LAMK Lahden ammattikorkeakoulu
Lahti University of Applied Sciences

Circular Economy Business Models

Case: UPM Plywood

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SALMELA, MIISA: Circular Economy Business Models
Case: UPM Plywood

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ABSTRACT

In today's climate, businesses are increasingly recognizing the tension between industrial growth and the pressure placed on economic, ecological and social systems. As the result of economic growth, extra input of natural resources is needed. Each year humanity uses resources and ecosystem services to the point that we are crossing the so called planetary boundaries. In order not to exceed them, we need to significantly consider the way we manage our resources. Accepting that there cannot be limitless exploitation of the earth's resources, makes a call for a new economic model relevant. Circular economy is a necessity on a planet with finite resources. It aims to reduce the input of raw materials and output of waste to the environment by closing economic and ecological loops of resources.

The study was commissioned by UPM Plywood, the case company, and is part of their ongoing development work. The objective was to study how the case company could implement the circular business models in its actions. Additionally, the purpose was to explore the key factors that help the implementation of circular economy in a business. Finally, the research provides a practical tool set for circular economy practises.

The theoretical section employs a literature review to identify the circular economy characteristics and business models. The data is gathered mainly from academic literature and online sources. The empirical part consists of eleven semi-structured interviews and a case study of UPM Plywood. The interviews provided understanding on how a company can move towards circular economy and the data was used to support the case study. The case study explored the Accenture's five circular business models from a plywood industry's perspective.

The research outcomes confirmed that the better utilization of wood by recycling, utilizing the industrial side streams and cascading is needed to close the material loops. Legislation plays a key role in guiding the path towards circular economy in a plywood industry. Reverse logistics are needed to capture the value of end-of-life plywood and facilitate the reuse and recycle.

Key words: circular economy, sustainability, resource efficiency, business models, plywood

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TIIVISTELMÄ

Tänä päivänä yritykset yhä enenevissä määrin tunnistavat teollisen kasvun asettaman jännitteen sekä taloudelliseen, ekologiseen että sosiaaliseen systeemiin asetetun paineen. Talouskasvun seurauksena tarvitsemme ylimääräisen panoksen luonnonvaroja. Ihmiskunta käyttää vuosittain resursseja ja ekosysteemipalveluita, minkä johdosta olemme ylittämässä niin sanotut planeettamme kantokyvyn rajat. Jotta näin ei kävisi, meidän on harkittava, kuinka hallita resurssejamme. Sen hyväksyminen, että maapallon resursseja ei voi hyödyntää loputtomiin, luo tarpeen uudelle talouden mallille. Kiertotalous on välttämättömyys planeetalla, jolla resurssit ovat rajallisia. Tavoitteena on vähentää raaka-aineiden ja jätteen määrää sulkemalla raaka-aineiden taloudelliset ja ekologiset kierrot.

Tutkimus oli case-yritys UPM Plywoodin antama toimeksianto, joka toimii osana heidän tekemäänsä kehitystyötä. Tarkoituksena oli selvittää kuinka case-yritys voi toteuttaa kiertotalouden liiketoimintamalleja toiminnassaan. Lisäksi tavoitteena oli tutkia keskeisiä tekijöitä, jotka auttavat yritystä siirtymään kiertotalouden suuntaan. Lopuksi tutkimus tarjoaa käytännöllisen työkalun kiertotaloudesta.

Teoreettinen osio tarjoaa kirjallisuuskatsauksen, jonka tarkoituksena on tunnistaa kiertotalouden ominaispiirteet ja liiketoimintamallit. Tietoperusta kerättiin pääosin akateemisesta kirjallisuudesta ja verkkolähteistä. Empiirinen osio sisältää yksitoista teemahaastattelua ja case-tutkimuksen UPM Plywoodista. Haastattelut loivat ymmärrystä, miten yritys voi siirtyä kohti kiertotaloutta ja tieto hyödynnettiin tapaustutkimuksessa. Case-tutkimus perehtyi Accenturen esittämiin viiteen kiertotalouden liiketoimintamalliin vaneriteollisuuden näkökulmasta.

Tutkimus osoittaa, että vanerin parempi hyödyntäminen kierrättämällä, hyödyntämällä teollisuuden sivuvirrat ja kaskadi käytöllä on tarpeen, jotta voidaan sulkea materiaalikierrot. Lainsäädännöllä on keskeinen rooli vaneriteollisuuden siirtyessä kiertotalouden suuntaan. Myös käänteinen logistiikka on tarpeen, jotta yritys saa taltioitua vanerin arvon sen elinkaaren lopulla ja saa järjestettyä sen uudelleenkäytön ja kierrätyksen.

Avainsanat: kiertotalous, kestävyys, resurssitehokkuus, liiketoimintamallit, vaneri

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1 INTRODUCTION

The first chapter, introduction, outlines the background of the thesis, reasons, objectives and examines the four research questions.

1.1 Background

Business as usual is heading for trouble. It is a well-known fact that earth's resources are limited. In order to regenerate the natural resources currently used, 1.5 planet earths would be needed due to the increase of the world's ecological footprint. The ecological footprint is the total hectare area which is needed to supply the ecological goods and services that humans use. (McDonald 2015.)

Both governments and businesses are beginning to realize that our linear systems of resource use expose both societies and businesses to a number of serious risks. For instance, precious metals are for all intents and purposes very limited due to the mining in the past 250 years. Others, like water, air and forests, are technically renewable but are increasingly stressed. Resource constraints, strong population growth, as well as increasing volumes of waste and pollution are likely to impose increasing threats to welfare and also from a business point of view, to competitiveness, profits and business continuity. Since the industrial revolution, the use of the finite resources has only gone up. (Lacy & Rutqvist 2015, 227-228.)

The concept of circular economy is several decades old. It has recently been present in political and business agendas. In contrast to today's linear" take-make-use-dispose" economy, a circular economy aims to decouple the economic growth from the scarce resources by using natural resources more effectively. The more effective use of materials not only enables businesses to save the environment but also creates more value, both by cost savings and by developing new markets or growing existing ones. (Potocnik 2013, 6.) Also businesses have started to realize that circular economy is no longer a matter of reputation and trust, but of a long-term

competitive advantage, security and survival (Elkington, Lim & Smith 2016, 3).

Selection of the topic

This bachelor's thesis is an assignment from UPM Plywood. Resource efficiency is a huge part of UPM's Biofore strategy. The company has realized the importance of circular economy and thus wants its businesses to comply to the principles of a more sustainable economy.

In a plywood industry, the share of production's side streams is around two thirds of the timber arriving to the mill. Currently around half of the industry's side streams are utilized in the production of pulp and paper making and the rest ends up to energy generation. As per circular economy thinking, there must be more sustainable uses for the portion which is now incinerated. For this concern, UPM Plywood seek to find solutions by organizing UPM Sidestream Boot Camp for students. The students' task is to find new business opportunities for the plywood industry's side streams.

However, moving towards circular economy not only includes the production side streams. UPM Plywood needs new solutions on how they can undertake activities to promote circular economy and also increase the awareness of the concept among the work community. As the side streams are already studied by the students, this thesis focuses also on the other possibilities moving towards circular economy.

The scope of research is motivational due to the novelty of the concept of circular economy as well as the limited number of research that has been, so far, of circular business models.

1.2 Research questions and methodology

The objective of the thesis is to describe the concept of circular economy and to understand the main characteristics and purposes. The thesis acts as an incentive for UPM Plywood in their change in the direction of circular economy.

Based on an analysis of literature and expert interviews, the study introduces the Accenture's (2014, 12) five circular business models from a plywood industry's perspective. The purpose of the research is to provide answers to the following research question:

- How can UPM Plywood implement different circular business models?

For a better understanding, the main question is complemented with the following sub-questions:

1. What is the concept of circular economy?
2. What is a circular business model?
3. What does it take for a company to implement a functional circular business model?

The first sub-question seeks to provide a comprehensive understanding of circular economy: which principles it follows, how the value is created and how it is seen in Finland and Europe. The second sub-question identifies the principles of a circular business model. Accenture's (2014, 12) five circular business models have been used in order to study if these models fit for plywood industry. The third sub-question seeks to give an understanding what it takes for a company to move towards circular economy. What are the challenges companies face and also the current enablers?

As the research is predominantly explanatory in its nature and requires understanding of the circular economy, its surrounding environment and business models, a qualitative strategy was chosen to answer the research questions. Qualitative data collection and analysis allows for the researcher to define concepts, categorize different types of behaviors and motivations, map the nature, dynamics and range of a certain phenomenon and develop new ideas or theories. (Ritchie & Spencer 1994, 312.)

Different methods were used to provide answers to the research questions presented above. The theoretical part (chapter 2 and 3) has been gathered

from versatile sources: oral, written and electronic sources. The empirical study consists of qualitative research methods, such as semi-structured interviews and case study. Using qualitative interviews as a way of gathering data is worthwhile when the researcher aims to understand a subject's perceptions, and how they attribute meaning or value to certain things (Qualitative Methods 2006).

Case study is an in-depth study method used in a specific or individual context (Qualitative Methods 2006). The case study research can be used for testing whether scientific theories and models actually work in the real world. This method will provide answer to the main research question: "How can UPM Plywood implement different circular business models?"

Semi-structured interviews can be regarded as a middle ground between in-depth interviews and structured interviews. Semi-structured interviewing can provide profound and comprehensive information about the subject from different viewpoints. By conducting semi-structured interviews, the aim is to make the interview situation resemble an ordinary conversation between two persons but there are a number of predetermined topics which need to be considered. (Qualitative Methods 2006.) The framework of the interview was purposely designed to be open-ended. That gives room for follow-up questions.

In total the researcher conducted eleven semi-structured interviews with people from different organizations such as businesses dealing with circular economy, expert organizations and a member of European Parliament. Interviewees were selected together with the case company. The information provided by the interviewees was of high value to the research and the diversity of their experiences and backgrounds was essential for answering the research questions. Furthermore, this allowed to see the implementation process from different perspectives, and also to get more insights in important topics related to circular economy.

The interview guide is found in Appendix 1 and the interviewees and backgrounds in Appendix 2. The interviews were conducted face-to-face

and each took about 35-90 minutes. All the interviews were recorded and conducted in Finnish. The interviews have been translated into English by the researcher.

Limitations

Firstly, the field of the study is new, and only a limited number of researches on the circular economy has been carried out. The previous studies have not investigated all the circular business models from one industry's perspective. The limited number of previous studies means there are no right and wrong answers. Thus the researcher has room for innovative thinking and that should be considered when evaluating the results.

1.3 Thesis structure

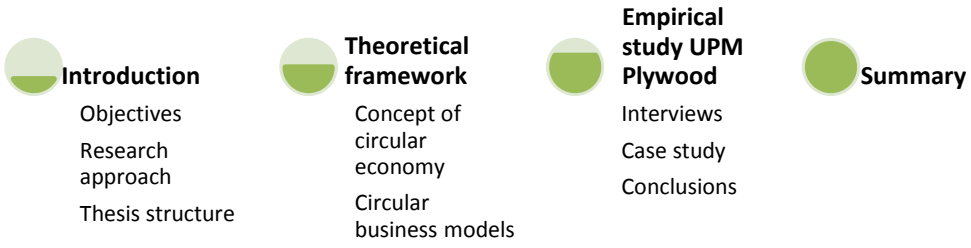

FIGURE 1: Structure of the thesis

This thesis is divided into two parts: theoretical framework and empirical study. The first chapter introduces the reader to the subject by clarifying the objectives and research approach of the study. The second and third chapters, definition of circular economy and business models, form the theoretical framework for the thesis. The fourth chapter, empirical study of UPM Plywood, includes qualitative interviews and the case study of UPM

Plywood. In the beginning of the chapter the interviews bring ideas from circular economy experts how a company can move towards circular economy. After that the UPM introduction, research outcomes, author's own suggestions for business models and also suggestions for further research are presented. To conclude the thesis, summary is conducted to re-evaluate the findings of the research.

