.d.a.). Lower weight implies lower fuel consumption and less emissions.

> After all, we are in a fortunate position because we are an aluminum supplier. And aluminum is a product that is interesting for many applications ... for example, the automotive industry, where it helps to reduce weight and energy consumption. So, given a substitution trend, we have the right material. The steel industry is fighting back and the plastic industry has bigger problems than ever. But aluminum has been considered pretty good, although there is a challenge that it [aluminum] is energy-intensive to produce the first time. (VP Strategic Projects Extruded Solutions, Strategy and Innovation)

What is pointed out is that the good properties of aluminum make the material competitive in itself—even if it is not low-carbon. The challenge of the energy-intensive production can, however, to a certain degree be handled by Reduxa and Circal. In other words, the combination of aluminum's good properties and the competitive carbon footprint of Reduxa and Circal can make Hydro a preferred supplier—in particular for customers who want to minimize their products' environmental footprints in a lifecycle perspective. The competitiveness can be further strengthened if knowledge about LCA also spreads to consumers. If it becomes more common to label products with their carbon footprints, it will be easier for consumers to choose the most environmentally sustainable alternatives. Hence, the demand for low-carbon products will potentially increase.

Growth opportunities related to the building and construction sector. Buildings require large quantities of materials and are designed to have a long life. Therefore, material choice will have a major impact on a building's environmental performance. Today, the European construction industry represents 40% of the total energy consumption, produces 35% of greenhouse gas emissions, and accounts for a third of the waste produced on the planet (Wicona, 2019). Total CO_2 emissions in 2018 were 37,000 tons. From December 31, 2020, European legislation will require that all new buildings be based on almost zero-energy buildings. This means that most of the building's energy needs must come from renewable energy. Furthermore, by 2030, the gases responsible for the greenhouse effect are required to be reduced by 40%, and by 80% from 2050. In other words, the building and construction sector goes through an environmental sustainability transition to satisfy the requirements. Low-carbon materials—like Reduxa and Circal—can be an important contributor to achieving these goals.

The potential in the building and construction sector is illustrated with the fact that the entire production volume of Circal in 2019 was sold to building projects (Hydro, 2020b, p. 75). Low-carbon aluminum has proven to appeal to construction projects that want to promote an environmentally sustainable profile. An example that is mentioned by several of the interviewees is Økern Portal—a large office and commercial building in Oslo that uses Circal 75R as facade material. Økern Portal is planned for completion in 2021 and the area of the building will be 80,000 square meters (Glass og Fasadeforeningen, 2019). To satisfy European legislation for new buildings, it has been important to design the building with low energy consumption and emissions in mind. As the building has a large facade, material selection has been an important factor in minimizing the carbon footprint. Circal—with its very low carbon footprint—proved to be the most attractive choice. This indicates opportunities for Circal and Reduxa in the future building and construction sector.

Growth opportunities related to public procurement. In the building and construction sector, legislation and requirements can have a major impact on which products are allowed to be

manufactured. The interviewees say that they believe environmental requirements will become more common in several sectors in the future. Stricter environmental requirements can be an advantage for Hydro as it is likely to increase the demand for low-carbon products. The CTO points out that especially increased requirements in public procurement can have large effects. "The public sector is responsible for significant purchases, so they have a great power" (CTO). If it becomes a standard that public procurement decisions are made based on environmental assessments, the demand for low-carbon products will become more predictable. With more predictable demand, it can be safer to invest in larger capacity and thus achieve economies of scale. Emission requirements in public procurement can also raise awareness of low-carbon products amongst consumers and the private sector. This can lead to the demand increasing further, and it will become more profitable to be a supplier of low-carbon products.

Growth opportunities related to corporate reputation. All the interviewees indicate that it is highly important for Hydro to have a reputation associated with environmental sustainability. In this context, Reduxa and Circal are likely to have a positive impact due to the dedicated marketing strategy. Circal and Reduxa is intended to "commercialize the company's sustainability position" (Hydro, 2020b, p. 75). If the marketing of Reduxa and Circal succeed, Hydro can obtain synergies in the organization. That is, the products can contribute to additional sales, as well as improving Hydro's reputation. Having a reputation for environmental sustainability is important for several reasons. First and foremost, to appeal to customers and consumers, but also to make the company attractive to collaboration partners and future employees. "It is implicit that being attractive to future employees is part of corporate profiling ... [B]eing environmentally sustainable is important to attract labor, good labor" (Head of Strategy Primary Metal Recycling). Consumers have become more sustainability oriented—and this applies to employees of the future as well. Knowledge is one of Hydro's largest competitive advantages and maintaining the knowledge level is critical to stay competitive in the future. In this context, using Reduxa and Circal to demonstrate the company's environmental sustainability orientation (ESO) can be an effective contribution.

4.2.2. Hydro Case 2: IKEA DELAKTIG

4.2.2.1. Product Description

DELAKTIG is a collection of furniture and accessories offered by the global furnishing brand IKEA. The collection is developed by IKEA in collaboration with the industrial designer Tom Dixon (IKEA, n.d.b.). The collaboration project also involved design ideas from 75 architect students, as well as Hydro as a key material supplier (Blikstad, 2018). The collection is developed based on circular economic principles. This means, first, that the products can be disassembled and rearranged into different pieces of furniture—as they have a modular design (Hydro, 2019f). Second, they are designed and produced in strong materials with the intention of having a long life and being reusable for many years. Third, the material composition is designed to be easily detachable and recyclable when the products can no longer be used.

The initial product in the DELAKTIG collection is a sofa that can be modified into a bed and other different styles of furniture throughout its lifetime (Aouf, 2017). The sofa (shown in figure 7) consists of 60 percent recycled aluminum from Hydro (Blikstad, 2018). Using recycled aluminum gives the furniture a lower carbon footprint than using primary aluminum. It also enables recycling of the product. The sofa was officially launched to the public in February 2018, after being shown for the first time at Tom Dixon's show at the Milan Furniture Fair in 2017 (Ferguson, 2018). Subsequently, IKEA has expanded the product family. As of July 2020, IKEA's online store offers more than 20 different items in the DELAKTIG collection (IKEA, n.d.a.).

Hydro's contribution to the development of DELAKTIG has been to create customized extruded aluminum profiles. This product development has taken place in Hydro Extruded Solutions—the company's most downstream business unit. Close collaboration with customers is a key feature of the NPD practice in Extruded Solutions (see section 4.1.1.4). DELAKTIG is an illustration of how this can typically happen and is therefore an interesting case to analyze. The fact that the design of DELAKTIG is based on environmental sustainability principles makes it highly

relevant for our research question. That is, analyzing Hydro's contribution to DELAKTIG can enhance our understanding of how industrial firms can build competitive advantage and improve their environmental performance based on NPD. We also think that it is interesting to explore Hydro's opportunities in the furniture industry—an industry that potentially makes the company more visible to consumers.

Figure 7: The initial DELAKTIG product (Tom Dixon Studio, n.d.a.)

4.2.2.2. Strategic Background

IKEA

Several of the interviewees point out that IKEA is an important customer for Hydro. For a long time, IKEA has purchased large quantities of Hydro's rolled aluminum to produce IKEA tealight cups (Haga, 2011). Now, the purchase of extruded aluminum for furniture production is increasing. That is, IKEA has become a large customer of Extruded Solutions. IKEA is the world's largest furniture retailer with 211,000 employees and 433 IKEA stores worldwide. The total retail sales were EUR 41.3 billion in the fiscal year Sep 2018 - Aug 2019 , which corresponds to a 6.5 % growth from the previous fiscal year (IKEA, n.d.d.). Since the company

was founded in 1943, low prices have been the cornerstone of the IKEA business idea. The company strives to operate as efficiently and cost-effective as possible, which is reflected in the IKEA products. One feature is that most of the furniture is flat-pack, ready to be assembled by the consumer. This increases storage capacity, saves production-time and reduces costs (O'Connell, 2020).

IKEA has in recent years moved towards a business strategy that significantly emphasizes environmental sustainability. In other words, the company has committed itself to increase its environmental sustainability orientation (ESO). Between 2009 and 2019, IKEA has invested almost $2.76 billion in green energy. In 2019, IKEA announced a further $220 million investment in green energy, reforestation, and forest protection projects (Cuff, 2019). This investment intends to help them reach their main climate commitment—to become *climate-positive* by 2030. Becoming *climate-positive* means that IKEA aims to remove more greenhouse gases from the atmosphere than it produces through the production and use of goods (IKEA, 2019b, p. 14). Therefore, the financial investment of 2019 will mainly focus on two areas—green energy and reforestation (Cuff, 2019). An important climate measure has been conscious material assessments. More than half of IKEA's climate footprint comes from the materials in its products. Using more recyclable and low-carbon materials is therefore an effective measure to improve the company's environmental performance (IKEA, 2019b, p. 38).

Another of IKEA's climate measures is to make environmental improvements in the design and production of new products. The company has set an ambition to design all products to be 100% circular by 2030. This means that the products will be "designed from the very beginning to be reused, refurbished, remanufactured, and recycled—extending their lifespan for as long as possible" (IKEA, 2019b). In other words, IKEA's strategy for achieving its climate ambitions is largely based on *environmental new product development* (see section 2.1.5). According to the literature (e.g. Paparoidamis et al., 2019; Pujari et al., 2003; Pujari, 2006), environmental NPD can improve a company's environmental performance by several means. For example, such NPD practice can lead to reduced consumption of materials and energy, and less waste related to

production and packaging. Environmental NPD can also be an efficient way for companies to strategically align themselves with consumers' growing environmental concerns (Paparoidamis et al., 2019). This can be a competitive advantage, as more consumers emphasize environmental aspects when making purchases. DELAKTIG—which is created based on circular economic principles—is an illustration of how IKEA's NPD practices are influenced by the company's increasing ESO.

Tom Dixon

To start the development of circular products, IKEA teamed up with the British industrial designer Tom Dixon. Dixon is known for his own brand, where he designs, develops, and distributes furniture, lamps, and accessories (Tom Dixon Studio, n.d.b.). As an industrial designer, Dixon is concerned with demographic trends. Since "[W]e live less, move more often and have a greater need for flexibility than before" (Blikstad, 2018), Dixon argues that circular furniture must be easy to handle. His initial idea for the new IKEA furniture collection was to make a bed. His rationale was that the bed is the most important piece of furniture in a home. It takes up considerable space, is often the piece of furniture you buy first, and you need it throughout your life. He therefore considered the bed as a good starting point for designing a circular product collection (IKEA, n.d.c.). IKEA, on the other hand, wanted to make a sofa. The solution became to design a sofa that can also be used as a bed, or vice versa—that is, using a modular furniture design.

Hydro's contribution

In 2015, Hydro received the request to participate in the development of DELAKTIG (Blikstad, 2018). It was primarily the properties of aluminum that made Hydro the preferred material supplier for the project. As aluminum is a light, strong, flexible and 100% renewable material (see section 4.1.1.3), it is well-suited for making circular products. Several of the interviewees point out that these material properties of aluminum are an important advantage for Hydro. The properties will be an increasing competitive advantage now that manufacturing companies must reduce their environmental footprint "[W]e are in a fortunate position because we are an

aluminum supplier. And aluminum is a product that is interesting for many applications … So, given a substitution trend, we have the right material" (VP Strategic Projects, Extruded Solutions, Strategy and Innovation). Compared to other materials, aluminum is often considered a good choice when creating circular products.

Hydro's expertise in aluminum extrusion is also a crucial reason why it was considered the most attractive supplier. Already at an early stage in the design project, it was decided that aluminum should be the main material in the furniture. IKEA's creative leader, James Flutcher, explained that aluminum is the right material for DELAKTIG because it is light and strong (Hydro, 2019f). The fact that the aluminum is long-lasting and recyclable, enabled IKEA and Tom Dixon to realize their ideas of furniture based on circular-economic principles. Flutcher also pointed out that aluminum is suitable for furniture production because it is easy to add features once the metal has been extruded into a profile.

Entering the collaboration with IKEA to develop circular products is in line with Hydro's climate strategy in several areas (see section 4.1.1.3). First, to help customers reduce their emissions by contributing to production of more environmentally sustainable products is a key measure in the strategy. Furthermore, Hydro places emphasis on delivering aluminum to segments where it can contribute to environmental improvements. As most of the furniture industry's carbon footprint is caused by material consumption, Hydro's deliveries of aluminum can have a significant positive impact. For IKEA, the carbon footprint has been large because many of the products have a low cost and a relatively short lifespan. For this reason, consumers have often associated them with "use and throw away". Delivering aluminum to IKEA with the intention of increasing the life of the furniture is therefore an important environmental contribution from Hydro. In this way, Hydro can utilize its role as a material supplier to lower the products' footprint in a life cycle perspective.