2 CONCEPT OF CIRCULAR ECONOMY

This chapter presents the concept and main principles of circular economy in comparison with the traditional ‘make-take-waste’-model. It answers the research sub-question “What is circular economy?”. Sub-chapter 2.4 focuses on Finland’s and Europe’s perspective on circular economy: demonstrating what is going on in these fields. The next chapter focuses on laws and regulations especially from a plywood perspective. The Sub-chapter 2.6 defines what is needed in order to move towards circular economy and why it is time to act now. These chapters also work as the basis of the conceptual framework applied in the empirical part of the thesis. The last Sub-chapter introduces the possible challenges and barriers a company can face.

2.1 The foundation of circular economy

The concept of circular economy has deep-rooted origins and cannot be traced back to one single date or author. However, it is assumed that the term circular economy first saw the light of the day in the late 1970s when it was discussed by a modest group of academics, innovators, and businesspersons. (Ellen MacArthur 2015a.) For example, architect Walter Stahel had an insight that the current linear economic model is not sustainable. This was based on the fact that if people kept increasing their consumption, it would lead to major problems in the future. This was highlighted by the Club of Rome in their report “Limits to Growth” in year 1972. According to the report, the current economic production model was not sustainable because of increasing demand for raw materials and worldwide accumulation of waste. Stahel proposed to close material cycles and reform the economy. (Meadows, Meadows & Behrens 1972, 18.)

The concept of closing the cycles has been studied and further developed in concrete business cases in the years. The generic concept of circular economy has been refined and developed by different schools of thought for example cradle-to-cradle, performance economy, biomimicry, industrial ecology, natural capitalism, blue economy and regenerative design. From

these disciplines the key principles for circular economy includes: “design out waste”, “build resilience through diversity”, “renewable energy”, “think in systems” and “think in cascades”. (Ellen MacArthur Foundation 2015b.)

It is a self-evident truth that a new economy that creates new values, connects responsibilities for people, planet and economy and in addition is profitable, is needed in our world of finite resources. Circular economy has attracted attention among business leaders in recent years all over the world. In terms of promotion and activity, the Ellen MacArthur Foundation gained popularity for the term circular economy with their report Towards the Circular Economy. Essentially, circular economy represents a fundamental alternative to the dominant linear economic model based on a “take-make-consume-throw away” pattern. (Reichel, De Schoenmakere & Gillabel 2016, 9.)

2.2 Difference between linear and circular economy

In order to understand the concept of circular economy, one must first understand the fundamental building blocks of the dominant linear economy. From a traditional point of view production and consumption was embedded to consumers’ minds as a linear approach. As said, we take, make and dispose materials. Each time we act accordingly, we tap into a finite amount of resources and leave behind toxic waste instead of nutrients for further life. (Timmermans 2015.) The linear model relies on large quantities of cheap, easily accessible materials and energy (Ellen MacArthur Foundation 2015b). According to Braungart and McDonough (2002, 27) in the linear model: “resources are extracted, shaped into products, sold, and eventually disposed of in a “grave” of some kind, usually a landfill or incinerator.” Each year around 80% of the $3.2 trillion worth of materials used in consumer goods are not recovered (Nguyen, Stuchtey & Zils 2014). This model is exhausting our planet and polluting the environment. It also leads to a shortage of raw materials and therefore the costs are rising.

Unlike the linear economy, circular economy seeks to respect the environmental boundaries by increasing the share of renewable and recyclable resources and meanwhile reducing raw materials and consumption. Emissions and loss of resources will thus be reduced. The circular economy creates value while it eliminates waste and maximizes product use, ultimately upending traditional notions of competitiveness. (The European Environment Agency 2016.) Figure 2 below demonstrates the difference between linear and circular economy.

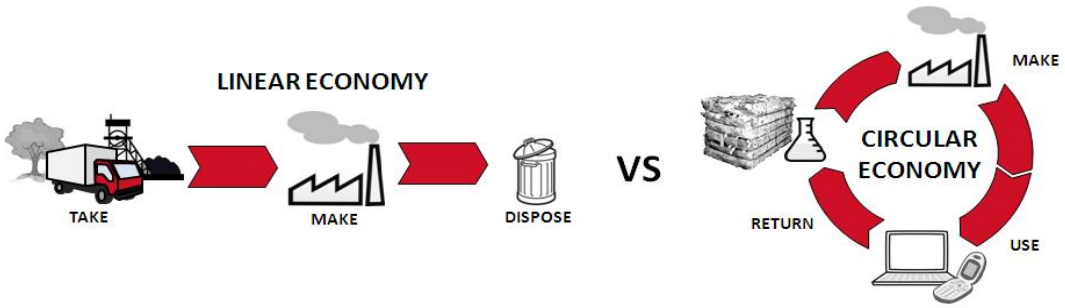

FIGURE 2: Difference between linear and circular economy (RPS Ltd 2014)

Moving towards circular economy requires a system change with parallel actions along the value chain. There is no single policy that would work for every industry and there is no single route to creating a circular economy. There needs to be institutional changes, cultural changes, technological innovation and stable regulatory field in order to move towards circular economy. Closer cooperation between governments and businesses is mandatory. (van Eijk 2015, 3.)

2.3 Ecosystem

Everything in nature's ecosystem is connected. An ecosystem is a community of living and non-living things interacting with each other and their environment of living organisms, water, mineral soil, heat and light from the sun, and other elements. These organisms influence each other, and

their terrain; they compete and collaborate, share and create resources, and co-evolve. If external disruptions occur, they adapt together. All the parts work together to make a balanced system. (Kelly 2015.) Thus, the circular economy should be just common. Production of goods operate like systems in nature: the waste and demise of a substance turns to be the food and source of a growth of something new. For example, a flower. A flower requires carbon dioxide and water to grow, combining them using light energy to form carbohydrates. Oxygen arises from that as a by-product. Oxygen is not typically defined as a “waste” but in a flower’s cycle, it is. However, when an animal is added to the cycle, it closes the loop. The animal utilizes oxygen and releases carbon dioxide that is, in turn, absorbed by the flower. That is a fully functional circular economy. (Svensson 2015.)

> *Business should be seen the same way as nature is seen as an ecosystem - where everything comes from, what materials everyone uses and with whom. There is no specific point in a value chain, instead there are many authors who control the whole value chain. (Pietikäinen 2016, translated from Finnish by Salmela).*

Figure 3 depicts a simplified circular economy model, where biological and technical cycles have been separated from each other’s as they have different material cycles and the means to keep them in the economic system differs. Materials that can be safely returned into the biosphere are categorized as biological. Everything else is defined as technological and designed to remain in use for as long as possible. (Potocnik 2013, 24-25.) Circularity introduces a strict differentiation between consumable and durable components of a product. Durable goods, such as machines and computers, are used until they are no longer functional, while consumable goods are designed and used to contain as little waste as possible and can be safely returned to the biosphere, either directly or in a cascade of consecutive uses. (Vaughn 2014, 6.)

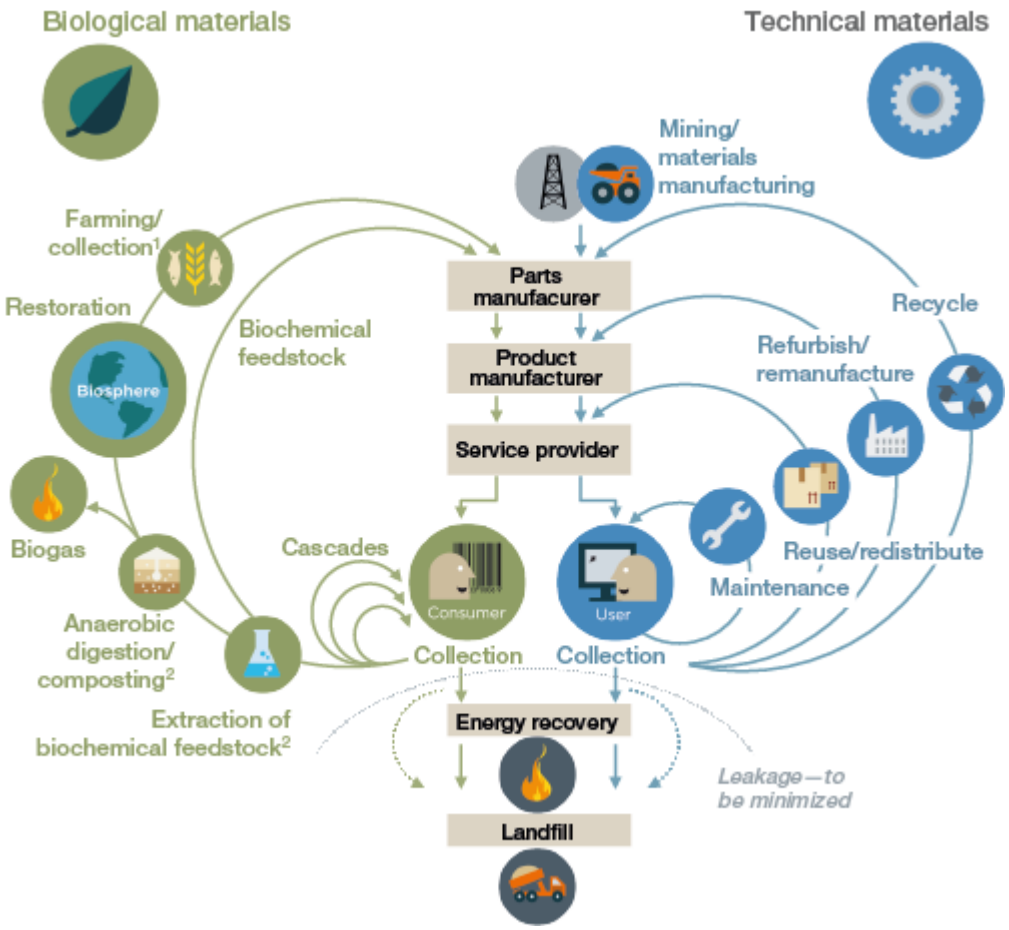

FIGURE 3: Outline of a circular economy (Ellen MacArthur Foundation 2015b)

> *A circular economy is one that is restorative by design, and which aims to keep products, components and materials at their highest utility and value, at all times (Ellen MacArthur Foundation 2015b).*

Referring to Ellen MacArthur's definition above of the circular economy, thereby the inner circles of Figure 3 are seen as most preferable and promotes the circular economy principles the most. The outer circles are still keeping materials within the technological and biological loops but energy and material value is increasingly lost. (Vanner, Bicket, Withana, Brink, Razzini, Dijl, Hudson 2014, 9.) The material flows ending at the landfill or incinerator are lost from the material flow. As per circular economy thinking,

this waste should be reduced. Returning the technical materials to the circulation is generally seen as more energy-efficient and produces less greenhouse gas emissions than incinerating them. (Seppälä, Sahimaa, Honkatukia, Valve, Antikainen, Kautto, Myllymaa, Mäenpää, Salmenperä, Alhola, Kauppila, & Salminen 2016, 11.) Through careful design and new innovative business models, technical and biological materials flow continuously within the economy, safeguarding valuable stocks and decoupling growth from finite natural resources (Dedicoat 2016).

In order to implement the principles of circular economy, it requires a link to a bioeconomy. The bioeconomy encompasses those parts of the economy that use renewable biological resources from land and sea to produce food, bio-materials, bio-energy and bio–products. (European Commission 2016.) Bioeconomy can be seen as the left wing of Figure 3, presented in page 11.