4.2.2.3. Future Challenges and Opportunities

DELAKTIG was officially launched in February 2018 and has since then grown as a product family (see section 4.2.1.1). Approximately one year after the first part of the collection was launched, IKEA introduced DELAKTIG part 2 (IKEA, 2019a). This second part was also developed in collaboration with Tom Dixon, and is based on circular economic principles. The intention of giving the DELAKTIG products a long life remained a key product feature. Using strong and recyclable materials in the production of the furniture is still one of the most important measures to make the products *circular*. This means that Hydro has remained a key material supplier. The fact that IKEA chooses to continue using Hydro's aluminum to develop more environmentally sustainable products indicates that there are opportunities for Hydro to grow in the furniture segment.

Analyzing Hydro's contribution to the development of DELAKTIG has given us insight into what role material suppliers can have in environmental NPD. We have illustrated how important the choice of materials is to reduce the environmental footprint of the furniture industry. In the discussion that follows, we will point out challenges and opportunities related to how Hydro can increase its competitiveness based on NPD in the furniture industry.

Challenges

Challenges related to competition from other furniture materials. Aluminum is not a typical material used for furniture manufacturing (Furniture in Fashion, 2015). Traditionally, materials such as wood, cane, plastic, and steel are considered more popular furniture materials—both by manufacturers and consumers. When choosing furniture for the home, the consumer is often more concerned with the aesthetics than the climate aspects. Manufacturers have traditionally been most concerned with the price and what their customers want when choosing materials. Challenging the established notions of what is neat and practical in a home can be difficult. As highlighted in the IKEA example, aluminum has properties that can be attractive from both the manufacturer's and the consumer's perspective. Using aluminum should be particularly relevant

now that the furniture industry must take more responsibility for the climate challenges. However, the established traditions related to what are socially accepted as furniture materials can be an obstacle for Hydro when trying to increase its presence in the furniture industry.

Challenges related to consumers' intention-action gap. The theoretical review showed that consumers are increasingly concerned with environmental aspects when making purchasing decisions (see section 2.2.1). This should mean that products labelled as *more environmentally sustainable* can attract customers and increase the profitability of furniture stores. However, there is a certain discrepancy between consumers' intentions and actions. This phenomenon is referred to as *consumers' intention-action gap* (see section 2.2.2) in the literature and is about how consumers' ESO influences their intentions to buy more environmentally sustainable products much more than their actual buying decisions. The gap may be an obstacle for furniture manufacturers to be willing to invest in more low-carbon materials. Although climate ambitions are important, companies will have to satisfy an economic bottom line. As the furniture industry is characterized by strong competition, customers' willingness to pay will have a major impact on the manufacturers' strategic decisions. This may limit Hydro's opportunities as a low-carbon material supplier in the furniture industry.

Challenges related to companies' knowing-doing gap. Hydro's aluminum can outperform many other materials when evaluated according to climate aspects. The use of more environmentally sustainable materials is an effective climate measure in the furniture industry. However, several of the interviewees point out that customers are not necessarily willing to pay the upcharge for low-carbon aluminum.

> We have customers who talk a lot about the environment ... But when they come to the negotiating table, they do not want to pay a penny more for a more environmentally sustainable product. They want to adorn themselves with an environmentally friendly product, but they want to pay the same price. (VP Strategic Projects, Extruded Solutions, Strategy and Innovation)

This illustrates the concept which in the literature is referred to as the *knowing-doing gap* (see section 2.2.2). Similarly, as *consumers' intention-action gap*, the *knowing-doing gap* concept means that there is a discrepancy between companies' knowledge and what they do (Pfeiffer & Sutton, 2000). In this case, what they *know* is which materials are the best choice in a climate perspective, and what they *do* is the choices they make in purchasing decisions. This is a challenge that may affect whether it will be profitable for Hydro to increase its presence in the furniture industry. However, the interviewees point out that there are indications that the willingness to pay for low-carbon materials will increase in the future. The reason is that an increasing number of industries will experience pressure from consumers and authorities. What is difficult to know is how long it will take before being a low-carbon material supplier manifests into a competitive advantage.

Opportunities

Growth opportunities related to substitution of less environmentally sustainable materials. IKEA has stated that an important measure to achieve the company's climate goals is to use more renewable and recycled materials (IKEA, n.d.e.). Wood and cotton are the materials that IKEA is most dependent on to produce the furniture that is offered in the stores today. As deforestation is a relevant climate challenge, IKEA is aware that the purchase and use of wood must be done in an environmentally sustainable way. The company's goal is that all wood they buy should come from sustainable sources. The company should try to utilize wood from sustainable sources to the extent possible. Additionally, it can be beneficial to substitute some of the wood with other materials. In this case, aluminum can be a good alternative, due to its material properties. This is assumed to apply to the general furniture industry as well.

Increased use of life cycle assessments (LCAs) in the furniture industry is also likely to make material substitution more common. An advantage of using LCA to measure the environmental impact of a product is that you identify which input factors have the greatest impact on the environment. In other words, as a manufacturer you get clear indications of what can be changed

to reduce the carbon footprint. Increased use of LCA in the furniture industry may therefore lead manufacturers in the direction of wanting to use more low-carbon materials than they have done in the past. This creates potential for Hydro to become an attractive supplier in the furniture industry. Another point is that the word "recycling" is a positive loaded word for consumers (see section 2.1.3). Being able to say that "this product is based on recycled materials" can be a competitive advantage for furniture manufacturers—as it may attract consumers with high levels of ESO.

Growth opportunities related to increased consumer visibility. One of the key findings from the literature review is that consumers are increasingly concerned with the environmental aspects of the products they purchase (see section 2.2.1). For Hydro, it can be considered as difficult to gain benefits from this, as it is a material supplier and does not have direct contact with consumers. In addition, Hydro has historically had a low focus on consumer marketing. This has resulted in the company appearing anonymous to many consumers. However, the Head of Brand and Marketing points out that there may be great growth potential for Hydro by making itself more visible to consumers.

> We have a material that we believe is very important as part of a future-oriented industry. It is a supermaterial—which we believe aluminum is—because of its properties. It is both light and strong and eternally recyclable. And we believe that we need to use more of such materials. (Head of Brand and Marketing)

Making consumers aware of Hydro's role in solving climate challenges can lead to a better reputation. More specifically, it can lead to increased popularity among environmentally conscious consumers. If such environmentalists talk positively about Hydro to others, it can lead to increased sales of furniture that contains Hydro's aluminum—such as DELAKTIG products.

One way to further increase consumer visibility is to enter more collaborations with renowned designers. “Creating “cool” and at the same time environmentally friendly designs which attract

the consumers could be a competitive advantage for Hydro as an integrated aluminum company with presence throughout the value chain" (Director of Corporate Business Development). As DELAKTIG was partly designed by Tom Dixon, it has received considerable media attention. The fact that the collection was shown for the first time in public during Dixon's show at the Milan Furniture Fair, led to further visibility for consumers. In this context, Hydro was highlighted as an important material supplier—which had enabled the development of Dixon and IKEA's circular collection. This may have been an eye opener for the use of aluminum to produce more environmentally sustainable furniture. In the furniture industry, designers can have a significant impact on which products attract consumers. Entering cooperation with designers can potentially lead to increased sales of furniture that contains Hydro's aluminum. It can also provide positive media coverage.

Growth opportunities related to the reputation of aluminum and enhancement of corporate reputation. Aluminum has unique properties and is particularly suitable for products that you want to have a long duration. Hydro can profit from communicating this to customers and consumers—that is, take responsibility for promoting the aluminum industry. Most of the interviewees highlighted that one of Hydro's largest challenges is the reputation of the global aluminum industry (see section 4.1.1.3). The aluminum industry has a bad reputation globally—in environmental sustainability contexts—because the average global carbon footprint is so high. With the goal of improving this reputation and making people understand that aluminum can be a good material in a life-cycle perspective, communication through furniture—a consumer-oriented industry—can be an effective strategy. The furniture industry is particularly suitable because almost all people in all parts of the world have a connection to it. Unlike the automotive industry—which is one of Extruded Solutions largest customer segments—the furniture industry is a segment that appeals to everyone, regardless of gender, nationality, and age. In addition, many furniture manufacturers—like IKEA—have a global presence. This provides opportunities to disseminate knowledge about aluminum as a furniture material to many consumers in an efficient manner. Contributing to improving the reputation of the aluminum industry will probably also strengthen Hydro's own corporate reputation. Having a

corporate reputation associated with environmental sustainability is important to appeal to customers and consumers, as well as collaboration partners and future employees.

4.2.3. Borregaard Case 1: EuroVanillin Supreme

4.2.3.1. Product Description

Borregaard is one of the world's leading suppliers of vanillin and ethyl vanillin. The company is the only producer of vanillin from wood, more specifically Norwegian spruce (Borregaard, n.d.b.). The company has different types of vanillin in its portfolio, but the focus in this case will be the product called EuroVanillin Supreme. Vanillin is what is commonly known as the vanilla flavor typically found in food and cosmetics. This flavor is due to a molecule which is called the vanillin-molecule. There are several ways to obtain this molecule, the most known way being from the Orchid-flower. Two other ways to obtain this molecule is from oil, and from wood. Most of the world's vanillin comes from oil, which is not a sustainable source for the vanilla flavor (Borregaard, 2020a). Vanilla from Orchid flower is much more expensive than vanillin extracted from either wood or oil (Hansen et al., 2009). The price for vanilla from the Orchid varies from 1,200 dollars to 4,000 dollars per kg natural vanillin, while synthetically produced vanillin is sold for around 15 dollars per kg on average. In addition, the production of vanillin from the Orchid is limited to under 1 percent of the market (Sveen, 2020). The remainder is chemically produced from lignin or fossil hydrocarbons. Borregaard is very clear about the fact that it does not provide an alternative to the Orchid, but rather a more sustainable alternative to the oil-based vanilla flavor.

> Most of the vanilla flavour in the world today comes from oil. That is, from the approximately 20 000 tons of vanillin made each year, 18 000 of them originates from oil. What you need to know—the most important thing to know about EuroVanillin Supreme—is that it is not a lesser alternative to the Orchid. It is a better alternative to the oil-based vanillin. (Sales Director)

In addition to being more environmentally sustainable, it has a better flavor range than vanilla from petrochemicals.

> Vanillin from wood is often described to have a creamier, rounder and more of a vanilla taste than vanillin produced from petrochemicals, i.e. guaiacol. It is likely that this is due to trace levels of certain components, which are also found in vanilla from vanilla orchids. (Dahlquist, 2012, p. 147)

Typical customers of EuroVanillin Supreme are actors in the food industry. The Sales Director states that most of these customers are multinational food producers. Another customer group is flavor and fragrance-houses. These are companies that buy a large amount of raw materials to create specialty flavors for its customers. When explaining what a flavor and fragrance-house is, the Sales Director claims that: "[T]hey are companies that buy a lot of raw materials, to make special flavors. E.g. if an ice cream producer wants a more creamy chocolate flavor, they can contact such a company, and it will make a special flavor for them". The Sales Director also elaborates on the different products Borregaard has within its vanilla-range, and states that it has around 15 standard products which it supplies to customers. In addition, if some customers have a special wish or request for another flavor, Borregaard can make a special-vanillin, tailor made, for that specific customer. However, this requires that there is an interesting buying volume. Borregaard has two or three such products in its portfolio that are made based on customer requests. That is, the company collaborates with customers in case of special requests. But usually, it offers solutions that Borregaard already has in its portfolio.

4.2.3.2. Strategic Background

Borregaard started producing vanillin from timber in 1962. The company had a stream of lignosulfanat, which is a molecule that is very similar to the vanillin molecule if it gets cracked. So Borregaard tried this and got the vanillin molecule out of the process. This was typical for

Borregaard's strategy, as a side stream from one process was leveraged to make a brand new product. The alternative was to let the side stream go to waste, or into combustion for energy.

> Back then [in 1962] all vanillin in the world was produced from lignosulfanat or woodwork. Eventually as environmental considerations became more and more important, a lot of producers disappeared. The reason was because they did not have a solution to what they should do with the waste stream. Some burnt it, but there was no particular economic gain in this. Others emitted it into the water and watercourses, but that was decreasingly popular beyond the 80s and 90s. Borregaard found a way to convert this waste stream into making other products. (Process Manager)

The excess stream from Borregaard's factory in Sarpsborg is not a waste stream—but rather a production stream to another factory. By operating this way, it takes advantage of larger amounts of the biomass, and can turn it into high value products instead of just burning it as energy. The Process Manager suspects that this is one reason why Borregaard has managed to uphold vanillin production from lignosulfanat in its factory in Sarpsborg. It can also explain why this factory is the only one in the world that makes vanillin from woodwork.