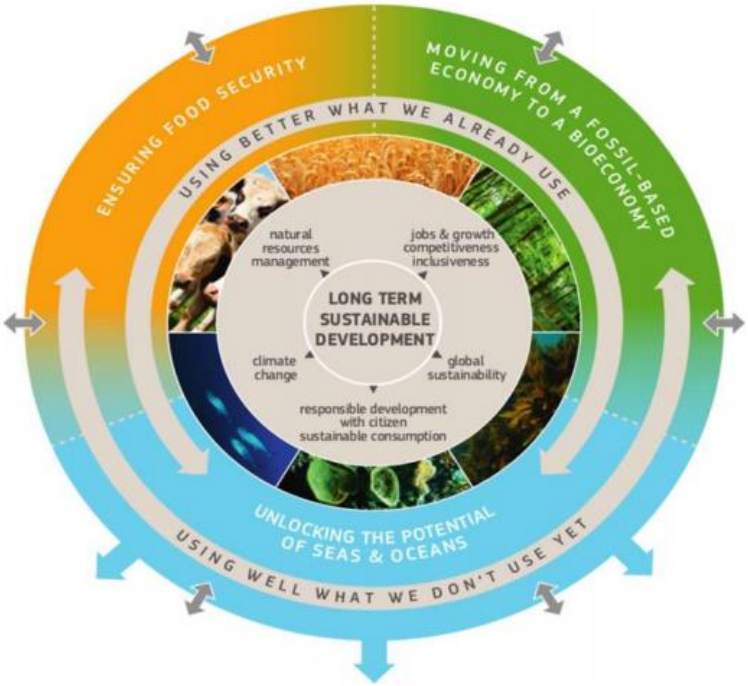

FIGURE 4: The bioeconomy (European Commission 2016)

2.4 Circular economy in Finland and Europe

Circular economy concept has gained a lot of awareness in Finland. It is one of the Finnish government's top schemes. According to the government's program, ran by Finland's Prime Minister Sipilä, Finland will be the world's leading country in the fields of bio economy, circular economy and cleantech. (Valtonen 2016, 13.)

Despite Finland's small size, it has good opportunities to thrive in the face of global competition: factors such as a high-quality education, solid technological expertise and a strong reputation as a cleantech operator are fundamental to Finland's success. Finland's pulp and paper industries have been great examples of industries where almost all the materials and side streams generated during wood processing are utilized in different products or to generate renewable energy. There are already many new applications found by Finnish businesses for innovative biomaterials derived from wood. In order to achieve as great environmental benefits as possible, the material flows need to be replaced by cleaner and more energy-efficient circulation. For example, petrol can be replaced by biogas made from bio wastes. Professor Seppälä, of the Finnish Environment Institute, states that new products developed by the Finnish forest industry may play a key role in the circular economy. (Seppälä et al. 2016, 49.)

According to the study "The opportunities of a circular economy for Finland", circular economy will offer the Finnish economy an annual value potential worth of 2-3 billion euros by year 2030 in five sectors: forest industry, mechanical engineering industry, paper industry, food industry, private consumption and the change of the properties purpose of use. As a whole, the value potential for the economy is multiple. (Arponen, Granskog, Pantsar-Kallio, Stuchtey, Törmänen, & Vanthournout 2014, 3.)

The Finnish Innovation Fund Sitra (2016a, 12) published in autumn 2016 an ambitious road map aiming to get goods and materials to circulate smoothly throughout the Finnish economy. The national action plan for circular economy has been created with ministries, research institutes, businesses,

municipals and cities. The roadmap “Kierrolla kärkeen: Suomen tiekartta kiertotalouteen 2016-2025” includes the objectives and aims on how Finland will be the top circular economy country by 2025. The roadmap includes five focus topics which are connected to each other’:

1) sustainable food system
2) forest based circles
3) technical circles
4) movement and logistics
5) shared actions.

The actions to these topics will be realized by three different levels: politics, key projects and pilot projects. The aim of the forest based circles is for Finland to become a leading bio- and circular economy country because of the high-class forestry. New commercial goods, services and co-operations and also development in digital technologies will bring a global competitiveness. Below, in Figure 5, are mentioned some of the ways on how to spur forestry to become more circular.

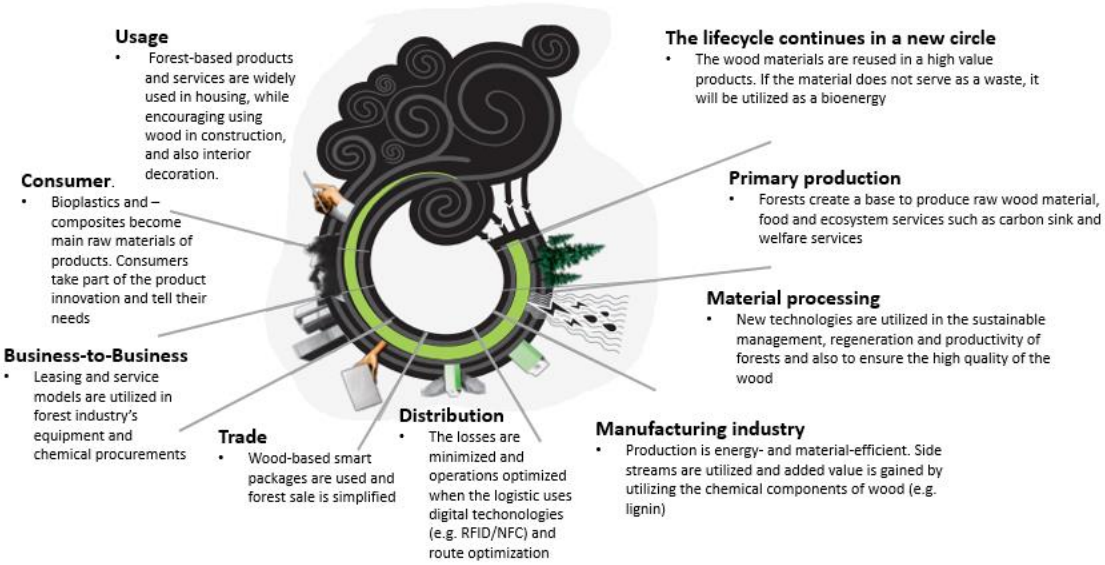

FIGURE 5: Creating circular economy in Finland, forest based circles (Sitra 2016a,18. Translated from Finnish by Salmela.)

From the national perspective, increasing the value of wood is more important than increasing the amount. As per circular thinking, the wood material is reused in high value products. If the material does not serve anymore, it will be utilized in a bioenergy. Production becomes more energy- and material efficient by making good use of the industry's side streams. The added value is gained by piggybacking the chemical components of wood as lignin. (Sitra 2016a, 18.)

Circular economy in Europe

Europe is more dependent on imported resources than any other region in the world. Approximately 40 percent of all the resources used in Europe have been imported from outside of Europe. (Fant 2016.) Circular economy would be solution to the increasing dependence on imports. Reducing the environmental pressures in Europe and minimizing the continent's increasing dependence on imports is becoming vital. As other regions develop, it gives rise to international competition for resources to increase. (Reichel et al. 2016, 6.)

The European Commission (2015) defines circular economy as one that:

> *aims to maintain the value of the materials and energy used in products in the value chain for the optimal duration, thus minimizing waste and resource use. By preventing losses of value from materials flows, it creates economic opportunities and competitive advantages on a sustainable basis.*

In December 2015, the European Commission, published an EU action plan for circular economy. It is a new strategy, which strives to support the transition to a circular economy in the European Union. Moving towards a circular economy in Europe would promote competitiveness, create new jobs and support sustainable growth. (Reichel et al. 2016, 5.)

According to this new strategy, the aim of the circular economy package is:

> *to ensure that the right regulatory framework is in place for the development of the circular economy in the single market, and to give clear signals to economic operators and society at large on the way forward with long term waste targets as well as a concrete, broad and ambitious set of actions, to be carried out before 2020 (European Commission 2015)*

The circular economy comprises elements on production, consumption, waste management, market for "secondary" raw materials, material-specific measures, innovation and indicators. The action plan promotes closing the material loop and controlling the lifecycle of the product (European Commission 2015).

The waste proposals establish an ambitious long-term vision to increase recycling and reduce landfilling, while proposing measures to improve waste management and taking into account the different situations across the member states (European Commission 2015). The action plan on the circular economy complements this proposal by setting out measures and initiatives that address all phases in the lifecycle of a product: from production and consumption to waste management and the market for secondary raw materials (Reichel et al. 2016, 5). The action plan also includes actions that will focus on market barriers on specific sectors or material streams, such as plastics, food waste, critical raw materials, construction, biomass and bio-based products, innovations and investments. (European Commission 2015.)

The European Commission's Action Plan is very important for forest industry as it highlights the proposed cascade use of wood. Cascade use is described as "the efficient utilisation of resources by using residues and recycled materials for material use to extend total biomass availability within a given system". (Vis, Mantau & Allen 2016.)

The cascading use of wood takes place when wood is processed into a product and this product is used at least once more either for material or

energy purposes. A single stage cascade means when wood is processed into a product and the product is used for energy purposes. Whereas in a multi-stage cascade, wood is processed into a product and the product is used at least once more in material form before disposal or energy recovery. (Vis et al. 2016.)

2.5 Laws and regulations

While companies clearly play a critical role of fostering the shift to a circular economy, governments play a no less important role. With any substantial economic change comes shift in policy. In many cases policy interventions are essential enablers. Governments need to use their powers to shape the market conditions at the national and global level in order to enable the right conditions for change. They also need to adopt the circular economy in their own substantial organizations and supply chains through areas like public procurement. There does not have to be a clash between business and government; bottom-up innovation will happen as the result of people's natural desire toward creativity and profit. (Accenture 2014, 20.)

Current regulations are giving the linear model an unfair advantage by making it more financially attractive for businesses to grow by expanding resource use. Changes are needed to these regulations in order to be able to level the playing field. (Lacy et al. 2015, 3541-3542.) In order to move towards circular economy, policies need to shift taxation from labor to resources, set specific recycling targets for industries, make companies responsible for products throughout their life cycles, implement tax premiums for the use of regenerated resources and create a physical infrastructure that facilitates circular resource flows. However, there already exist some good examples including producer responsibility, waste taxation and product labelling. (Accenture 2014, 20.)

The higher prices for linear end-of-use treatment options (particularly landfilling and energy recovery) would increase the use of more sustainable alternative options (European Panel Federation 2016, 241). Directive 2008/98/EC of the European Parliament and of the Council of 19 November

2008 on waste and repealing certain Directives (hereinafter Waste Framework Directive) helps to define what is product, what is waste, and when waste ceases to be waste and becomes a secondary raw material (so called end-of-waste criteria). The application of these definitions has a huge importance when considering the utilization of any material.

Under the Waste Framework Directive, European Union member states have increased landfill costs for discarding construction and demolition waste aiming to boost the reuse and recycling rate of concrete, timber and other construction materials. Also the construction processes have been improved in order to reduce waste. (European Commission 2011, 89.) In Finland the organic waste landfill ban (VNa 331/2013) came into effect in the beginning of year 2016. It prevents the disposal of organic waste into landfills and thus aims to direct the waste streams into recycling and energy production. (Valtioneuvoston asetus kaatopaikoista 331/2013).

Figure 6 represents an EU Waste hierarchy of the Waste Framework Directive. The top, prevention, is the most favorable option and the bottom, disposal, is the least favorable option. Therefore, the ambition is to first strive for waste prevention, then for reuse, recycling, energy recovery and as a last resort disposal. (Lacy et al. 2015, 3599-3601.) Stages one to three deal with product related aspects while stages four and five are waste related.

FIGURE 6: European Union's waste hierarchy (Recyctec Holding AB 2016)

In order to fulfil the principles of waste hierarchy, presented in Figure 6, a waste incineration tax has been proposed. The European Commission will publish a bulletin “From waste to energy” which sees the waste incineration tax as a good thing (Pietikäinen 2016). By taxing the incineration, the competitiveness of recycling can be promoted relative to energy exploitation. Today’s issue is that incineration is relatively too profitable and inexpensive (Pietikäinen 2016). As incineration becomes popular, recycling decreases and due materials used as resources threaten to run out (Morris 2016).