The later years, environmental sustainability has been increasingly important. Both customers and businesses are focused on environmental sustainability in multiple aspects of the value chain: the harvesting of raw materials, production process, transportation, and finally usage, and recycling.

> You see terms like plant based, bio based, sustainable, they are all over the market place. That makes it important for us, because we have been doing this since 1962, to take ownership of it. It is important for us to let stakeholders know that this is not something we are going along with just now because it is becoming

> modern, rather this is how Borregaard is built. [It is important] that we create confidence in that. (Sales Director)

Since the beginning, Borregaard has followed the same strategy—taking side streams from processes and turning them into new products. It is important for Borregaard to communicate this to its stakeholders. To gain trust, and make them understand that this is the foundation of its business strategy. Not just some trend that it is following or jumping on because it is popular now. The process Borregaard uses today is basically the same as it started with in 1962. However, there has continuously been a focus on incremental improvements. The Process Manager says that there has always been a strive for using the best available technology and reducing the environmental impact in the form of pollution.

> There is a lot of collaboration between research and development, and production. And even though it is an old process, we continuously try to improve the process. That means that it is very important [for production] to collaborate with research and development. We do this all the time. It is a continuous process. (Process Manager)

When continuously trying to improve the process, Borregaard searches for ways to get out more vanillin from the raw material, reducing losses in the waste streams that go out of the factory, making less rejected products (waste), etc. All these questions are asked continuously, both in the production department, and in research and development.

4.2.3.3. Future Challenges and opportunities

Vanillin is a traditional Borregaard product, and it has been a part of the company's portfolio since 1962. The demand for environmentally sustainable products has increased during the past years (see chapter 2). This gives fruitful opportunities for EuroVanillin Supreme, and can lead to Borregaard increasing its competitive advantage. The following will discuss challenges and opportunities for EuroVanillin Supreme and how it can affect Borregaard in the future.

Challenges

Challenges related to communication. Borregaard is facing challenges related to the reputation of industrial companies. Borregaard has since its beginning operated processes that require large energy consumption and emit different by-products. It can be difficult for Borregaard to convince customers that their products are in fact more environmentally sustainable than its competitors. The general idea about industrial companies is that they operate energy demanding processes, and that there are large amounts of emissions from these processes. What most of the customers are not aware of when it comes to Borregaard, is that the company utilizes its excess streams as input into new processes, or burns it for energy. Here, it becomes important for Borregaard to communicate its strategy with its stakeholders. Another aspect is the fact that Borregaard operates in several countries. "One can also say that cultural differences have an impact. Even though we have solid documentation for each of our products. It is also about teaching stakeholders in different industries and cultures" (Marketing and Sustainability Coordinator). What the Marketing and Sustainability Coordinator mentions, is the fact that the relationship with customers and other stakeholders is a somewhat learning process. Borregaard is an expert on its products and operations, and it requires clear communication and sometimes teaching for the stakeholders to fully understand how Borregaard operates, and what it values. The Innovation Manager mentions that in all outwards communication, the first two-three slides include information about Borregaard's environmental sustainability orientation. "Environmental sustainability is always the first point [of business] that shall be presented. We are continuously emphasizing to stakeholders how important this is for us" (Innovation Manager).

In addition, most customers are not aware of the fact that vanillin is traditionally made from oil, or that Borregaard produces vanillin from wood. The general idea on the global market is that vanillin comes from orchids, which it does, but only in a small amount (see section 4.2.3.1). This lack of knowledge in the market can make it difficult for Borregaard to position itself as a sustainable option. The company is working on marketing and how to best communicate the benefits of its products. It has also recently hired people that will work exclusively with sustainability and communication to the market. The Sales Director mentions that the sales

department are thinking about renaming EuroVanillin Supreme to BioVanillin or something similar. This will make it more intuitive for the customer to understand that the product is an environmentally sustainable alternative.

Challenges related to environmental sustainability. It is indicated amongst the interviewees that environmental sustainability has had an increased focus during the past years, and has had an impact on Borregaard's operations. The Process Manager mentions that the environmental footprint has changed a lot during the past two decades. There has been an increase in focus on sustainability and climate when it comes to emitting side streams from production processes, and what energy sources are used in production. This has also affected the process for making EuroVanillin Supreme. During the past years the process has become more environmentally sustainable than it originally was back in 1962.

> Borregaard utilizes a lot of energy in its processes. It is an industry company, and a large chemical company. There are several difficulties connected to emissions and energy consumption. I would say that the largest challenge the past few years has been the energy consumption. There have been several actions to mitigate this problem, e.g. the outphasing of heavy oil in 2012. We have started utilizing hydroelectric energy instead, and excess streams from production are burned as bio energy. (Sales Director)

Borregaard has encountered several challenges over the years, which it has taken action to solve. It has specifically executed changes to reduce its climate footprint regarding emissions and energy consumption. There will always be a potential to do even better, and Borregaard is continuously working on improving its processes to increase its environmental sustainability orientation.

Challenges related to outside regulations and factors. Several challenges come from outside regulations, e.g. EU regulations and regulations from the Norwegian government.

> We are still getting stricter emission regulations from the government which we have to meet. Borregaard has also committed itself to the Paris agreement where the aim is to reduce greenhouse gas emissions. This will demand large investments from Borregaard. Some of which the company can carry out itself, others need to be executed in collaboration with external partners. (Sales Director)

The Sales Director is pointing to two challenges regarding outside regulations and factors. First, The Norwegian government is regularly imposing stricter regulations on the Norwegian industry companies. There is a strong focus on reducing greenhouse gas emissions, and in general an encouragement for the companies and their processes to become more environmentally sustainable. The second is regarding transportation of Borregaard's products. The company transports a large amount of its products by road and by sea. "A lot of heavy transportation and trucks run on diesel as of now, which is not the most environmentally sustainable" (Sales Director). This is one challenge that Borregaard can not solve on its own, but needs to carry out in collaboration with external parties. It will demand more environmentally sustainable solutions within the transportation sector for this challenge to be solved.

Challenges related to availability. When asked about other possible challenges and opportunities for vanillin in the future, the Innovation Manager mentions the availability. He talks about the fact that it is challenging to get hold of enough vanillin. Biobased vanillin is a challenge, and Borregaard is currently working on a project now to increase the production capacity.

> It is an extremely complicated process, there are low proceeds, and it is difficult to extract the vanillin. Based on this, I do not see that there will be many other companies trying to start doing the same. But the largest threat is that if the value were to increase and become large enough, that the large companies start spending money trying to find other ways to get it [the vanillin] out. For now, we

> [Borregaard] are happy that there are few alternatives when it comes to biobased vanillin. (Innovation Manager).

Meeting the demand of the market is a common challenge for most industries. For Borregaard to remain competitive in this market, they need to increase their availability of vanillin. To increase the production capacity will require significant investments, which brings risk and challenges for the company. Additionally, there is the possibility for new entrants in the market which can create competition for Borregaard. As of now, it is the only company producing biobased vanillin, and Borregaard hopes that it will remain this way.

Opportunities

Growth opportunities related to environmental sustainability oriented (ESO) customers. The company has been developing in a direction of more environmental sustainability, and it is also noticing that its customers are beginning to care about environmental sustainability. When discussing the demand for more environmentally sustainable products, the Process Manager says that: "Especially those of us who work in vanillin are noticing an increasing interest for a green product. And by green, we are thinking about green carbon". This is an indication that the sustainability trend has a positive impact on Borregaard's business. There are also indications that the customers are willing to pay more for green products.

> And then there is biovanillin, which purely competes with oil-based vanillin, where there has been a major change now regarding the fact that we used to compete directly on price, and we did not get paid extra because of the environmental sustainability-factor, but now we see a large demand for biovanillin. (Technology Manager 1)

The Sales Director supports this and explains that—amongst the different vanillin alternatives in Borregaard's portfolio—the most known is Supreme which is made of sustainable wood. "We

have gotten a significant demand for this [EuroVanillin Supreme], because of the environmental sustainability factor. Customer demand is also the reason why we have to make investments to have enough [EuroVanillin Supreme] available" (Sales Director).

From the theoretical review, we learned that there was an increase in consumers' intentions to purchase environmentally sustainable. For this to have an impact on sales, it is important to communicate clearly to the customers that Borregaard's vanillin is more environmentally sustainable than vanillin made from petrochemicals. The rise in customer demand most likely comes from a combination of the fact that Borregaard has an environmentally sustainable raw material, in addition to becoming more aware and persistent in communicating this clearly to stakeholders. The Process Manager emphasizes the increased focus on environmentally sustainable raw materials from the marketing department when communicating outwards, and makes a point of mentioning that this is a conscious choice made by Borregaard. When talking to customers and other stakeholders directly and on its web pages, there is a significant focus on the environmental sustainability impact of its products.

> Vanilla flavor from timber has a biological origin. While most of the vanillin made in the world is manufactured from petrochemicals. The raw material comes from oil, which means that it is black carbon. This is something that we try to sell to the customers, that our product has a green carbon, and that we try to replace the oil-based carbon with our product. (Process Manager)

The Process Manager also states that: "It [the demand] has been very increasing. So for us, the prices have gone significantly up". In an article written by *Finansavisen,* Borregaard's Chief Financial Officer mentions that simultaneously as oil-based products have become decreasingly popular, the demand for natural vanillin products have gone up (Sveen, 2020).

> We have always had a little premium for our wood based vanillin compared to oil-based vanillin. Now, the prices for wood based vanillin is multiple times

> higher than for the oil-based vanillin. Our profit from vanillin production has been fluctuating ever since we started our production, but it has never been close to what it is now. (Chief Financial Officer)

The market for bio-based vanillin is growing, and Borregaard expects this trend to continue. The increasing focus on environmental sustainability throughout most industries will likely strengthen the increased demand for environmentally sustainable products (Borregaard, n.d.b.). As a result of the increased demand for its bio-based vanillin, Borregaard is increasing its production capacity. This expansion will deliver approximately 250 extra tons of bio based vanillin yearly. The project has a total cost of 130 million NOK and will be finished during the first half of 2021.

Growth opportunities related to LCAs. Recent years have shown an increased use and interest in Life Cycle Assessments (LCAs) in the industry. LCAs are utilized to measure and document the environmental impact of different products and applications. Borregaard already performs LCAs on several of its products, and we believe that this will become even more important in the coming years. As a supplier of products and applications with a low carbon footprint, it can help Borregaard in convincing customers that its products are as good as they claim to be. By actively using the LCAs of EuroVanillin Supreme, Borregaard can show customers all the benefits of its product. For customers who want to minimize their own environmental footprint and the footprint of their products, it is likely that Borregaard will become a preferred supplier. If the knowledge about LCAs is further spread to the end consumer, this can create additional opportunities. Consumers that are environmental sustainability oriented, will continue to demand climate friendly products. If it becomes more common to label consumer products with their carbon footprints, it will be more visible for the consumers. This can increase the interest for low-carbon products, which with time will affect the demand.

Growth opportunities related to new applications. Another potential opportunity for vanillin is derived from some of its other characteristics. There is more to vanillin than only flavor. “It

[vanillin] has very anti-biological features, which means that it kills mold and that sort of thing. This means that products that contain vanillin can have an increased durability" (Sales Director). The Sales Director also mentions expanding within food and cosmetics, but also other applications in which durability is an important trait. This can potentially open up new markets for Borregaard in the future.

Growth opportunities related to reputation. Several of the interviewees from Borregaard indicate that it is important for Borregaard to have a reputation associated with environmental sustainability. The Team Manager for Research mentions that this is how Borregaard identifies itself, as a green alternative to fossil based products. In this context, EuroVanillin Supreme is likely to have a positive impact on the company's reputation. The most important part for this to go from a possibility to reality, is a dedicated marketing strategy. Borregaard has during the recent years dedicated resources directly to environmental sustainability, by hiring a sustainability coordinator which exclusively works with sustainability. The sales department is also considering changing the name of EuroVanillin Supreme to something containing the word bio, e.g. biovanillin, as mentioned in *Challenges related to communication.* If Borregaard follows through with this name change, and it shows to have an effect on how the customers perceive the product, this can in turn affect Borregaard's reputation. Having a reputation that builds on environmental sustainability can increase the company's competitiveness in the ever increasing ESO market. Not only when it comes to direct customers or consumers, but also related to collaboration partners and future employees. When discussing recruitment of future employees, the Team Manager for Research emphasizes that new hires, especially summer interns, have a strong perception about Borregaard being an environmentally sustainable company. Several of the candidates for summer internship in Borregaard mentioned this during their hiring process as one of the main reasons for choosing Borregaard. "They perceive us as an environmentally sustainable company, which is important. This is an important point that we try to utilize and emphasize in recruiting processes" (Team Manager Research). The Innovation Manager also mentions new generations of employees, and that they have new demands when it

comes to environmental sustainability. “There is a generational shift, and environmental sustainability is an important driver” (Innovation Manager).

4.2.4. Borregaard Case 2: Exilva

4.2.4.1. Product Description

Exilva is microfibrillated cellulose (MFC), which is sourced from Norwegian Spruce (Exilva, n.d.). “If you imagine timber, you have the part that is cellulose, and then you have the other part which becomes lignin, vanillin and ethanol” (Technology Manager 2). Exilva is cellulose, only further treated so that it gets other effects and application areas. It is a bio-based additive, with several benefits. It can improve performance in anti-setting and anti-sedimentation through robustness to shear, pH and temperature (Exilva, n.d.). It is a revolutionary product with potential in a large range of applications (Bio-based Industries Joint Undertaking, n.d.). Potential applications include: personal care, cosmetics, home care, pharmaceutical excipients, adhesives, composites, agricultural chemicals, concrete, CO_2 capture, and many more. Due to its biological origin, it has the potential to replace several fossil fuel-based products, which also gives the incumbent product a better overall sustainability profile (Exilva, n.d.).

> And what is special about Exilva, is that it is an extremely effective product … You only need a small amount of it to get a good effect. Usually, you add less than 1% of it, and it gives either a certain stability or a desired texture to the receiving product or application. In addition, it is a 100% natural product. (Team Manager Research)

4.2.4.2. Strategic Background

Exilva started out with a plan to do something new, something radical, back in 2005. It was a top managed initiative, which is important for such radical processes to get a long term anchorage. Technology Manager 2 was made responsible for the project. The mission was to use half of the resources on existing technology and the other half on something completely new. Working in

interdisciplinary teams, they spent a lot of time learning about wood chemistry, and the team was challenged to have at least ten new ideas for value creation from fiber.

> It was top managed by the management team, so we did radical innovation, which means that we innovate in more than two dimensions. We created 10-14 ideas, which were followed up as projects by a so-called Innovation Management Team (IMT). … [T]he IMT is an interdisciplinary management forum, where the person in charge of each business unit sits. In addition, there are people from production, market, sales, and R&D. This is to ensure that we are working on the right things, which are feasible both commercially, technical and production wise, and market wise. (Technology Manager 2)

Technology Manager 2 continues to elaborate on how some of the ideas were pretty crazy, but in the end they ended up with two possible projects. One of these projects was continued—namely Exilva. It was not called *Exilva* at the time, but it got this name eventually as "ex silva" is latin for "from the forest".

The IMT followed the typical innovation funnel, and when the project was chosen, it went from idea to laboratorie, to a bigger laboratorie, then a small pilot, followed by a larger pilot in 2012. The pilot was made so that the customers getting the raw material would know that they could have more. After successfully completing these stages, and successfully running the pilot for about two years, Borregaard decided to build the factory in Sarpsborg. According to the Innovation Manager, this required an investment of 250 million for the factory, which is the world's largest microfibrillated cellulose factory. The factory was ready at the end of 2016, so it is a fairly new innovation. After the factory was finished, Borregaard created a new organization for the sale of the product. At the same time, it was granted financial support from the Bio-Based Industries Joint Undertaking for the development and commercialization of this project (GlobeNewswire, 2018). This funding was a part of the European Union's Flagship programme "Horizon 2020". It was given support for three years, where 60% of Borregaards costs would be

covered during this time. After this, the project grew and became a bigger and more important part of Borregaard's innovation portfolio.

> It is of course difficult when you are doing radical innovation, to harmonize the three dimensions: product, process, and market. But at one point, we had to choose process and product, based on the feedback we had gotten from the market at that time. Two of the main reasons for this, is that our largest customers do not want to work with something that is not commercially available yet. This meant that we had to build a factory before the market was fully developed. In addition, you must fix some of the dimensions, in this case it was the process and the product. It has been an intense past five-four years trying to develop the market. What we experienced is that there is a large interest, but it takes time to develop it. (Technology Manager 2)

As this is a new product both for Borregaard and its customers, there will be a challenge in adopting it into the customers processes. It is not a substitute for existing or similar products. This product commands the customer to think in new ways, and to develop together with Borregaard to find a solution to its challenges. Technology Manager 2 mentions that—by experience—it takes at least three years from the customers receiving a sample until they have a sale. If it requires additional investments or larger changes, it can take up to five years.

The Team Manager for Research talks about how they are working with following up what is produced of Exilva, in addition to developing new applications for the product. The R&D group is working closely with the marketing department on how to introduce this new product to the market, and The Team Manager for Research mentions that "some of the researchers in the R&D department also work in what we could call hybrid positions, which is a position between research and development, and market, to support the market and the customers". Again, we can see the close collaboration between the different departments in Borregaard. R&D working together with the market department to fulfill the market demand, and to find a best possible

usage for its product. When elaborating on Exilva and the development process, The Team Manager of Research mentions that MFC has been known in the literature since the 80s, but it has not been commercially available.

> We have been working on this for several years here at the R&D department, both with developing the production process, which has possibly been one of the largest focus areas, but also finding out, because it is a completely new to the world product, where it can be used. We have tested a lot of applications or usage areas, before we built the factory which was finished in 2016. (Team Manager Research)

What they are currently working on now, is to find a place, or several places for it in the market, and work with getting it out there. It is a demanding process, where it is not enough to innovate in only one dimension, but rather several dimensions at the same time.

> This is where the innovation includes multiple dimensions. You need to innovate on the product, on the process, but also on the market. Here you are trying to get something out that does not exist in the market already, it is not supposed to replace a similar product. It will replace something completely different or be an addition to something that already exists. So what has been important in the product development of Exilva, has been to be present in the market, helping the customers to better understand how they can utilize Exilva, both where and how they can use it. (Team Manager Research)

In the development of Exilva, it has been essential for Borregaard to collaborate with external partners and customers. The fact that MFC is such a new product to the world, Borregaard does not have any competitors yet, but it will come eventually. In the development process, "[I]t has been essential to cooperate with external parties to succeed with this product" (Team manager

Research). It is mentioned that Borregaard cooperates with external parties through all their business areas, but that it has been particularly important for this product.

> A large challenge has been to build the market, getting the market to understand that this is an important product, so we have been working together with both institutes and universities, in addition to customers. It is very important to get feedback, information about how the product is working, how the different product types are working, etc. So absolutely, this has been important, and it still is today. (Team Manager Research)

To sum up, Exilva started out as a top managed innovation process. It has been important throughout the process to work in interdisciplinary teams across the organization, in addition to having the support of the top management. In the testing phase of the process, collaboration with external partners have been key for the project to be able to continue.

4.2.4.3. Future Challenges and Opportunities

Exilva is a new innovation and a new product to the world. As of today, there is no established market, which gives several challenges and opportunities. The research department is currently working in close collaboration with the market department, where the main focus is on uncovering possible applications, i.e. new places where Exilva can be used. The market introduction is currently happening, and the Team Manager for Research emphasizes that some of the researchers are working in somewhat hybrid positions between R&D and the market, to support and build the market together with its customers. Getting a novel product into the world market is always challenging, but it also has fruitful future opportunities.

Challenges

Challenges related to developing the market. When developing the market, Borregaard is depending on the customers to develop themselves, in addition to communicating clearly and

upholding an interest for the new product. This will be an important focus for Borregaard moving forward, as it will not have a successful product without any customers. The Sales Director states that: "The downside is of course the fact that there has not existed something like this before, which means that the people working with Exilva have to create their own market. They need to create their own path and highlight the needs. … [B]eing a pioneer is a tough role to have". The Innovation Manager mentions that the process of developing the market is both challenging and time consuming.

> We have spent three years finding out how to use it [the product], so the time to market is as of now, three years. This is closely linked to the fact that the customer has never tried such a product before. They [the customers] need to try out the product, test different formulations, which takes time. If you, in addition to this, have full regulatory aspects, it would take additional one to two years. (Innovation Manager)

Exilva is a completely new product, and it will take some time for the market to be ready. One thing that Borregaard has done to try to expedite the process, is to make Exilva available for customers. The original strategy was to keep the product information secret to avoid sharing Intellectual Property (IP).

> This is something we have changed during the past five-four years, by making Exilva available and visible. Everybody who wants to work with Exilva will get it from us. We recognize this as a moderate IP risk. This is a risk that we are willing to take for the product to develop faster. We also acknowledge that our customers are motivated by creating IP for themselves. And we will maintain the IP surrounding our product. (Technology Manager 2)

Releasing Exilva to the public like this is a bold strategy. At the same time, it lowers the barriers for the customers to incorporate Exilva into their processes. It enables them to experiment and try out the product and assess different application areas through their own processes.

Challenges related to Technology Readiness Level (TRL). The Process Manager mentions TRL when discussing possible challenges. The TRLs are seemingly high for Exilva because the factory is built and ready to produce, and the product is ready to be produced. On the other hand, "The TRL levels will never be higher than the weakest link. So, in reality, the customer's TRL in utilizing new technology is relatively low, which means that this will be the limiting factor in the development" (Process Manager). Team Manager for Research emphasizes the importance of communicating the benefits Exilva will give to the incumbent product, including details about usage. E.g. if it will be used as an additive in paint—where in the process you should add it, how you should add it, and how much you should add.

> This is a challenge for us, because we are experts on the Exilva-product—but we are not experts in all the different application areas where it can be utilized. ... [T]his is something that we have had to develop during this time period—knowledge and understanding of the different product areas and how our product fits into that. (Team Manager Research)

This is one of the reasons why there is such a strong focus on cooperating with external partners and customers when developing Exilva. This allows customers to experiment and explore how they can utilize it in their own processes and products. Until now, Borregaard has been collaborating with different customers, institutes, and universities. This has been important to receive feedback about how the product works in different applications and product types. "This has been extremely important for us, and it will continue to be important for us" (Team Manager Research). This indicates that Borregaard will continue to work closely with external partners in the future when further developing the product and the market, in addition to exploring other

possible applications for Exilva. Lastly, external partners have been important to gain recognition for Borregaard's ideas and projects.

> It is important for Borregaard to receive support to relieve risk. This is also important when it comes to confirmation. When we send an application, it is evaluated by a third party. If the application is approved, this gives recognition to us, and to the public. It exhibits that our projects are worth pursuing and investing in. This all relates back to communication with the outside world. (Technology Manager 2)

To summarize, collaboration with external partners is important for Borregaard for many reasons. It is important to relive risk, receiving confirmation that its ideas and projects are worth pursuing. In addition, collaborating with a third party can help strengthen the outside world's perception of Borregaard.

Opportunities

Growth opportunities related to benchmarking. The fact that Borregaard is creating and developing the market for Exilva, gives them a unique position. If the product is a success, the company can claim that it was the first to offer Exilva. "It is a slow process, but when you get there you get to say that you were number one, and the barriers to enter then will be pretty big. We are hoping to create a benchmark for this type of product by being the first" (Innovation Manager). Borregaard is hoping to create a benchmark by launching Exilva. The company believes that Exilva can be a success, and this is also the reason why they have chosen to invest such a significant amount into this project. "There is a large risk connected to building a factory which is the first in the world to produce something, so we clearly have faith that it [the product] will be a success" (Team Manager Research). As with all innovations, it takes time, especially when you are innovating in multiple dimensions.

> Even when you have the product ready, you need to get the market ready. So, things often take time, but Borregaard fortunately has experience with this, which is probably one of the reasons why we dare to take such risks. We have done it several times before. Started out with completely new ideas, and it has taken a few years, but if we are patient enough, we have made it work several times before. So, we believe that we can do it again, absolutely. (Team Manager Research)

Borregaard is a stable company, with significant former experience in driving innovation processes. It has the resources and knowledge to make this product a success. They are in a unique position now to set a benchmark, and create a market that works in Borregaards favor. When there is already an established market, the barriers to enter will increase. "There should be great barriers to enter the markets in which we operate, and there are [great barriers]. The investments are large, and you need a significant amount of "know-how" to transform the timber into what we are doing" (Innovation Manager). Borregaard has made a point of being in several segments and niches, which is a risk-reducing strategy. When one market is underperforming, another might overperform. If Borregaard succeeds in creating a benchmark with Exilva, it will be more demanding for competitors to enter the market after it is established.

Growth opportunities related to new applications. The fact that Exilva is a completely new product to the world, gives fruitful growth opportunities for Borregaard in the future. Before building the factory, which was finished in 2016, Borregaard conducted several tests in different applications and usage areas. What they learned is that it can be used in several application areas, e.g. paint, glue, and construction materials. Borregaard has continuously collaborated with customers when developing Exilva, so that both Borregaard and the customers can learn how to best utilize Exilva and benefit from its specifications. The customers of Exilva will be other industrial companies, typically companies which develop and produce paint, glue or other technical applications and products.