The European Commission is intending to shape a policy for the sustainable use of biomass for energy purposes as a part of the revision to the Renewable Energy Directive. New research on the life cycle analysis (LCA) of clean wood waste management methods by Dr. Jeff Morris claims that the use of wood waste biomass does not fit the sustainability criteria.

> *This LCA shows that wood waste combustion for electricity, heat energy or combined heat and power (CHP) is typically the least preferable management option from a combined climate, human health and ecosystems impacts perspective versus recycling into reconstituted wood products or papermaking pulp, or even versus landfilling with methane capture and flaring or use to generate electricity. Only in the case of replacing high-sulphur-coal burning that uses minimal emissions controls does wood burning for heat energy look slightly better for climate impacts versus recycling the wood wastes. (Morris 2016.)*

The EU Forest Strategy (COM(2013)659) states that cascade use fulfils the criteria of resource-efficiency. According to the strategy, under the cascading principle, wood should be used in the following order of priority: wood-based products, extension of their service life, re-use, recycling, bioenergy and disposal. (European Commission 2013.)

Policy shifts need to allow for self-correction and response: no change happens overnight, perfectly. Still, all of the above mentioned should make businesses reconsider their ways of acting.

2.6 Instruments needed and drivers

Moving to circular economy implies full systematic change and innovation not only in technologies, but also in society, businesses, finance methods and policies. Product design, research and innovation activities play a key role in creating a circular economy. Changes in policy instruments and infrastructure support the systematic change. In order to move towards circular economy, we need new business models and completely new way of thinking. Without the courage from businesses to change their strategies, the transfer is not possible. We need brave forerunners to show us the way towards circular economy. (Seppälä et al. 2016, 16.)

If all of these work in the same direction, these enablers can reinforce each other and accelerate the change. These actors can be imagined as the roots of “circular economy tree”, enabling it to grow as seen from Figure 7.

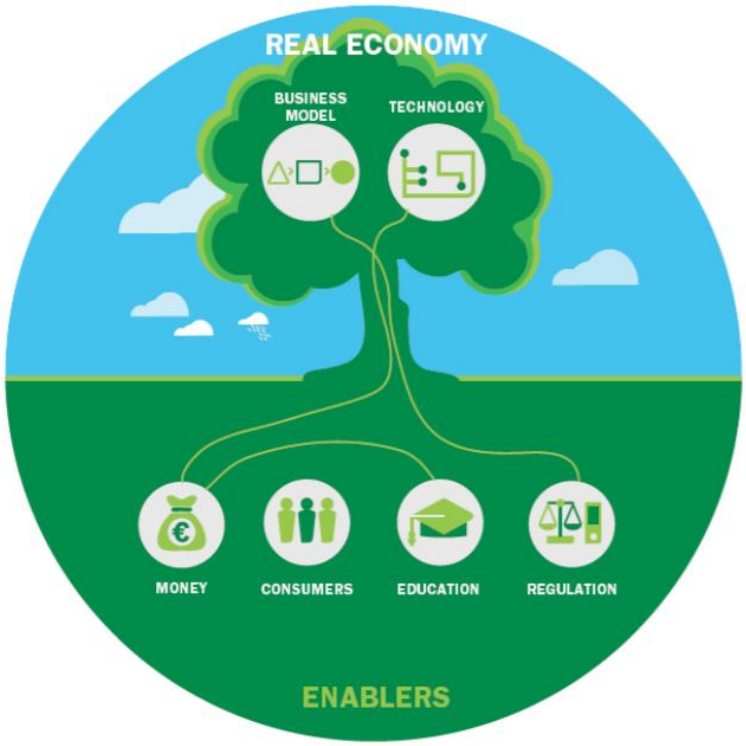

FIGURE 7: Enables of the transition to a circular economy (Kraanen 2016, 23)

In order to move towards circular economy, cross-chains and cross-sector collaboration is needed (Potocnik 2013, 9). Reverse logistics (see Figure 8) is the process of moving products from the point of consumption to consolidation point for the purpose of capturing value or proper disposal. It includes the collection of goods, transportation to a central location and also sorting according to ultimate destination, e.g., remanufacturing, refurbishing, reusing or recycling. Reverse logistics closes the loop of product lifecycles and due plays an important role in transition to a circular economy. (Le Moigne 2016.)

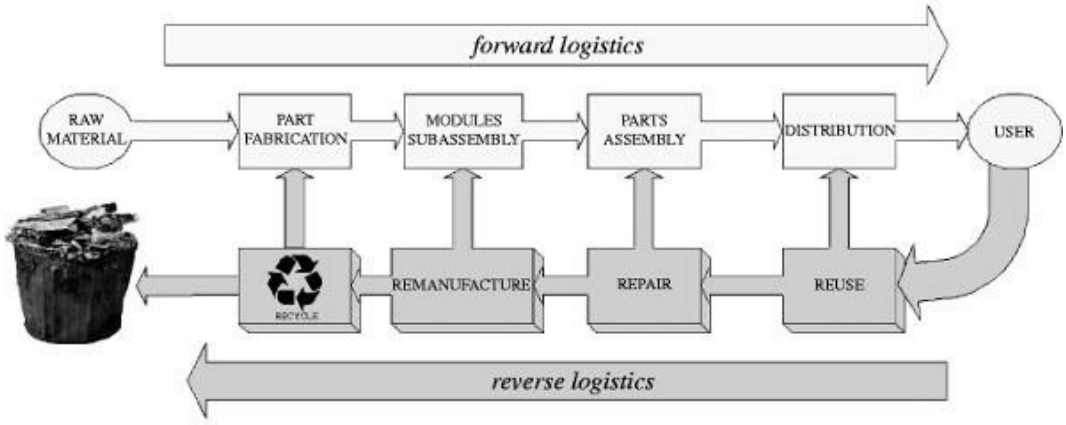

FIGURE 8: Reverse logistics in a circular economy (Findlow 2016)

When products are returned to a manufacturer or to a third party who is responsible of the reverse logistics for the manufacturer, several scenarios may arise:

- The product is still functional and can be repackaged, repaired or remanufactured and after will be sold as refurbished product in a secondary market.

- The product no longer functions but the parts that still have value can be sorted out.
- The product has reached the end of its life and must be disposed of in some way.

At each of these points, businesses need to be creative about how to find value in the product, while still adhering to green practices. (Partridge 2011.)

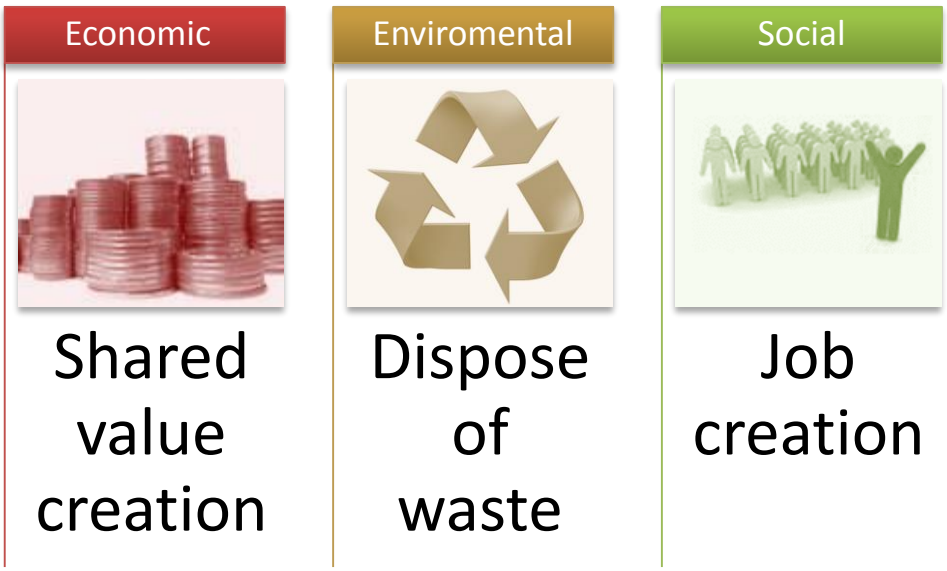

FIGURE 10: Circular economy benefits to the economy (adapted from Ellen MacArthur Foundation 2015c, 2)

The Circular Economy could bring significant environmental, social and economic benefits to the economy, presented in Figure 10 (Ellen MacArthur Foundation 2015c, 2). Naturally, businesses are aiming to maximize the asset value, which is in tune with something that is part of their DNA. In a circular economy, manufacturers are creating more value from each unit of resource. (Vaughn 2014, 5.) The international investors are withdrawing from the businesses that contain a big climate risks. Circular economy has

a key role in the fight against climate change and renewable energy revolution (Sitra 2016a, 4.)

Technology is a fundamental driver of this changing economy. Information and industrial technologies are spreading rapidly at a scale, which supports closing the reverse loops. There are already technological solutions that enable circular economy for instance, mobile internet, the internet of things, advanced materials, renewable energy and energy storage technology, that levels the momentary imbalances between the demand and production of renewable energy. (Timmermans 2015, 23.) The advances of new technology allow better tracking of materials, more efficient collaboration and knowledge sharing and also improved reverse logistics setups (Ellen MacArthur Foundation 2015c, 4).

Additional three billion people will ascend to the middle class by 2025. This addition will only increase the severe shortage on our finite supplies of energy, materials, food and water. (Vaughn 2014, 9.) It is a true fact we cannot continue wasting our scarce resources. Experts are sounding warnings about the growing demand for resources, leading to looming shortages in supply. A circular economy could help increase the efficiency of primary resource consumption. By conserving materials embodied in high value products, or returning wastes to the economy as high-quality secondary raw materials, a circular economy would reduce demand for primary raw materials. (Reichel et al. 2016, 12.)

Also governments, as seen from Chapter 2.4 and 2.5, have been getting behind the idea of circular economy. Governments and regulators are about to take up legislation that would support the shift to a circular economy. There are efforts towards circular economy among lawmakers, on national levels as well as on a wider scale.

A shift in consumer behavior has also activated the application of circular thinking. Consumers tend to be more aware now than ever of the ethical and environmental impact of goods and services. They are looking for ways to make a value judgement of their material desires with an aim to do more

good in the world. (Vaughn 2014, 9.) The commitment of consumers and their active demand-side push are helping to drive new innovation and investing in research and development. Shifting away from ownership of assets towards accessing or experiencing the economy will be the future.

If the demand for resources continues as usual, the world will face a huge gap between the demand and supply, as seen in Figure 10. As natural resources are becoming scarcer, it leads to price increases. Rising commodity and energy prices are a major motivation for companies to seriously reconsider making the shift to more circular (Vaughn 2014, 9).