If Exilva becomes a success, this can possibly lead to a completely new business unit for Borregaard. When discussing future opportunities for Exilva, and what Borregaard is hoping will happen, several possibilities are mentioned.

> An upscaling of the factory, large revenues from the production process, and a new organization. A new part of Borregaard, and a new Business Unit which stands alone. Ideally, we want to get a good foothold in the market, so that the Exilva organization can be its own Business Unit, and in time become a significant part of Borregaard. (Innovation Manager)

This is what Borregaard is aiming for in the future, and what the company is working towards. There are several possibilities for this product in the future. What is special about it, is that it is very effective. "You need very little of the product to have a significant effect. Often, adding less than 1 % of Exilva is enough to give the stability or consistent texture that is required" (Team Manager Research). "Ideally, the product base will replace other, more dangerous chemicals. This will lead to the customers needing less of other chemicals in their solutions and applications, because Exilva is very potent" (Innovation Manager). These two statements capture the essence of Exilva, and what Borregaard is hoping it will lead to. It is also indicated that the success of Exilva can have a positive effect on Borregaard's reputation and possibly its competitive advantage.

> The customers that Exilva is working with are on another level. It is a somewhat different business than Borregaard is used to. A part of what these customers are working with, will have synergies with our lignin production and our cellulose production. We can explore new business values together, through the entire portfolio that Borregaard has. This can give a new dimension to Borregaard's product portfolio in bio chemicals, or bio based solutions. (Innovation Manager)

In addition to the opportunity of a completely new business unit, it can increase Borregaard's competitive advantage as a company in general. What is also emphasized is that this is a time consuming process. It takes time to develop new application areas, new markets, and to get a foothold in the market. What will be important for Borregaard going forward is to have patience. Being present and available for customers and other stakeholders, and working together to develop new applications for Exilva.

Growth opportunities related to reputation. One important aspect related to reputation, is the fact that Borregaard is a Norwegian company. Its factory is located in Norway, and it utilizes Norwegian, locally sourced, raw material. From several discussions in meetings with representatives from the expert group for *product- and service development* in *Prosess21,* it was emphasized that the label *"*Made in Norway*"* has value outside of the country. Norway is often associated with environmental sustainability, beautiful nature, and access to hydropower. Borregaard's customers are mostly international, which gives the company an opportunity to present itself and its products in a certain way. Norway is known for having a stable economy and politics, and is perceived as a reliable country when it comes to secure supply. The Team Manager for Research discusses the fact that sustainability entails more than just the environmental factor.

> We try to profile ourselves in a manner that presents a stable and reliable company. To remain stable over time, it is important with a stable income and good regimens for both the people and community around us. So, we focus on all aspects of sustainability. This is important for us. (Team Manager Research)

Sustainability consists of environmental, social, and economical aspects. As emphasized in chapter 2, this thesis will focus on the environmental aspect of sustainability. However, this quote communicates something important for Borregaard—that it is important to be perceived by stakeholders as a reliable and stable company, in addition to its strong environmental sustainability orientation.

The Team Manager for Research emphasizes that Exilva is a 100% natural product. “We always mention that this is a bio-based product—a green alternative. Especially if we know that it will replace something with an inferior climate profile, this is an important sales argument” (Team Manager Research). Exilva is a good addition to Borregaards’ already environmental sustainability oriented portfolio. It also has an effect on the recruitment process, as it brings in new talent.

> The Exilva organization—being something new and cool—brings in good people. This will help to elevate the rest [of the company]. They provide new insights and new ideas about how to carry out innovation, how to work with marketing, and how to drive and take advantage of environmental sustainability. (Innovation Manager)

Exilva brings in new talent, creates new business applications and opens up the possibility for new markets for Borregaard. To summarize, it is important for Borregaard to be perceived as a reliable company, in addition to communicating its ESO strategy. This can also help increase the company’s competitive advantage in the future.

4.3. Cross-Case Analysis

This section consists of two cross-case analyses—one for each of the companies.

4.3.1. Hydro Case 1 and Hydro Case 2

This section provides a cross-case analysis based on the two within-cases from Hydro. First, we present a summary in tabular form. Then we discuss differences and similarities, and highlight what we consider to be the main findings of this comparison.

4.3.1.1. Summary of Within-Cases

Table 4: Summary of Within-Cases for Hydro

	Hydro Case 1	Hydro Case 2
Unit of analysis	Reduxa and Circal	DELAKTIG
Environmental sustainability features	- Low carbon footprints - Based on electricity from renewable sources - Reduxa: Max. 4.0 kg CO_2 per kg of aluminum. - Circal: Max. 2.3 kg CO_2 per kg of aluminum.	- Designed for a long lifetime - Designed for recycling - Recycled Aluminum
Accordance with the company's climate strategy	- Increase recycling activities - Lowering emissions in the company's own production - Helping customers reduce their emissions through more environmentally sustainable products	- Helping reduce customers emissions - Substitute less environmentally friendly materials - Help create a market for more environmentally sustainable products - Increase consumers' knowledge about environmental sustainability and LCA

Challenges	- Communication as a traditional industrial company - Differentiation from the global aluminum industry - Different interpretations of "post-consumer scrap"	- Substitution of more accepted furniture materials, aesthetics important for consumers - Consumers' intention-action gap - Companies' knowing-doing gap
Opportunities to increase the company's competitiveness	- Increased use and awareness of LCAs and EPDs - Building and construction: increased demand for low-carbon materials - Public procurement: environmental requirements are expected to increase - Enhancement of corporate reputation	- Substitution of less environmentally sustainable materials - Increased demand for low-carbon materials as a result of stricter requirements from authorities and consumers - Increased consumer visibility - Increase the presence in customer segments that appeal to the majority of consumers — worldwide - Enhancement of the reputation of aluminum as material - Enhancement of corporate reputation

4.3.1.2. Discussion

Unit of analysis

In Hydro Case 1, we analyzed the two products Reduxa and Circal. Reduxa and Circal are two distinct product families of primary aluminum. Both products are developed and sold by the

Primary Metal business unit. The customers of the products are both Hydro's more downstream business units, and external companies. Reduxa and Circal are new to the market, as the brands were officially launched in August 2019.

In Hydro Case 2, we analyzed DELAKTIG—a furniture collection offered by IKEA. The DELAKTIG collection is developed in collaboration with IKEA and the industrial designer Tom Dixon. Hydro is a key material supplier, as the company delivers customized extruded aluminum profiles to the production. The first products in the DELAKTIG collection were launched to the public in February 2017.

The two cases explore product development in two different business areas in Hydro. While Reduxa and Circal belong to the Primary Metal business unit, DELAKTIG is a product from Extruded Solutions. The way product development is done in each of the units is highly influenced by the nature of the business. Primary Metal rarely launches something that can be described as radically new products, while Extruded Solutions has a small amount of more radical innovations. The products that were analyzed in the different cases therefore illustrate how product development based on NPD can take place both upstream and downstream in Hydro.

Environmental sustainability features

Reduxa and Circal are recognized by their low carbon footprints. Reduxa has a CO_2-footprint of maximum 4.0 kg CO_2 per kg of aluminum. Circal has 2.3 kg CO_2 per kg of aluminum, which is the lowest available carbon footprint in the global aluminum market. The main reason for the footprint being this low is the high amount of recycling content of the product—minimum 75% post-consumer scrap. In addition, the production processes for both of these products are mainly based on electricity from renewable sources.

DELAKTIG is designed with the goal of having a long lifetime, while at the same time being easy to disassemble and recycle at the end of life. LCA has been an important factor when

developing this product. This product line contains significant amounts of recycled aluminum, which helps reduce the carbon footprint from production.

Both these product groups are designed based on environmental sustainability principles, where the aim is to reduce the total footprint of the products. LCAs have been actively utilized in the development and production processes of the aluminum in these products.

Accordance with the company's climate strategy

Reduxa and Circal has been an important contribution to Hydro's recycling development and activities. The product also has a significant position as environmentally sustainable, and helps lower Hydro's emissions from its production processes. These products are also developed to help customers reduce their own emissions through creating more environmentally sustainable products with the use of Reduxa and Circal.

DELAKTIG gives a special opportunity for Hydro to position themselves as an environmentally sustainable material supplier. This collaboration with IKEA allows Hydro and its products to be closer to the end consumer, and can help the company communicate its climate strategy. It is also consistent with the company's climate strategy in the way that it substitutes less environmentally sustainable materials for use in furniture. This particular product can help Hydro create a market, and increase the demand for aluminum in the furniture industry, and to increase customer's knowledge of what is environmentally sustainable in a life cycle perspective.

Both of these product groups help communicate to stakeholders the importance of environmental sustainability, and the effectiveness of recycled material in products and the importance of recycling materials after the end of life. Communicating the positive aspects of these products clearly, will help Hydro communicate its climate strategy to stakeholders and customers.

Challenges

The main challenge for Reduxa and Circal, is to communicate the significantly better climate footprint. Most consumers lack enough competence about production processes and recyclability, specifically related to post-consumer scrap. Post-consumer scrap means different things to different companies, which has proved to be a challenge for Hydro. In addition, it is difficult for Hydro to differentiate its products from the global average aluminum.

Aluminum is not the most accepted material to use in furniture as of today. DELAKTIG and its use of aluminum is new for the furniture industry. It has been a challenge to substitute other, more accepted materials, much because of aesthetic reasons that are important to consumers. This relates back to the consumer's intention-action gap (see chapter 2), which often leads to consumers ending up buying lesser environmentally sustainable alternatives.

The similarities for the two product groups, revolves around outward communication and the attractiveness for customers. If Hydro is not able to communicate the benefits of its products so that the pros way stronger than the cons, the customers will not procure its products, but rather stick with what is traditional.

Opportunities to increase the company's competitiveness

Reduxa and Circal have helped Hydro increase its use of LCAs and EPDs. LCAs and EPDs can help the company increase its competitive advantage in the market, as it makes it easy for customers to understand the environmental impact of its products. These two products are particularly useful in building and construction, where there is an increased demand for low-carbon materials. By positioning itself as a supplier to this market, Hydro can increase its competitiveness and possibly expand in this market. Reduxa and Circal has also had a positive impact on the company's reputation, as they are associated with environmental sustainability.

DELAKTIG helps Hydro to be more visible with the end consumer. This can be beneficial for Hydro as a material supplier, specifically when there is an increased use and awareness of LCAs

and EPDs. Hydro with its environmentally sustainable aluminum has a unique opportunity to position itself as a climate friendly supplier to the building and construction business.

Both of these product groups have a significant focus on environmental sustainability, and the use of LCAs and EPDs. If Hydro manages to communicate and utilize this in its marketing strategy, it can give the company competitive advantage in the aluminum industry. Differentiating itself from the global average aluminum industry will be beneficial for Hydro, and can increase its market position. The main difference for these two product groups is that one is more upstream than the other. This requires Hydro to take two different approaches when it comes to communicating the benefits of these particular products.

4.3.2. Borregaard Case 1 and Borregaard Case 2

This section provides a cross-case analysis based on the two within-cases from Borregaard. First, we present a summary in tabular form. Then we discuss differences and similarities, and highlight what we consider to be the main findings of this comparison.

4.3.2.1. Summary of Within-Cases

Table 5: Summary of Within-Cases for Borregaard

	Borregaard Case 1	**Borregaard Case 2**
Unit of analysis	EuroVanillin Supreme	Exilva
Environmental sustainability features	- Originates from wood from sustainable forestries - Biobased alternative to oil-based vanillin - Low CO_2-footprint	- Originates from wood from Norwegian spruce (sustainable forestries) - 100% natural product

Accordance with the company's climate strategy	- Result of a side stream from another process, and its own side streams are utilized into other processes - Continuous improvement on the production processes to reduce climate footprint	- Sustainably sourced - Can be utilized as an alternative for other, lesser environmentally sustainable products
Challenges	- Availability of the product. - The process is both energy consuming and complicated and it is difficult to extract the vanillin - Communication outwards to stakeholders	- Innovation in multiple markets - Completely new market - Technology Readiness Level - Energy demanding processes
Opportunities to increase the company's competitiveness	- A more environmentally sustainable alternative to competing products - Will help increase customers' products footprint - Growing market for bio-based Vanillin - New application areas - Green alternative to black carbon - ESO-market is increasing	- First in the market - Environmentally sustainable product that can potentially substitute other, less environmentally sustainable solutions - Helping customers reduce their emissions - New business areas - Strengthen Borregaard's reputation

4.3.2.2. Discussion

Unit of analysis

The unit of analysis for this case-comparison is on product level, specifically EuroVanillin Supreme and Exilva.