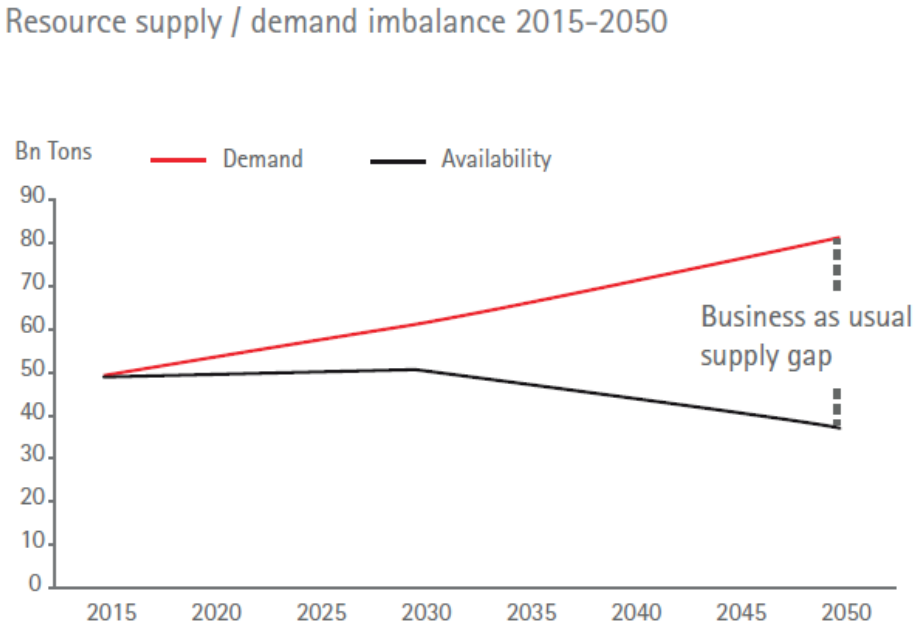

FIGURE 10: The widening gap between sustainable resource availability and demand (Accenture 2014, 9)

2.7 Challenges and barriers

Moving towards a circular economy would be a major change at a time of economic crisis. Despite the growing interest on the circular economy, making the shift is not that easy at a practical level. Most companies are

simply not built to capitalize on the opportunities the circular economy offers. Their strategies, structures, operations and supply chains are deeply rooted in the linear approach to growth. (Lacy et al. 2015, 337.) As in all transition processes, there are winners and losers. Some industrial sectors, businesses, regions and consumers are likely to lose while others will benefit. For instance, industries where virgin materials are produced could lose through such strategies. That is why we need policies to manage these kinds of effects. (Reichel et al. 2016, 14.)

Even though a circular economy would incentivize economic growth and reduce resource price risks, in the short term, it would require high investment to implement it. Businesses may not be ready for the significant upfront investments as the immediate cost savings may not be guaranteed. Additionally, there may be so-called hidden also indirect costs such as time and human resources which businesses need to devote in order to make environmental improvements. (Yacob, Aziz, Makmor & Zin 2013, 56-68.)

In many cases co-operation in the supply chain can be found difficult due to complex, international supply chains and low levels of trust among companies. Inadequate recovery infrastructure can be seen as a barrier when value chains are designed for a linear approach. If there is no proper reverse logistics infrastructure nor any willingness to arrange it, it is challenging to organize circular activity. (van Renswoude, ten Wolde, & Jan Joustra 2015, 4.) On the other hand, Preston (2012, 7) claims that the value chains will become more complex when adding reverse logistics.

Institutional barriers can be for instance lack of environmental policy and weak enforcement of regulations. Uncertainty on regulatory revisions or conflicting regulations complicates investments in capacity and technology development. Unfavorable regulations can in the worst case restrict a company using by-products of another company as its inputs. (Bastein, Koers, Dittrich, Becker, & Diaz Lopez 2014, 26-28.)

3 CIRCULAR ECONOMY BUSINESS MODELS

The aim of this chapter is to answer to the second research sub-question "What is a circular business model?". Five different circular business models will be presented in this chapter.

3.1 Definition of circular business model

A business model represents organization's way to create; deliver and capture value (Osterwalder & Pigneur 2010, 6). It is a comprehensive understanding how a company does business and how value is created. Managers use business models to explore possibilities for future development (Timmermans 2015, 28.) Innovating new business models is about creating new value for the society and its different actors, companies and consumers, through changing one or several constituents of the business model (Osterwalder & Pigneur 2010, 14).

Throughout the world, many businesses have understood they can no longer focus on profits generated by driving volume and cutting cost through greater efficiency. Instead, businesses should focus on rethinking products throughout the value chain in order to be prepared for a future of resource constraints. The development of technology, urbanization, resource scarcity and stricter environmental regulations guides companies and consumers to move towards more circular. (Lacy et al. 2015, 2533-2534.) Companies could achieve a great competitive advantage by using circular economy strategy and concentrating on efficient material circulation and service based models (Seppälä et al. 2015, 18).

The circular business model differs from the traditional one by concentrating on creating value for a broader range of stakeholders and taking into consideration also the benefits from societal and environmental perspectives (Antikainen & Valkokari 2016). The ambition of a circular business model is to keep resources in circulation for as long as possible. By replacing scarce resources with fully renewable, recyclable or biodegrable inputs reduces resource consumption, waste and the depletion

of non-renewable resources. The circular economy business models demand companies to be intensively involved in product usage and disposage, to find new opportunities to offer usage or access instead of selling goods and to optimize the ability to function through the whole value chain. (Antikainen et al. 2016.)

Profitable circular economy business models will encourage other players and will be copied and expanded geographically. In order to implement circular economy, there are notable changes companies need to do. These changes may include different products and services, different relationships, perhaps different customers, different production processes and different revenue models. (Mentink 2014, 4.)

Accenture (2014, 6) has introduced four areas of circular economy value creation: 1) lasting resources; 2) liquid markets/multiple users at the same time; 3) linked value chains / next life opportunities of resources; and 4) longer life cycles. On the basis of these areas of value creation lead to the following business models (Figure 11) which will be presented below.

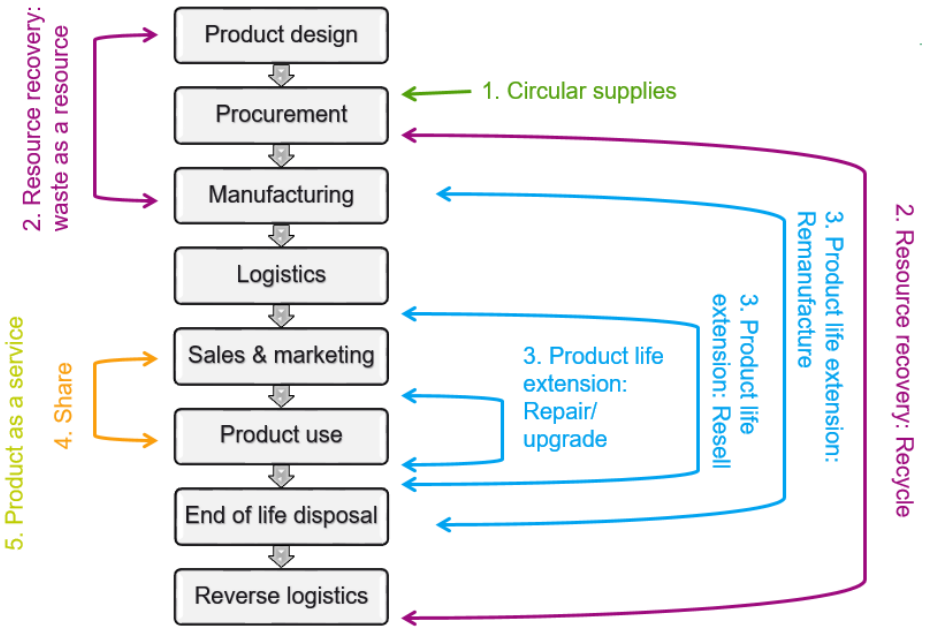

FIGURE 11: Five circular business models (adapted from Accenture 2014, 12)

3.2 Circular supplies

When a company is in need for a scarce or environmentally destructive resource, it can either pay a higher price or try to discover alternative resources. Circular supplies model allows companies to provide renewable, recyclable, or biodegradable materials in its commercial processes to reduce costs and increase predictability and control. (Lacy et al. 2015, 344-346.) In other words, as a substitute for the linear resource approaches and use of scarce resources, companies start using renewable and more sustainable materials while also cutting waste and removing inefficiencies (Accenture 2014, 13).

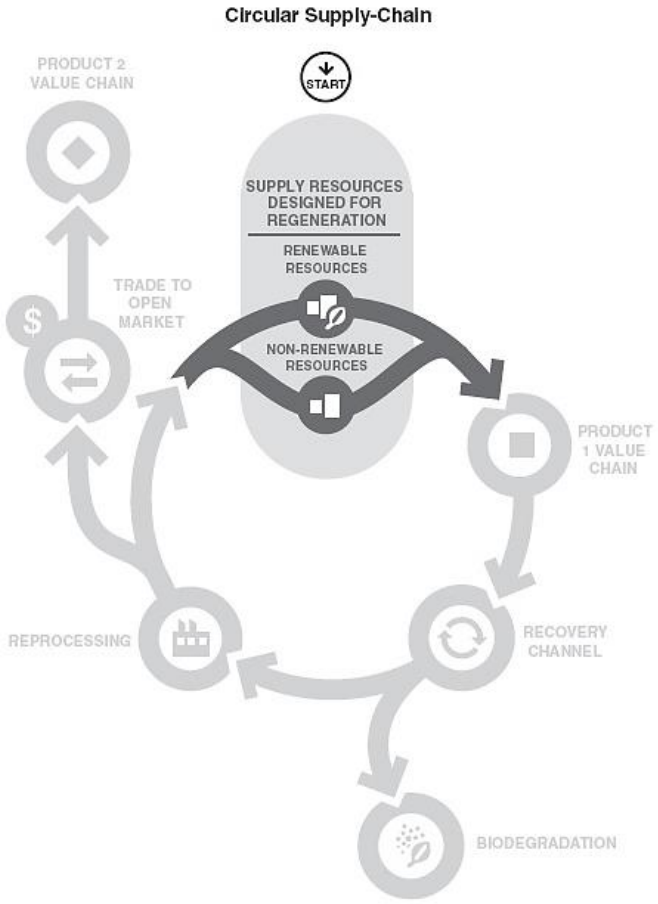

FIGURE 12: Circular supply chain- business model (Lacy et al. 2015, 1010)

The circular supply chain model, presented in Figure 12, becomes outstandingly important in a world of finite resources. As a provider weans itself from the scarce and sometimes toxic commodities, it develops a more predictable, long-term, cost-effective source for the energy or materials it sells to manufacturers. Companies providing circular supplies will be in greater demand as manufacturers desire an access to materials that are more circular and energy, which are less exposed to price increases and volatility. This model thus offers a competitive edge on demand. Customers are looking for reduced risk, secure stable pricing, and comply with regulations and long-term supply. A large majority of consumers would prefer a sustainable alternative over a conventional one if comparable on price and quality. This is the market share power of circular supply chains. (Lacy et al. 2015, 1001.)

As said the production is based on renewable, nontoxic materials and products which are biodegradable and easy to recycle. The company has an advantage as it can provide easily predictable resources and safe and cost-effective solutions. Materials must be nontoxic in order to reach the circular economy's goals. If toxic resources are used to design a more reliable, longer-lasting product, it still is not fully circular. (Lacy et al. 2015, 35-39.) For example, phenol glue used in a plywood industry.

Supply and demand are controlling the speed at which circular supplies can scale. Strong demand for virgin resources and diminishing opportunities for cheap extraction are presuming to drive up costs for virgin resources. Regulatory factors can also encourage the demand for circular supplies. For instance, the use of virgin resources is often subsidized which means their full cost is not necessarily reflected in their price. If this subsidy were eliminated, it would force companies to raise prices and move the interest towards more circular resources. (Lacy et al. 2015, 1113-1115.) Companies in some industries also need to take under consideration the CO_2 emission right. As the costs of those rights are reflected in product pricing, the permit price is low relative to the environmental damage these emission cause. If the costs of emission right would be changed to reflect pollution's true impact, circular supplies model's interest would swell. (Gayer 2011.)

Shifting to the circular supply model involves long research and development cycles and also major capital to get the production at scale. Energy and chemicals sectors are early adopters of the circular model. Bioenergy is the most mature industry sector, where significant interest has existed for more than a decade. Many chemical companies are changing over from fossil to bio-based supplies in order to make performance chemicals, platform chemicals, plastics, detergent, coatings, adhesives and more. (Erickson, Nelson, Winters 2012.)

As an example of circular supplies business model, North European Bio Tech Oy has developed a cellulosic ethanol in which agricultural residue is converted into renewable fuel. Local sawdust will be used as a feedstock. The cellulosic bio-ethanol created a new source of revenue for the company, while reducing emissions, creating jobs and strengthening national energy security. (NEOT 2015.)

Well-designed products play an important role in the success of any businesses. The sad but true fact is that most products are designed with a linear “cradle-to-grave” lifetime in mind. Products are consumed until they are broken or no needed and then thrown away so that the consumer will have to buy more and more. Waste, emissions and toxins are a result of bad design and we cannot get rid of them without thinking how we should design things. Using unsafe and unnecessary resources in product design, to designing products that, during use, will consume much more energy than needed. As consumer need to buy constantly new products, it leads to another issue of the current linear economy: industrial growth. Producing more and more seems to be the main goal of many industrial businesses. However, if businesses could be able to use less resources, produce less products with a higher quality, it is still possible to be an economic growth – just not in the current “faster, cheaper, more” mindset. (Kennard 2015.)

The circular economy demands designers to consider the subsequent use of materials, components and embedded energy in a product. Material selection, standardized components, designed-to-last products, design for easy end-of-life sorting, separation or reuse of products and materials and

design-for-manufacturing, that take into account possible useful application of by-products and wastes, are important for economically successful circular design. Designers must consider how every product can be made to be made again. There are three central models to this: cradle-to-cradle design thinking, design for disassembly and design where there is no waste (biomimicry). Innovative design can be for example using smart memory clips rather than screws or adhesives and using biological materials, which can be safely returned to the biosphere without toxic dyes. (Kennard 2015.)

Cradle to Cradle

Braungart and McDonough (2002) have introduced a new production model called Cradle to Cradle, which is also based on circular supplies business model. Cradle to Cradle draws influences from the nature, where resources are circulating and bringing added value to each other's. The main idea of the model is "waste equals food". (Braungart et al. 2002, 92.) According to this model, the main focus should not be in the eco-efficient approach where the aim is to reduce waste, but instead on how to design systems with outputs that can be included to nutrients by other processes. This goes both for emissions during the production stage of a product and for the product itself once it reaches the disposal stage. According to the Cradle to Cradle Model, the value of products and materials does not get weaker, instead re-using them, may bring additional value for the material, nature or people. (Braungart et al. 2002, 93.)

Biomimicry

> *You could look at nature as being like a catalog of products, and all of those have benefited from a 3.8-billion-year research and development period. And given that level of investment, it makes sense to use it. (Pawlyn 2010.)*

Benyus (1997) defines biomimicry as a new science that studies nature's best ideas and then imitates these designs and processes to solve human problems. There is a great need for products and manufacturing processes that use a minimum of energy, materials and toxins. Due to technological

advancements and a new spirit of innovation among designers, there are now plenty of ways to mimic Mother Nature's best assets. (Isaacson 2006.)

3.3 Resource recovery

Industrial Revolution has given the world a great many technological advances but also pollution and waste on a scale never seen before. And, digital revolution, has given us the possibility to use the waste products. This will change the way in which we define the waste from "waste products" to "ingredients" and "materials". (Svensson 2015.)

With global consumption accelerating and resources becoming more and more costly, businesses are starting to look for new ways to protect, recapture, and reuse the sources hiding in their production outputs and discarded products. Today not only large amount of waste is generated but also businesses are paying a lot for the privilege of disposing it. They may be discarding a profitable revenue streams in the form of materials that could, after reprocessing, be valuable to another company. (Lacy et al. 2015, 1298-1299; 1336.) The resource recovery business model (presented in Figure 13) focuses on repairing and recovering the embedded value in products through innovative upcycling and recycling technologies. (Ovaska, Poutiainen, Sorasahi, Aho, Levänen, & Annala 2016, 24.) Upcycling in this context means turning an old product or material over into something more valuable (Lacy 2015, 1304-1305). Thus, the aim is not only to recycle products, but to retain or even increase the value of the product (Ovaska et al. 2016, 24). Resource recovery- model would be convenient for businesses producing large volumes of by-product or ones that can effectively reclaim and reprocess waste materials from products (Accenture 2014, 13).

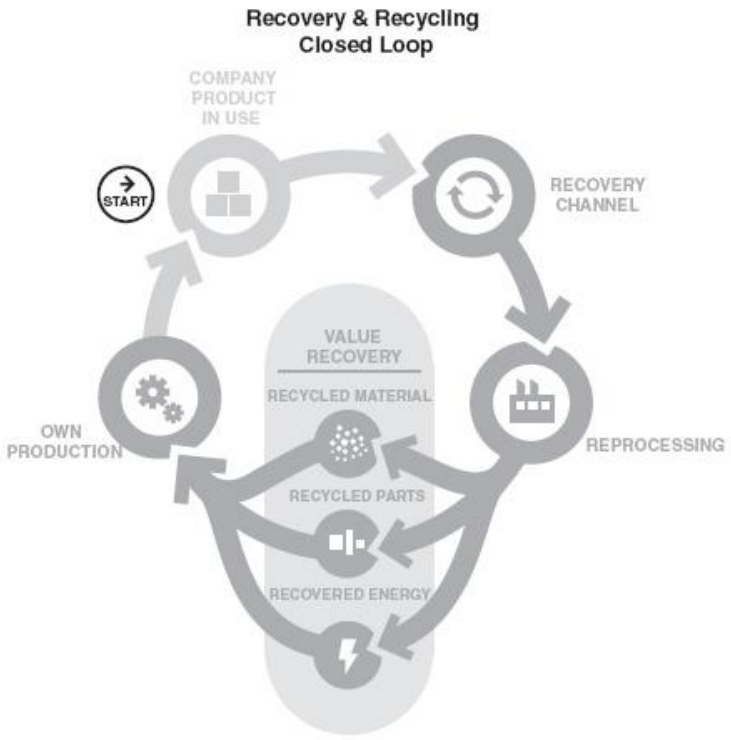

FIGURE 13: Recovery & recycling closed loop (Lacy et al. 2015, 1338)

More businesses have started to evaluate their production chains to discover new ways at which waste could be turned into a commodity of value. The benefits of doing so creates a more circular business and new revenue streams. (Vaughn 2014, 16.) Resource recovery model does not see the waste as an external problem to be dealt with by legislation, but instead of an opportunity and resource. Implementing this model would eliminate the material leakages and maximize the value as the products are returned back. Companies are not only looking for value when considering its end products but all material streams that run through its business. The embedded value can be found from one's own company's products or side streams or even from another industry. Companies can then remake the same product or build new ones from those salvaged materials. To ease this process, products should be designed so they can be easily disassembled. For instance, using clips or screws to connect components rather than fusing them with glue, would make sorting easy through

identification carriers, using only pure material or cutting down on the number of parts. (Lacy et al. 2015, 1309-1313; 1300-1302;1426.)

The business benefits of resource recovery:

- reduced costs of waste management
- increased revenue streams from selling unwanted outputs
- diminished environmental impact with lower demand for virgin resources and energy
- convenient options for customers to dispose of unwanted products
- new interaction points between companies and customers where disposal and new purchases can be combined
- deeper insights into how products are disposed of
  → can be used in product development
  (Lacy et al. 2015,1329-1330).

Companies using new technologies and operating a two-way supply chain (i.e., moving products to customers and bringing end-of-life products back), companies are able to recover almost any resource output to a level that is at least equivalent to their initial investment. (Lacy et al. 2015, 1304-1305.)

Industrial symbiosis

The changes in economy's structures, the worry about environmental issues and the increasing demand of finite resources requires companies to use their resources wisely. Industrial symbiosis is a coherent whole formed by many companies, where they are creating added value for each other by effectively utilizing resources, technology, services and energy. The waste or the side stream from other business may be a resource for other and vice versa. Thus the waste or industry's side stream, which has been considered as a cost item, transfers to a monetary valued resource. Even though the industrial symbiosis practices often take place at the process and manufacturing level and benefit businesses located closely within a geographical area," extending resource value" can occur at the product level and may also happen across geographical areas. (Bocken, de Pauw, Bakker & van der Grinten 2016.)

The classic definition of industrial symbiosis involves physical exchanges of materials, energy, water, and by-products between different industrial facilities (Taranic, Behrens & Topi 2016, 4). By-products from one manufacturer can be used as a resource for another as seen in Figure 14, saving money and the environment.

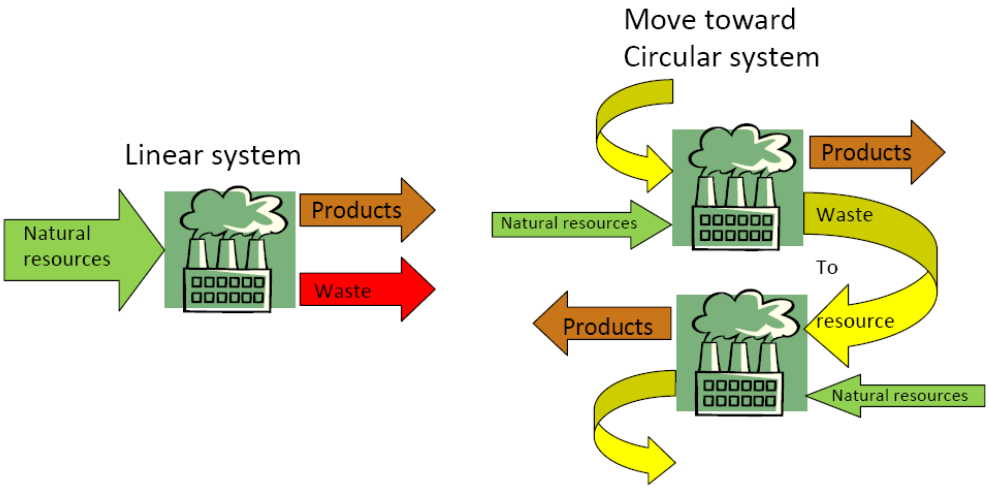

FIGURE 14: Industrial symbiosis (United Nations Development Programme 2010)

Developing the industrial symbiosis will create a new way to improve product innovation, while new knowledge is gained bringing new businesses. New innovations help to reduce the overall operation costs and risks (e.g. environmental fines) and help to achieve long-term resource security. Businesses can agree collaborative agreement in order to reduce costs across the networks for instance by sharing communal services (e.g. maintenance, recycling) and exchanging by-products. Value can be captured through joint cost reductions. (Bocken et al. 2016.)

3.4 Product life extension

The useful life of consumer products, meaning the time between buying and discarding them, is getting ever shorter. What's more, most of the discarded products are still functioning. Products are being used for increasingly shorter times, which causes environmental degradation and increasing scarcity of natural resources. (Määttä 2013, 42.) Combining these facts with the extremely volatile rise in the price of raw materials over the past decade, it becomes instantly clear that continuity and cost of supply are potentially major business risks. What if instead of continuously forcing consumers to replace products, manufacturers try to squeeze as much value as possible out of every ton of resources consumed. The profitability would be maximized over the products' lifecycle rather than at the point of sale as the product's useful life is designed to be as long as possible. (Lacy et al. 2015, 68.)

Product life extension business model is based on extending the lifecycle of products and assets as long as technically and economically feasible. The model is appropriate for most capital-intensive B2B segments and B2C companies in markets where pre-owned products are common. Product life extension model lengthens the useful life of products, which creates opportunities for designing and marketing value adding services. The product characteristics as durability, quality and functionality are highly valued in this model. (Ovaska et al. 2016, 24.)

Different ways to extend a product's useful life are presented in the Figures 15, 16 and 17.