In Borregaard case 1, we analyzed EuroVanillin Supreme. This product is one of Borregaard's core product types, and has been produced since 1962. The product belongs to the product group BioVanillin, and its main customers are actors in the food industry, e.g. multinational food producers and flavor and fragrance houses. As this product has been a part of Borregaard's portfolio for a significant amount of time, it has been through several incremental improvements, especially regarding the production process.

In Borregaard case 2, we analyzed the product Exilva, which belongs to the product group Cellulose Fibrils. The product is a radical innovation, and a new addition to Borregaard's portfolio. The innovation process has been carried out by interdisciplinary Innovation Management Teams (IMTs), and has been innovative in several dimensions. Through this innovation process it has been particularly important to work with what Borregaard calls *the innovation triangle,* which includes product, process, and market.

EuroVanillin Supreme and Exilva are two different products, which are produced in different business units in Borregaard. EuroVanillin Supreme belongs to the business unit BioSolutions, while Exilva belongs to the business unit BioMaterials. While EuroVanillin Supreme is the result of an exploitative strategy, Exilva is more explorative. Exilva is a radical innovation that has required Borregaard to uncover and develop its own market.

Environmental sustainability features

EuroVanillin Supreme originates from wood harvested from sustainable forestries, and is a biobased alternative to oil-based vanillin. Throughout the production process, there is added energy, but the remaining product still has a low CO_2-footprint. Exilva originates from

Norwegian spruce, and the product is 100% natural. Both products originate from sustainably sourced forestries. They are produced based on environmental sustainability principles, and have significantly lower footprint than competing products. The products originate from different parts of the timber, but the wood they are sourced from has the same origin. Both of the products can be used as substitutes for lesser climate friendly products.

Accordance with the company's climate strategy

EuroVanillin Supreme is the result of a side stream from another process, and its own side streams are utilized into other processes. Circular economy, which this process is built on, is the core of Borregaard's business and climate strategy. Here, the company has exploited its expertise, and created a product that fits well into its portfolio. Continuous improvements are carried out on the production processes to reduce climate footprint. Exilva is sustainably sourced, and can be used as an alternative to other, lesser environmentally sustainable solutions. This is in line with Borregaard's strategy, as it aims to provide environmentally sustainable solutions. The climate strategy for these two products are rather similar, as they are both in line with Borregaard's overall strategy about being an environmentally sustainable company at its core.

Challenges

The first challenge for EuroVanillin Supreme concerns the availability of the product, as it is difficult to extract the vanillin from the log. Second, the production process is very energy demanding. The last challenge is related to outward communication, specifically about the origin of the product—most people are not aware that vanillin originates from either wood or oil. This makes it important to teach customers that they can obtain additional value for their own products if they use EuroVanillin Supreme instead of oil-based vanillin. In addition, most consumers are not aware that Borregaard uses its side-streams from the process into other processes.

For Exilva, one challenge has been innovating in multiple dimensions at the same time. It also requires Borregaard to innovate and create its own market while simultaneously developing the

product. Another challenge is related to the Technology Readiness Level. Borregaard is depending on customers willingness to try out this new product in order for it to succeed.

Clearly, there are different challenges for the two products, but they do have some challenges in common. First, communicating to consumers and other stakeholders that the products are in fact environmentally sustainable, and that customers can create additional value for their own products Second, both processes are energy consuming, which is a general challenge for Borregaard as a company. One of the main differences between the two is that EuroVanillin Supreme already has a significant number of customers, while Exilva is still developing the market.

Opportunities to increase the company's competitiveness

EuroVanillin Supreme is a more environmentally sustainable product than its competing products. Most of its competitors use oil-based raw material, e.g. guaiacol. The product can have a positive effect on Borregaard's reputation, especially regarding ESO. It can also help increase the climate footprint of customer's products, and thus help them reduce their own emissions through more environmentally sustainable products. There is a growing market for bio based vanillin, which creates opportunities for Borregaard to expand its production. Borregaard has already started a process that aims to increase its production capacity of vanillin. The increased demand for bio-solutions also pushes the prices to go up, so that Borregaard can charge more for its bio based vanillin. In addition, there are a few other specifications of vanillin that can be exploited. It has anti-bacterial features which can kill mold and reduce bacterial growth. If Borregaard chooses to explore this aspect of the product, it can lead to opportunities for new applications and new markets for the company.

Exilva is a completely new product with the possibility to set a Benchmark. It is an environmentally sustainable product with potential to substitute other, less environmentally sustainable products or solutions. It can help customers reduce their emissions by substituting other, less environmentally sustainable additives with Exilva. You need very little of the product,

which will help in reducing climate footprint of incumbent products. This new innovation creates opportunities to enter new application areas and new businesses for Borregaard. Exilva is an environmentally sustainable product that fits well into Borregaard's already ESO-portfolio, and can help strengthen Borregaard's ESO-reputation

The most significant similarity of these two products is the opportunity they give Borregaard to increase its ESO-reputation, and help customers reduce their environmental impact. If Borregaard uses this actively in its marketing and communication with stakeholders, this can create additional competitive advantage for the company.

4.4. Cross-Company Analysis

This section presents our cross-company analysis of Hydro and Borregaard. The purpose is to highlight differences and similarities between the two companies, which will further help us to answer our research question. First, a summary of the companies is given in tabular form. Then we discuss the differences and similarities in specific areas of interest.

4.4.1. Summary of Companies

Table 6: Summary of Companies

	Hydro	**Borregaard**
Unit of analysis	Norsk Hydro ASA	Borregaard ASA
Core Business	- Aluminum and energy production - Five business areas 1. Bauxite and Alumina 2. Energy 3. Primary Metal 4. Rolled Products 5. Extruded Solutions	- Processing wood into specialty products. - Three business units: 1. BioSolutions 2. BioMaterials 3. Fine Chemicals

Company strengths	- Covers the entire aluminum value chain - The material properties of aluminum - Access to renewable hydro power - Long experience and extensive knowledge of aluminum production -Production and recycling technology - Large organization with strong financial resources	- Environmentally sustainable raw material - Produces specialty products - Active in several niche markets - Access to renewable hydro power - Long experience with processing wood into specialty products - Stable company over many years
Company weaknesses and challenges	- Energy consumption - Emissions of environmentally harmful gases - High average carbon footprint of the global aluminum industry - Marketing has long been a low priority - Low visibility for consumers - Competition from low-cost countries, e.g. China	- Energy demanding processes - Emissions from production processes - High up in the value chain creates barriers to communicate environmental sustainability to consumers - Competition from low cost, oil-based alternatives - Teaching customers how to benefit and create competitive advantage from using Borregaard products

Environ-mental sustainability orientation (ESO)	- Key element of the current corporate strategy - Continuous focus on reducing emissions and energy consumption through incremental improvements across the value chain - Perception of aluminum as a key contributor to a more sustainable society - ESO reputation - Current climate strategy: *30 by 2030*— reducing the company's gross CO_2 emissions by 30 % throughout the value chain by 2030	- Important part of the company strategy - Focus on utilizing every part of the raw material - Continuous improvements in production processes to reduce climate footprint - Focusing on communicating environmental sustainability to the customers - Borregaard associates itself with environmental sustainability as a company - Climate strategy: reduce emissions by 53% within 2030, and 100% by 2050
New product development (NPD)	- Different NPD practices in the different business units. - Common characteristics: Continuous or incremental improvements rather than radical innovations. Must be a market pull. - NPD in Primary Metal: Limited opportunities for radical new products. Process improvements can result in low-carbon products. Case example 1: Reduxa and Circal. - Extruded Solutions: Variety of opportunities due to varied customer segments. Close collaboration with customers is important. Case example 2: IKEA DELAKTIG.	- Practice for NPD: Mostly market pull, a small amount of ground research or technology push - Innovation Funnel and Stage-gate - Impact of ESO on NPD: 1. More ESO-projects/products in the portfolio 2. When making new products they need to be more environmentally sustainable than the current products - Case example 1: EuroVanillin Supreme - Case example 2: Exilva

4.4.2. Discussion

4.4.2.1. Unit of Analysis

The two companies analyzed have a number of similarities. First of all, they are both public limited companies listed on the Oslo Stock Exchange. Both companies can be categorized as *process industry companies*, which means that they operate large processes with significant energy consumption (Norsk Industri, 2016, p. 11). They both have a global presence with customers all over the world, with the main customer base located outside of Norway. However, their headquarters are located in Norway. When it comes to differences in respect to the companies as units of analysis, the main difference is the size of the companies. Hydro is the largest with 36000 employees, while Borregaard has 1100.

4.4.2.2. Core Business

Hydro is a fully integrated aluminum company, which means that it operates and controls every part of the aluminum value chain. The company is organized into five business units: Bauxite and Alumina, Energy, Primary Metal, Rolled Products, and Extruded Solutions.

Borregaard is one of Norway's largest actors within the wood processing industry, and it operates one of the world's most advanced bio-refineries. The company's business entails producing different specialty products from wood. It is organized into three business units: BioSolutions, BioMaterials, and Fine Chemicals.

Both of the companies are material suppliers, and operate business-to-business (B2B). Neither of them sell to the end consumer. Hydro supplies aluminum which is mainly categorized as a commodity, while Borregaard produces and supplies specialty products and applications. While Hydro is present in the entire value chain, and sells from one business unit to another, in addition to selling to other companies. Borregaard develops, produces and sells to other industrial companies exclusively.

4.4.2.3. Company Strengths

One of Hydro's main strengths is the fact that it covers the entire aluminum value chain—from bauxite mines to complete product solutions. Furthermore, all the interviewees point out that the material properties of aluminum are an important competitive advantage for the company. The material is light, strong, flexible, and recyclable—and therefore fits a variety of applications. As explained by the VP of Strategic Projects, Extruded Solutions, Strategy and Innovation, it is a great advantage to be an aluminum company now that society needs to become more environmentally sustainable. Since materials are necessary to build this society, it will be a competitive advantage to be able to offer the most environmentally sustainable alternatives. The use of LCA in material assessments has indicated that aluminum is a competitive material when the purpose is to minimize the environmental impact.

Another strength of Hydro as a company is the long experience within aluminum production. It has extensive knowledge about the whole production process from cradle to grave, which makes it an attractive supplier and collaboration partner. During the past years the company has developed leading recycling technology, which strengthens the company's competitiveness in the market. Lastly, it is a large organization with significant financial resources—which enables investments in new technology and other development projects to keep the company competitive.

Borregaard's most important strength—according to the interviewees— is the fact that its raw material is environmentally sustainable. The timber it utilizes in its production processes comes from certified and sustainably sourced wood. As consumers and the business community are becoming more concerned about the climate, this strength has become increasingly important for Borregaard. Second, the company produces specialty products to several different niche markets. Being in multiple markets is a risk reducing strategy, as all markets will have its ups and downs. When one marked is down, another might go up. Additionally, the markets where Borregaard operates have high barriers to enter, which gives the company a competitive advantage.

Borregaard has been a stable company over many years, and has developed significant know-how about the wood processing industry, and how to produce specialty products. According to the Innovation Manager, this has enabled the company to utilize 100% of the timber in its processes. What is not possible to use in other products is used as energy into other processes. By utilizing 100% of the timber, Borregaard reduces waste while simultaneously increasing the value creation of its processes.

We have got the impression that the most important strengths for both Borregaard and Hydro are related to the level of knowledge in the companies, and the fact that they offer more environmentally sustainable materials than their competitors. They are both companies with a long experience and significant technical know-how. We believe this gives them a significant potential to exploit NPD processes to increase both their ESO reputation and their competitiveness. Additionally, both companies have access to renewable hydropower, which is a significant strength in the industry they are operating in. Based on interviewees statements and our own research, we believe this will continue to give the companies competitive advantages in the future, as environmental sustainability will continue to be important in the industry and in the world.

4.4.2.4. Company Weaknesses and Challenges

One of Hydro's main weaknesses is its energy consuming processes. Its processes also emit environmentally harmful gases, and CO_2 is used in the process of making aluminum. Several of the interviewees point to this as a dilemma. It is difficult to show that the company can contribute to solving the climate challenges and at the same time be responsible for the fact that the company has for a long time—and will for a long time—affect the environment with its emissions. Another weakness for Hydro is the fact that there is a high average carbon footprint in the global aluminum industry. This affects Hydro in a negative way, as most people are not aware of the company's footprint being significantly lower than the global average. What follows from this, is the challenge related to communication. This makes it important for Hydro to communicate to customers and other stakeholders that its products have a significantly lower

footprint, and that Hydro has a strong focus on environmental sustainability throughout its operations. Lastly, the fact that Hydro is a material supplier which is not in direct contact with the end consumers, proposes an additional challenge related to communication and visibility.