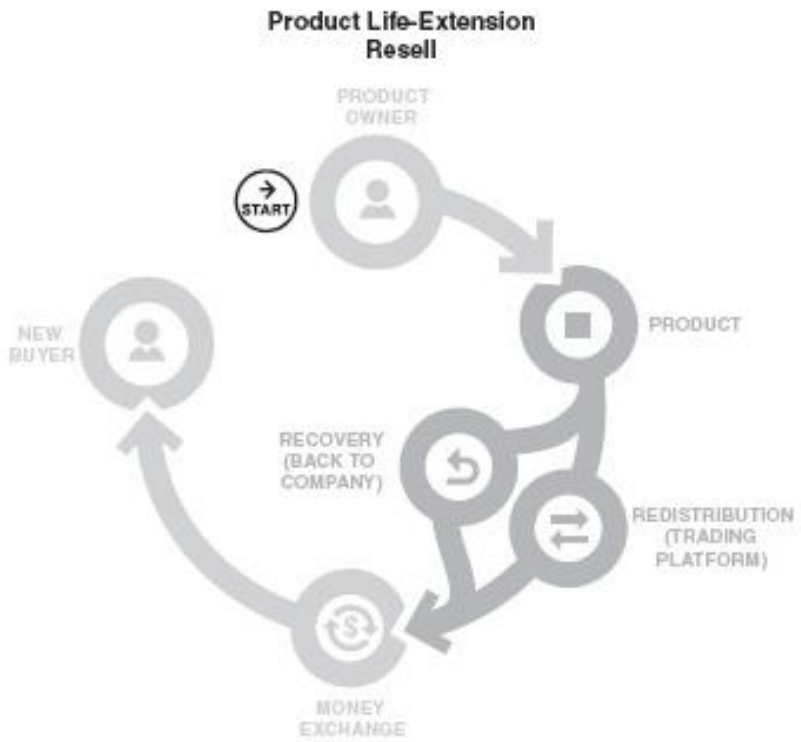

FIGURE 15: Product life-extension: resell (Lacy et al. 2015, 1605)

FIGURE 16: Product life-extension: repair/upgrade/refill (Lacy et al. 2015, 1605)

FIGURE 17: Product life-extension: refurbish & remanufacture (Lacy et al. 2015, 1607)

According to Lacy et al. (2015, 1620) there are many ways to extend a product's useful life and at the same time generate additional revenue streams. The ways are presented below in Figure 18.

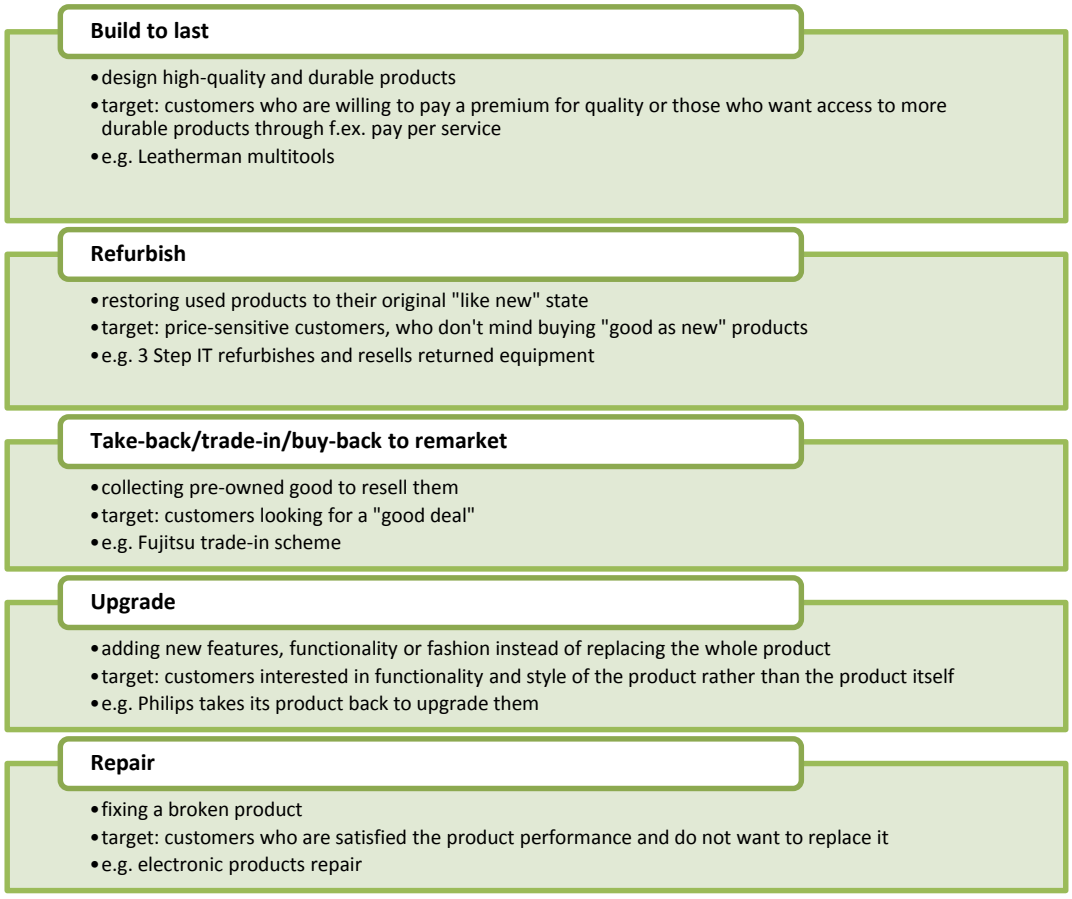

FIGURE 18: Means to extend product's life cycle (adapted from Lacy et al. 2015, 1633-1634)

This business model is also about creating close relationships with the customers. Customers appreciate that supplier is honestly interested in adding value to their relationship and in improving the product's functionality and quality. The close relationship enables company to market upgrades and add-ons and help strengthening the customer loyalty and satisfaction. (Lacy et al. 2015, 1676.)

A product sold through this model must bring higher revenues than the traditional one over the product's lifecycle (as it is replaced less frequently), that still does not have to mean a higher price. Businesses have used a "freemium model" which involves giving core products away for free. All

revenue streams are generated from upgrades, content and add-on sales. (Lacy et al. 2015, 1612-1613.)

Industrial manufacturing companies have the biggest potential to decouple from dependency on constrained resources by innovating ways to extend their product's lifecycles. The manufacturer also faces significant changes to their existing businesses as they may need to invest in remanufacturing processes to revive used goods. Also updating product designs, components and material selection need to be considered in order to make the remanufacturing cost-effective. (Lacy et al. 2015, 1681-1683.)

3.5 Sharing platforms

The traditional view of competitive advantage" the more you own, the better you win" has broken down. Sharing platforms (presented in Figure 19) includes the shared creation, production, distribution, trade and consumption of goods and services by different people and organizations (Matofska 2016). The platform can be coordinated either within a local community or network, or on a larger scale coordinated through community-based online services (Hamari, Sjöklint, & Ukkonen, 2015). The concept is not novel: people have shared and exchanged products for decades. The novelty of the current sharing economy concept comes from advances in digital technology, which are opening new opportunities to share via the internet on a far larger scaler than ever before. (Lacy et al. 2015, 1944-1945.) Sharing platforms is a socio-economic ecosystem built around the sharing of human, physical and intellectual resources (Matofska 2016). It will entirely change the mind-sets how businesses think about their values and their revenue generation model but also how consumers fulfil their needs (Lahti 2012).

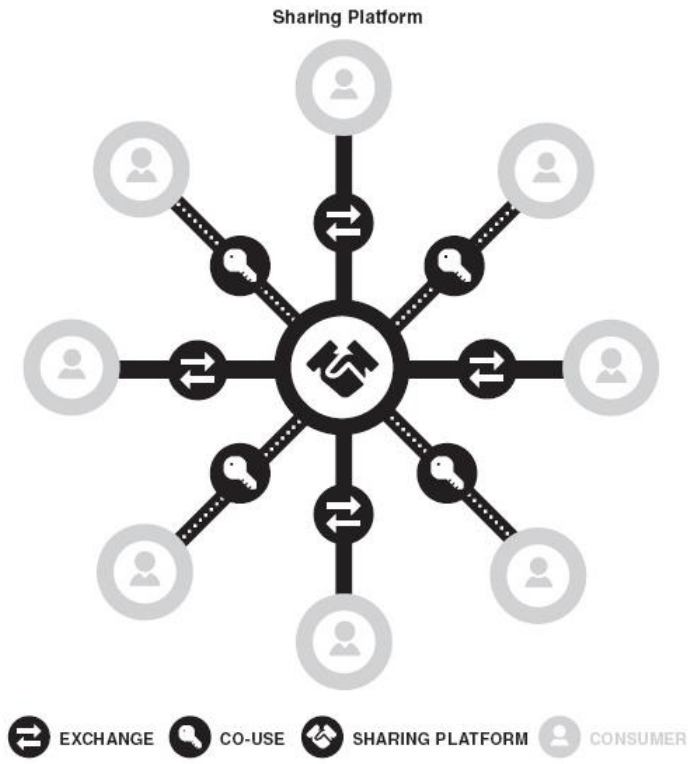

FIGURE 19: Sharing platforms (Lacy et al. 2015, 1943)

The sharing economy combines benefits from economic, environmental and communal perspectives. Sharing enables more efficient and resilient use of financial resources, more efficient and sustainable use of resources and deeper social connection among people. (Crowther & Gilman 2016.)

This business model provides a platform for product owners, individuals and organization to connect and share (Lacy et al. 2015, 1910-1911). The benefits to users are increased flexibility and availability. Customers can get an access to thousands of products at various price points and locations. The business instead relinquishes ownership to the ecosystem. The value gained for businesses is not in owning resources but in managing the marketplace. Putting users together with owners creates entirely new revenue streams. (Lacy et al. 2015, 1914-1917.) Resources are not the definition of scale anymore. Airbnb and Uber did not gain the multi-billion-dollar business because of the employees and resources they control in-

house but for the ecosystem, they succeed in attracting. Ecosystems are becoming the new scale and the new source of competitive advantage.

The resource efficient sharing platform model is spreading through the world but currently it is more common in Business-to-Consumer (B2C) markets than Business-to-Business (B2B) markets. However, the opportunities for this model could be huge in the B2B markets. The fields involving the sharing of large assets with significant carbon footprints (cars, trucks, industrial equipment and buildings) should consider the industrial sharing economy. As online platforms that are oriented toward industrial companies emerge, the companies will find it more feasible to share large raw materials, distribution infrastructure and other capital costs. Shared sourcing platforms could also make it easier for companies to pool their purchases of materials with low environmental impact. (Vaughan 2014.)

3.6 Product as a service

The product as a service model represents highly different way of doing business for companies whose strategy has included selling large volumes of new products. Instead of the conventional buy-to-own approach, companies are starting to provide service solutions which offers multi-issue (i.e. economic, environmental and social) value for the customer' need. The customer is buying a desired function or performance instead of a specific product. (Lacy et al. 2015, 2310-2311; 2204-2205.) With this model product longevity, reusability and sharing are no longer seen as a risks but instead drivers of revenues and reduced cost. Thus, the focus is shifting from sales volume to product and service performance (for instance, hours of thrust in a Rolls- Royce, Power-by-the-Hour jet engines). (Accenture 2014, 14.)

Companies can rent or lease products out or provide pay-per-use or performance arrangements that allow customers to gain access to the functionality of products without the burden of ownership. This model especially attracts companies that have high operational cost (Gerholdt 2015) and skill advantage relative to their customers in managing maintenance of products (Accenture 2014, 14).