Borregaard's main weakness is its energy demanding processes, and the emission that comes from these processes. Another weakness is the fact that Borregaard is placed high up in the value chain, with a significant distance from the end consumer. This makes it a challenge to communicate with the end consumer, specifically about its environmental sustainability strategy. Most of the competitors have similar products that are oil-based. When the consumers are not aware of the fact that Borregaard's products are significantly more environmentally friendly than its competing products, it is difficult for the company to create competitive advantage based on ESO. One way to mitigate this, is to create more visibility around its environmental sustainability strategy, e.g. changing the name of EuroVanillin Supreme to BioVanillin, as mentioned by the Sales Director. We have got the impression that this will help show customers that Borregaard's products are in fact bio-based and environmentally sustainable. Lastly, we believe that this can lead to a competitive advantage when it comes to competing with lesser environmentally sustainable products.

These companies have several weaknesses and challenges in common. This results from them both being process industry companies. The main challenge they both have in common, is the energy demanding processes of their operations, which also leads to a significant amount of emissions. Both companies mention that this is something they have been working on in the past years, to use renewable energy to the extent possible and to decrease emissions from its processes.

4.4.2.5. Environmental Sustainability Orientation (ESO)

Environmental sustainability is a key element of Hydro's current corporate strategy. The company has a continuous focus on reducing emissions and energy consumption through incremental improvements across the value chain. Its goal is to have a reputation that is closely

associated with ESO. In addition, the company aims to recognize and create awareness around the fact that aluminum as a material can contribute to a more sustainable society. Hydro's current climate strategy has a goal to reduce the company's gross CO_2-emissions by 30% throughout the entire value chain within the year 2030. To obtain this, the company will focus on greener sourcing and production, and helping customers reduce their own emissions through producing greener products.

Environmental sustainability and circular economy has always been an important part of Borregaard's business strategy. Its raw material is sustainably sourced wood, and the company aims to utilize every part of the raw material for either products or energy. The company continuously improves its processes to reduce emissions of harmful gases and reduce the overall climate footprint of its products and processes. What has been increasingly important the past years, has been communicating its ESO to customers and other stakeholders. The company identifies itself as a sustainable company, with special focus on the environmental aspect of sustainability. Borregaard's current climate strategy is to reduce emissions by 53% within 2030, and 100% within 2050.

Both companies have environmental sustainability orientation as a core element of their business strategy. They position themselves as an environmentally sustainable option to other, lesser environmentally sustainable companies. Both companies have committed themself to climate strategies for the next 10 years and beyond, and we believe that they will do whatever they can to reach these goals, as stakeholders will hold them to it. By reaching these goals, they communicate to stakeholders that they are reliable and solid companies that take action to mitigate climate challenges.

4.4.2.6. New Product Development (NPD)

Hydro has different NPD practices in the different business units. Some common characteristics are: continuous improvements rather than radical innovations, and market pull as a drive for

innovation. NPD in Primary Metal is mainly incremental improvements on existing processes, with the aim to improve the carbon footprint of its aluminum. The CTO explains that improvements of products and processes has always been a priority in the company. Extruded Solutions is a more downstream BU, which enables them to carry out NPD processes together with its customers. This BU often collaborates with customers to create new products, which we believe is a significant strength that Hydro can benefit from in the future. The Director of Corporate Business Development also claims that this proximity to the end consumer is a benefit for Hydro to build competitive advantage through NPD based on environmental sustainability.

Borregaard's NPD practices are mainly based on market pull, but it also has a small amount of ground research or technology push. It always follows the innovation funnel-method, and a Stage-gate process. ESO has affected Borregaard's NPD practices the past years, which is shown in the increasing amount of ESO-products and projects in its innovation portfolio. When creating new products, it is important that they are more environmentally sustainable than the current solutions. One example is from the first case, EuroVanillin Supreme. Here, Borregaard took a side stream from one process and made it into a new product. The side stream from the resulting new process is then used into another process. This is a good example of how the company utilizes every part of the raw material, either as a product or as energy for new processes. The second example is from the second case, and is the new radical innovation Exilva. This was top managed by the management team, and innovation management teams were involved in every step of the innovation process. There was a strong focus on the golden triangle, which consists of collaboration between the three dimensions: product, process, and market. NPD in Borregaard can be both incremental improvements and more radical innovations. We believe that with Exilva, Borregaard has created a great opportunity to expand its business and potentially enter new markets.

Both companies have a significant amount of incremental innovation in their new product development. This is related to the industry that they belong to. Borregaard, however, has a strong focus on radical innovations, in that 20% of its revenue should come from new products.

Compared to Hydro, it has a significantly sized R&D-department, where there is constantly done research on both existing processes and new possible applications and products. Both companies use NPD actively when communicating with customers, and what they can do to help customers succeed in their own industry and market. We believe that communicating to stakeholders that they in fact use NPD based on environmental sustainability principles will strengthen the corporate reputation, and in turn increase their position in their respective markets.

4.4.3. Key findings

Based on the literature review and the empirical analysis, we have arrived at four key findings that we believe can help answer our research question. The findings are listed below.

Key finding 1: Environmental sustainability aspects are becoming increasingly important for consumers' purchasing decisions. The companies experience that NPD can be used to demonstrate to consumers that they take responsibility for the climate. Even if the companies do not sell directly to consumers, this is perceived as a competitive advantage because it affects the demand from their direct customers. Both the empirical data and the theory indicate that the willingness to pay a little more for products that are more environmentally friendly is increasing.

Key finding 2: Increased use of LCAs and EPDs can make it more profitable to invest in and develop products with low carbon footprints. The companies experience that documenting their products' footprints in a standardized way has made them a more attractive material supplier. In particular, they are experiencing increased demand from customers who must satisfy environmental requirements for the end product—e.g. building and construction. Hence, investing in process improvements can provide both competitive advantages and improved environmental performance.

Key finding 3: NPD can be an effective way to spread knowledge about environmental sustainability. The companies consider it challenging that both consumers and customers lack knowledge of what an environmentally sustainable industrial product is. Developing products

based on environmental sustainability principles, and communicating these well, can increase the understanding of this—and thus help develop the market for more environmentally sustainable products. This can make it more profitable to invest in environmental improvements.

Key finding 4: NPD based on sustainability can strengthen the corporate reputation. The companies consider it important to have a reputation associated with environmental sustainability. Having a good reputation makes the company attractive to both customers, consumers, collaboration partners and employees. Products with environmental benefits can serve as tangible proof that the company takes responsibility for the environment.

5. Implications for Theory and Practice

5.1. Implications for Theory

In the literature review (chapter 2) we investigated the relationship between environmental sustainability orientation (ESO), consumers' jobs-to-be-done (JTBD) and companies' new product development (NPD). We found that these topics were well covered in the literature separately, but that little was written about the relationship between them. We hope that our results can help fill this research gap. In addition, we argue that it is important to conduct studies on topics related to environmental sustainability. Although much has been written in this field in recent years, it is important to continue exploring environmental sustainability in new contexts because climate change is an important societal challenge. We hope our study is a valuable contribution in this field.

Through our case studies, we have provided empirical data from two Norwegian industrial companies. We hope that the thesis, in this way, can contribute to the literature by helping substantiate theories. We also encourage research communities to continue to explore the theme of environmental sustainability in a strategy and innovation perspective. To complement the weaknesses in our thesis, we recommend that similar studies be conducted at several companies—and preferably in other industries and with other nationalities. As our study aims to highlight and discuss opportunities, we encourage future research to further concretize different strategies and quantify the potential results.

5.2. Implications for Practice

The firms that were used as case companies in this thesis both belong to the Norwegian process industry. The fact that both companies are Norwegian and from the process industry, leads to certain limitations in who can benefit from the results. Therefore, it will primarily be practitioners within similar companies who can directly benefit from the findings in the study.

However, we believe and hope that the overall findings in the thesis can also provide insight to companies from other industries—and provide an increased understanding of how NPD can be can be an effective way to increase both competitiveness and environmental performance.

Our first key finding is that environmental sustainability aspects are becoming increasingly important for consumers' purchasing decisions. Although many industrial companies do not sell directly to consumers, it can be beneficial to adapt to this trend because consumer preferences often propagate upwards in the value chain. We believe that all companies that have the opportunity to make their own products more environmentally sustainable will benefit from this—at least in a long-term perspective. Reviewing the company's existing products and considering where environmental improvement measures can be put in place is a good place to start.

Our second key finding is that LCAs and EPDs for measuring and documenting the environmental performance of products makes it more profitable to develop low-carbon products. Our recommendations to practitioners are therefore to ensure that the company possesses knowledge of and is able to use these tools. We encourage companies to perform LCAs of their products, and use the results actively together with sales and marketing. By presenting the LCA results, the company can promote itself as an environmentally sustainable producer without risking greenwashing.

Our third key finding is that NPD can be an effective way to spread knowledge about environmental sustainability, and help develop the market for more environmentally sustainable products. This presupposes that the company ensures that the buyer acquires knowledge in connection with the purchase of the product. Therefore, we believe it is important to be aware of how the product is handed over to the customer, and make adjustments that facilitate that the knowledge you want to convey emerges in a customer-friendly way. These can be adaptations in packaging, operating instructions, information papers, and other communication.

Our fourth key finding is that NPD based on sustainability can strengthen the corporate reputation. To take advantage of this opportunity, the company must be aware of how its products are perceived by the outside world. We therefore recommend preparing a conscious communication strategy for how the company's products are to be brought to market. For example, it can be advantageous to use trademarks and visual forms of communication.

6. Limitations

This chapter sheds light on the limitations of our master's thesis. As section 3.2.4 highlighted some of the limitations associated with the quality of study, this section will address other limitations for our study.

First, there are certain limitations that stem from the embedded case design. This type of case design gives us detailed information into our research with focus on the chosen units of analysis, namely the products—Reduxa and Circal, DELAKTIG, EuroVanillin Supreme, and Exilva—and the companies—Hydro and Borregaard. However, it can limit the holistic overview of the two case companies and other aspects of their business.

Second, there are limitations related to the cross-case analysis and cross-company analysis. The two companies are different in that Hydro produces mainly commodities, while Borregaard has specialty products and operates in niche markets. The two companies are also organized in different ways, so the roles of the informants and the products are not directly comparable. In addition, we only studied two companies. As our RQ addresses Norwegian industry in general, it would be fruitful to study companies from other parts of the industry also.

Third, there are some limitations linked to the structuring of our interviews. Our interview guide was semi-structured, with open-ended questions. This may have led to different wording for some of the questions, and some topics may have been more focused on than others for some interviews.

Lastly, our study is limited to the short time frame for our master’s thesis. Ideally, more time should have been allocated to data gathering. This could have enabled us to do follow-up interviews to capture deeper insight into the themes and topics of our thesis.

7. Conclusion

In this thesis we have explored how Norwegian industrial companies can improve their environmental performance and simultaneously increase their competitiveness based on new product development (NPD). The underlying theoretical review sought to find answers to how consumers' and companies' environmental sustainability orientation (ESO) influences their behavior in terms of jobs-to-be-done (JTBD) and new product development (NPD). To our knowledge, these relationships had not received much attention by previous studies. Even less research had been done to explore the topic in the context of Norwegian industrial companies. We hope our study will contribute to the literature through empirical data on NPD based on environmental sustainability. Moreover, we hope our findings can provide inspiration and practical advice for any company seeking to improve its environmental impact through NPD.

Our study indicates that increased use of life cycle assessments (LCAs) and environmental product declarations (EPDs) can increase the profitability of investing in and developing products with low carbon footprint. Through our case study we have explored how LCA and EPD can help Borregaard and Hydro to become more visible and to increase their position as environmentally sustainable producers. Standardized documentation—LCAs and EPDs—has increased their attractiveness to environmental sustainability oriental customers.

New product development can be an effective way to spread knowledge and to communicate environmental sustainability orientation to stakeholders. As we learned through the theoretical review, an increasing number of consumers care about environmental factors. The two industrial companies we examined cooperate with customers to a large extent when developing new products. Utilizing new product development to communicate environmental factors of new products and applications, can increase both visualization and understanding for customers and other stakeholders.

We also found that new product development based on environmental sustainability can help strengthen the corporate reputation of companies. This can in turn lead to increased competitive advantage, and help the companies position themselves as an environmentally sustainable option.

In terms of answering our RQ: *"How can Norwegian industrial companies leverage new product development to improve their environmental sustainability performance and simultaneously increase their competitiveness?"*, we argue that there are several ways to leverage new product development. By the use of LCA and EPD, companies can set a clear focus on the environmental sustainability performance of their products. Additionally, both of the companies examined have experienced an increased demand for environmentally sustainable products, often measured by CO_2 footprint. Creating trademarks that clearly communicates the CO_2 footprint of products, can help increase the competitiveness of these companies.

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Appendices

Appendix A: Interview Guide for Hydro

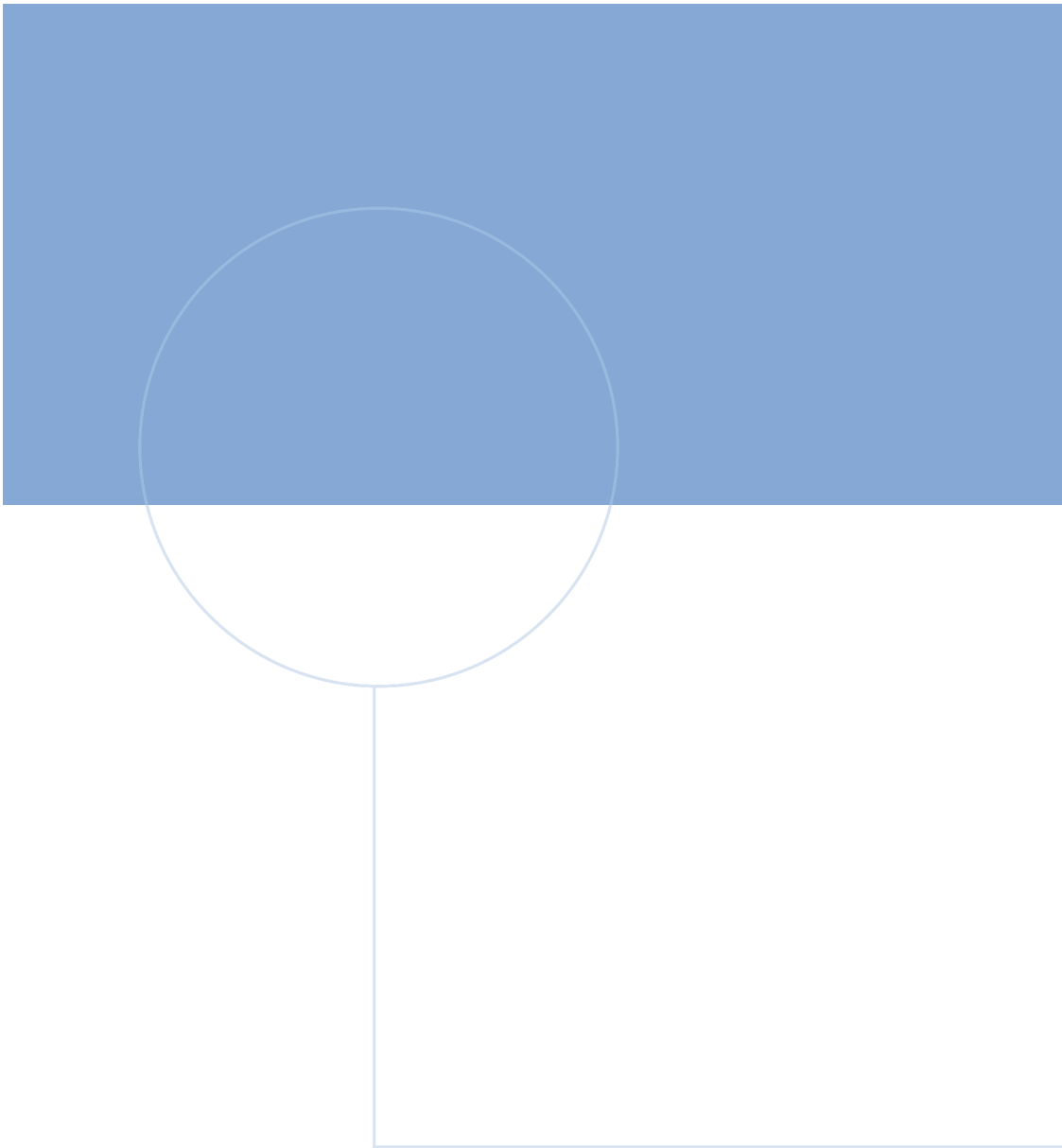
Nr:	Temakategori:	Spørsmål:
1	Introduksjon *Først har vi noen introduksjonsspørsmål for å få med litt om hvem du er og hva som er din stilling/rolle i selskapet.*	➔ Kan du fortelle oss litt om din rolle i Hydro? ◆ Hvor lenge har du vært ansatt i Hydro? ◆ Hva er dine overordnede arbeidsoppgaver?
2	Bærekraftsutfordringer (miljømessige) for Hydro *Nå går vi over til temaet bærekraft, og ønsker å snakke litt om utfordringene Hydro opplever tilknyttet bærekraft.*	➔ Hvilke bærekraftsutfordringer mener du har vært de mest sentrale for Hydro som bedrift det siste tiåret? ◆ Hvilke utfordringer kommer fra nye og strengere reguleringer? ◆ Hvilke utfordringer kommer i form av krav fra kunder? ◆ Hvilke utfordringer kommer i form av krav fra andre forretningsrelasjoner? (partnere, eiere osv.)
3	Bærekraftstiltak (for å håndtere utfordringene) *Så ønsker vi å snakke om tiltakene Hydro gjør for å håndtere slike utfordringer.*	➔ Hvilke bærekraftstiltak har Hydro gjort for å håndtere disse utfordringene du nevner? ◆ Kan du nevne konkrete eksempler på endringer i Hydros kultur? ◆ Kan du nevne konkrete eksempler på endringer i praksis (altså konkrete aktiviteter)? ◆ Hvilke tiltak har blitt gjort for å imøtekomme eksterne krav? ◆ Hvilke tiltak har Hydro selv initiert for å forbedre selskapets miljøavtrykk? ➔ Hvor viktig er det for Hydro å ha et bærekraftig omdømme?
4	Produktutvikling i Hydro *Nå ønsker vi å spisse oss inn på produktutvikling og produktinnovasjon.*	➔ Kan du fortelle litt om hvordan utvikling av nye produkter foregår i Hydro i dag? ➔ Hvordan har produktutviklingspraksisen i Hydro blitt påvirket av økt fokus på klima og bærekraft? ➔ På hvilken måte har det vært utfordrende å balansere økonomiske krav med bærekraftskrav?

5	<u>Grønn produktinnovasjon</u> *Slik vi har forstått har Hydro jobbet med å utvikle mer bærekraftige produkter, ofte kalt "grønnere produkter". Dette er noe vi har valgt å fokusere på i masteroppgaven, og derfor ønsker vi å snakke mer detaljert om det nå.*	➔ I hvilken grad mener du lansering av "mer bærekraftige", ofte kalt "grønne" produkter, kan bidra til å løse dilemmaet mellom økonomi og bærekraftsinvesteringer? ➔ Kan du nevne eksempler på slike "grønne produkter" Hydro har utviklet det siste tiåret? ◆ Kan du si litt om den strategiske bakgrunnen? ➔ Hvordan er kundens respons på slike produkter? ◆ Direkte kunde? ◆ Sluttkunde (konsument)?
6	<u>Case 1: Reduxa og Circal</u> *Et av casene vi skal analysere skal handle om Reduxa og Circal. Derfor ønsker vi å lære mer om disse produktene, sett i lys av din rolle.*	➔ Kan du fortelle det viktigste man bør vite om Hydro Reduxa og Circal? ➔ Kan du fortelle mer om utviklingsprosessen fra idé til lansering på markedet? ➔ Hva er den strategiske bakgrunnen for denne produktsatsingen? ➔ Hvordan har etterspørselen etter disse produktene vært? ➔ Har dere merket resultater eller effekter etter lanseringen?
7	<u>Case 2: Ideer til vår 2. case</u> *Case nummer 2 skal også brukes til å illustrere hvordan ny produktutvikling basert på bærekraft kan gi konkurransefordeler. Derfor ønsker vi å høre om du har noen tanker rundt hva som kan være et passende case.*	➔ Kan du nevne andre konkrete caseeksempler der Hydro bevisst har gått inn for å utvikle produkter for å forbedre selskapets miljøpåvirkning? ◆ Gjerne noe som gjenspeiler en annen type strategi enn Reduxa og Circal. ◆ Gjerne noe som er nærmere forbruker.
8	<u>Avslutning/oppsummerende</u> *Da er tiden vår snart over, så vi ønsker vi til slutt å stille noen avsluttende spørsmål.*	➔ Er det noe du har kommet på underveis som du mener kan være relevant for studien vår? ➔ Har du forslag til flere Hydro-ansatte vi evt. kan kontakte, som sitter på kunnskap som er relevant for casestudiene våre?

Appendix B: Interview Guide for Borregaard

Nr:	Temakategori:	Spørsmål:
1	Introduksjon *Først har vi noen introduksjonsspørsmål for å få med litt om hvem du er og hva som er din rolle i selskapet.*	➔ Kan du fortelle litt om din rolle i Borregaard? ◆ Hvor lenge har du vært ansatt i Borregaard? ◆ Hva er dine overordnede arbeidsoppgaver?
2	Bærekraftsutfordringer (miljømessige) for Borregaard *Nå går vi over til temaet bærekraft, og ønsker å snakke litt om utfordringene Borregaard opplever tilknyttet bærekraft.*	➔ Hvilke bærekraftsutfordringer mener du har vært de mest sentrale for Borregaard som bedrift de siste ti årene? ◆ Hvilke utfordringer kommer fra nye og strengere reguleringer? ◆ Hvilke utfordringer kommer i form av krav fra kunder? ◆ Hvilke utfordringer kommer i form av krav fra andre forretningsrelasjoner? (partnere, eiere osv.)
3	Bærekraftstiltak (for å håndtere utfordringene) *Nå ønsker vi å snakke om tiltakene Borregaard gjør for å håndtere disse utfordringene.*	➔ Hvilke bærekraftstiltak har Borregaard gjort for å håndtere disse utfordringene du nevner? ◆ Kan du nevne konkrete eksempler på endringer i Borregaards kultur? ◆ Kan du nevne konkrete eksempler på endringer i praksis (altså konkrete aktiviteter)? ◆ Hvilke tiltak har blitt gjort for å imøtekomme eksterne krav? ◆ Hvilke tiltak har Borregaard selv initiert for å forbedre selskapets miljøavtrykk? ➔ Hvor viktig er det for Borregaard å ha et bærekraftig omdømme?
4	Produktutvikling i Borregaard *Nå ønsker vi å spisse oss inn på produktutvikling og produktinnovasjon.*	➔ Kan du fortelle litt om hvordan utvikling av nye produkter foregår i Borregaard i dag? ➔ Hvordan har produktutviklingspraksisen i Borregaard blitt påvirket av økt fokus på klima og bærekraft? ➔ På hvilken måte har det vært utfordrende å balansere økonomiske krav med bærekraftskrav? ➔ I hvilken grad mener du lansering av "mer bærekraftige", ofte kalt "grønne" produkter, kan bidra til å løse dilemmaet mellom økonomi og bærekraftsinvesteringer? ➔ Kan du nevne eksempler på slike "grønne produkter"

		Borregaard har utviklet det siste tiåret? ◆ Kan du si litt om den strategiske bakgrunnen? ➔ Hvordan er kundens respons på slike produkter? ◆ Direkte kunde? ◆ Sluttkunde (konsument)?
5	<u>Case 1: Exilva</u> *Et av casene vi skal analysere skal handle om Exilva. Derfor ønsker vi å lære mer om dette produktet, sett i lys av din rolle.*	➔ Kan du fortelle det viktigste man bør vite om Exilva? ➔ Kan du fortelle mer om utviklingsprosessen fra idé til lansering på markedet? ◆ Var dette en naturlig retning for Borregaard? ➔ Hva er den strategiske bakgrunnen for denne produktsatsingen? ➔ Hvordan har responsen fra markedet vært?
6	<u>Case 2: EuroVanillin Supreme</u> *Case to vil handle om EuroVanillin Supreme. Derfor ønsker vi å lære mer om dette produktet, sett i lys av din rolle.*	➔ Kan du fortelle det viktigste man bør vite om EuroVanillin Supreme? ➔ Kan du fortelle mer om utviklingsprosessen fra idé til lansering på makedet? ◆ Var dette en naturlig retning for Borregaard? ➔ Hva er den strategiske bakgrunnen for denne produktsatsingen? ➔ Hvordan har responsen fra markedet vært? ➔ Med tanke på at forbrukerne blir mer og mer bærekraftsbevisste - ser du noen muligheter der fremover eller er det noe på gang? ➔ Har dere fokus på å kommunisere tydelig til kunder at deres Vanillin er mer bærekraftig enn konkurrentenes? Er dette noe dere aktivt jobber med?
7	<u>Avslutning/oppsummerende</u> *Da er tiden vår snart over, så vi ønsker vi til slutt å stille noen avsluttende spørsmål.*	➔ Er det noe du har kommet på underveis som du mener kan være relevant for studien vår? ➔ Har du forslag til flere Borregaard-ansatte vi evt. kan kontakte, som sitter på kunnskap som er relevant for casestudiene våre?



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