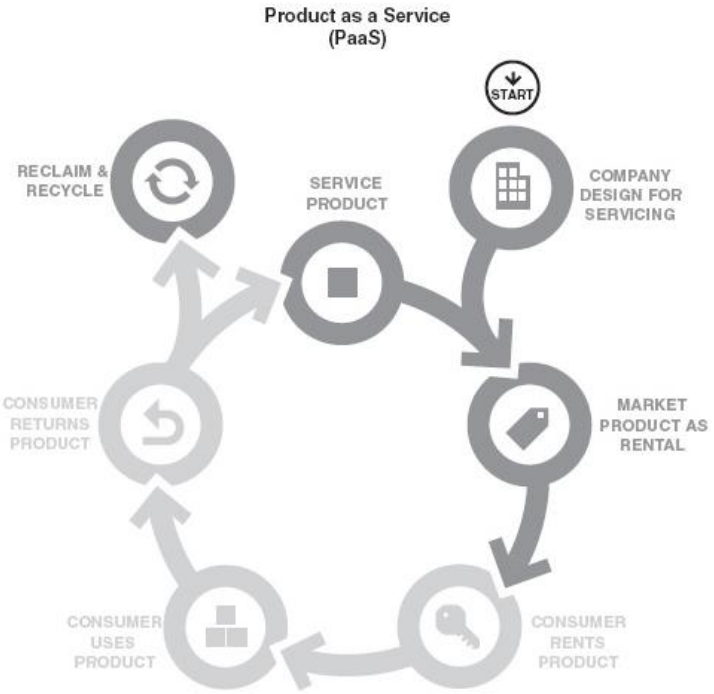

FIGURE 20: Product as a service (Lacy et al. 2015, 2223)

Product as a service business model (presented in Figure 20) allows closer relationship with the customer. The company is able to innovate faster since being closer to the customers and understanding their needs better which provides greater business value to both parties. The users benefit both from getting an access to more high-quality products with an affordable price and the benefits offered by the customer relationship. (Accenture 2014, 14.)

Customers are able to reduce upfront capital expenditures while at the same time affording the manufacturer a continuous service revenue stream. Product as a service business model enables companies to fulfil client needs in an integrated and customized way. Implementing this model, a company can, reduce volume of raw materials, energy usage and waste generation. While the volume of raw materials is reduced, it works as a hedge against a cost volatility. (Lacy et al. 2015, 2328-2331.)

This business model also requires new ways of earning money compared to a traditional" make and sell" approach. Revenues will shift from a lump sum payment to a continued fees collected over the life of a contract or as the service is used. Due to the new kinds of revenue streams, this model requires the production cost to be paid for with upfront capital. In order to do so, companies' balance sheet must be in a level to be able to absorb. (Lacy et al. 2015, 2328-2332.) In cases where a product is used for a long period of time, the capital costs of depreciating the product over time and presenting those costs on to customers, may cause the overall offering to become too expensive. In order to be able to implement this business model, company could collaborate with a financial institution and mix the provision of the product with add-on services that create value for both parties. This approach is currently more appealing in the business-to-business and public area than in business-to-consumer markets. As this kind of business models, become more common, the financial institution become more comfortable with these kinds of calculations and risk. (Lacy et al. 2015, 2344-2350.)

A great example of a company using product as a service business model is Desso. Desso is supplying carpets to commercial customers. Instead of conventionally selling their product, they lease their carpet to the users. Through leasing Desso offers a full service to its customers including installation, cleaning, maintenance and eventually removal. The company owns the product and at the end of its life, the carpet is collected and recycled in to new carpet, which will be leased again. Via this leasing construction collection of old carpets, it positively contributes to closing the loop. (Desso Holding BV 2016.)

The theoretical part acts as a base for the research. By now the reader has an understanding of circular economy and its business models. From now on, in the empirical part, the paper will focus on circular economy in the plywood industry's perspective.

4 EMPIRICAL STUDY UPM PLYWOOD

The empirical part consists of two sections. The first section consists of eleven semi-structured interviews. It gives an answer to the sub-question “What does it take for a company to implement a functional circular business model?

In the second section the main research question is answered: “How can UPM Plywood implement circular business model?”. It starts with introducing UPM as a company, concentrating on the plywood industry. The current stage of circular economy at UPM will be presented in this chapter as well. The most important instruments when moving towards circular economy, in the interest of UPM Plywood, are presented and also the five circular economy business models.

4.1 Interview outcomes

The main subjects of the interview are the instruments needed for moving towards circular economy, drivers and how regulations are currently seen.

Circular economy

At the beginning of the interview, the respondents were asked what is circular economy.

> *Circular economy is waste free. Nonrenewable resources are in a fully closed cycle. Resources goes from one place to another and will not go out of productive use. Renewables are consumed with the limits of renewal. (Pietikäinen 2016)*

The majority of interviewees emphasized that circular economy does not produce waste. “In traditional systems, mainly the utilization of the waste has been studied and developed, but in circular economy the heart of matter is that no waste is generated.“ states Horttanainen (Professor of Lappeenranta University of Technology). Resource efficiency was also mentioned during the interviews, as Laurinsilta (Director, Strategic

Partnerships at UPM) states: “In circular economy the products are designed so that they use as little as possible resources and energy.”

Two of the interviewees pointed out that many people have not heard of the term circular economy and if they have, it is used as a synonym for recycling.

Instruments needed

The interviewees were asked to name factors that need to be considered when moving towards circular economy. All of the interviewees emphasized the need for new business models. According to Hartikainen (Circular Economy Specialist at Sitra):

> *Business models need to be rethought. Companies must have their strategies functional as for circular economy. Sustainable business has traditionally been considered as a communicative thing and that it cannot be. Circular economy needs to be in the core of company’s strategy.*

One respondent pointed out an example of a Dutch carpet company Desso. The company has reorganized the whole business; new products, new factories, re-educating the employees and business networks, new business partners and engaging in new parts of the value chain.

Attitude change is mandatory in order to move towards circular economy according to six of the interviewees. Kaivos (Cleantech and Sustainability Professional and Program Manager at CLIC Innovation) pointed out adjectives about attitudes such as braveness, innovativeness, believe in change, willingness to experiment and courage. Huhtisaari (Sustainability and Biofuels Expert at North European Oil Trade) pondered there probably is not attitudinal issues but the question is how to get people involved and how to find the profitability. “We need to change the way we think, and also search for the added value of circular economy what is it for your company and products. The company’s management need to believe in circular economy.” Hartikainen also mentioned that the trust and belief is needed

from investors and government as well. We need to drive circular economy forwards together with consumers, businesses and government.

Close and open collaboration was mentioned by four respondents. “Companies need to reconsider new parts of the value chain which have not traditionally been in response of that company,” states Horttanainen.

Two of the interviewees mentioned the price of the materials. The usable products need to have a price tag, which enables the material to be reused. The price must be cheaper than using a virgin resource. As we are living in a free market, where minerals and materials are available everywhere, the price system needs to be global.

Product design was mentioned by two respondents. Also the knowledge of one’s products were pointed out. According to Raudaskoski (Circular Economy Expert at Ethica): “It is necessary to go carefully through one’s own products; both the raw material acquisition and where the products end.” Antikainen (Specialist in Circular Green Economy and Senior Researcher at Finnish Environment Institute) introduced a new way of thinking by pointing out that companies need to find their own “corner” as it will not work if every business will start competing with the same resources.

Drivers

The interviewees were asked about their opinions on the biggest drivers of the circular economy. The drivers were easy to name by all respondents. All of them started their answer with emphasizing the meaning of the economic value in business. It is, in most cases, a prerequisite for existence of businesses. Four of the interviewees also brought out that the business goes hand in hand with the environment. “When we use less resources and design our products well, it is possible to get a cheaper product,” states Laurinsilta. Huhtisaari adds: “I personally think very ideologically, environmental values and saving the world is mandatory, but it need to be understood that by doing so we can create good business.”

The meaning of circular economy will be emphasized as the world's population grows leading to continuously increasing use of energy. The scarce resources were seen as a huge driver among the interviewees. As the resources are getting scarcer it causes increases in their prices. According to Aistrich (Senior Lead, Business Development at Sitra), companies need to find new alternatives in order to keep their competitiveness.

Two of the interviewees thought that strict legislation drives companies towards circular economy. Also it was pointed out that the demand for circular options can be created through public procurements. However, it was also mentioned that currently in Finland public procurements of circular economy are relatively little used.

It was mentioned that the transition is about brand and image of the company. The company gains added value by moving towards circular economy.

Aho (Director in Public Affairs and Communications at ST1 Nordic Oy) sums up:" If all of these things are thought at once, this kind of a business model where most of the businesses are based on, cannot continue forever."

Circular economy regulations

It was agreed among six out of ten interviewees that the legislation currently is guided too much by the governments. One of the interviewee mentioned that the current system is built for a linear thinking and then causing so called bottlenecks both inside and between the countries, which need to be solved. Other pointed out that the legislators try to define where those future innovations come from, when instead it should be so that they define what is the objective and then companies should be the ones finding the way to fulfill that objective. The findings demonstrate that the current regime is hindering the scale up of circular business models and the political system currently does not create enabling conditions.

The importance of regulations was pointed out by many interviewees as Aho clarifies:

> *One of the key points of regulation is to ensure that players in the field do not ruin the environment. Regulation is a key element in our economy and in fact it is kind of a catalyst of a technical development. The stricter demands you have, the more you need to put effort on so the likelihood to achieve a clean technical solution, is bigger.*

Four of the respondents highlighted the inflexibility and slowness of regulations. One respondent captured that by stating: “If one has a business idea and needs to wait for years to carry it out, it is not right.” Also it was mentioned that the wholeness should be seen rather than just defining if some material is bad or good and is not subsidized for a specific purpose.

The difference between a product and waste and how waste is defined was mentioned by four interviewees. One interviewee highlighted the waste hierarchy. As per waste hierarchy, first the waste need to be diminished, then reuse, recycle, and as the last options incinerate and then to landfill. It was seen as a threat if waste hierarchy will be linked to be binding with circular economy, it may prevent many new industrial processes and possible innovations.

Two interviewees thought that regulations as a barrier moving towards a circular economy is a common excuse which gets highlighted often. A good expertise in a specific legislation matter is needed in order to take a stand on it. According to one interviewee there may occur barriers when having a look at a wholeness of something. Often businesses come up with the fact that waste material needs to have waste handling permits and in order to utilize the waste materials, different licensing systems are needed compared to utilizing the resources. These originates from the basic principles of waste treating that no additional problems are created.

Other findings

During the interview it was discussed with Parkko (Production Planning Engineer at Gasum) that wood-based biogas has the challenge of sustainability criteria. As an investment, the facility is very big and there are many political risks, for example, if it is said that timber is not a –zero emissions any longer, so that the final product will have an emission factor.

Pietikäinen (Member of European Parliament) highlighted that in a circular economy things need to be solved using back casting instead of forecasting. She uses running a marathon as an example. If you want to run a marathon and you only do things a bit better (linear way) - walking more than usual - you will never be in marathon shape. But if you know you need to run the marathon, you have a certain ambition and you use your resources to reach it; you eat better, go to the gym, sleep more and practice in various ways. It is about change in a paradigm, which is the biggest shift when considering circular economy. You cannot achieve the circular economy by doing things a bit better. You only end up walking more.

4.2 UPM - The Biofore Company

UPM-Kymmene Corporation is a Finnish forest industry company. UPM leads the integration of bio and forest industries into a new, sustainable and innovation-driven future. The company consists of six business areas: UPM Biorefining, UPM Raflatac, UPM Paper Asia, UPM Paper ENA (Europe & North America) and UPM Plywood. As a forerunner in the integration of the bio and forest industries, UPM is committed to building a greener, cleaner, innovation-driven future. (UPM 2016.)

FIGURE 21: UPM The Biofore Company (UPM 2016)

UPM in a circular economy world

UPM develops constantly new innovative smart and sustainable businesses. As examples of UPM's extensive know-how and strong position in the forest biomass sourcing and processing value chain are biofuels, biocomposites and biochemicals. These innovative products based on the use of waste or residuals from UPM's own production. (UPM 2016.) Figure 22 depicts how circular economy works at UPM.

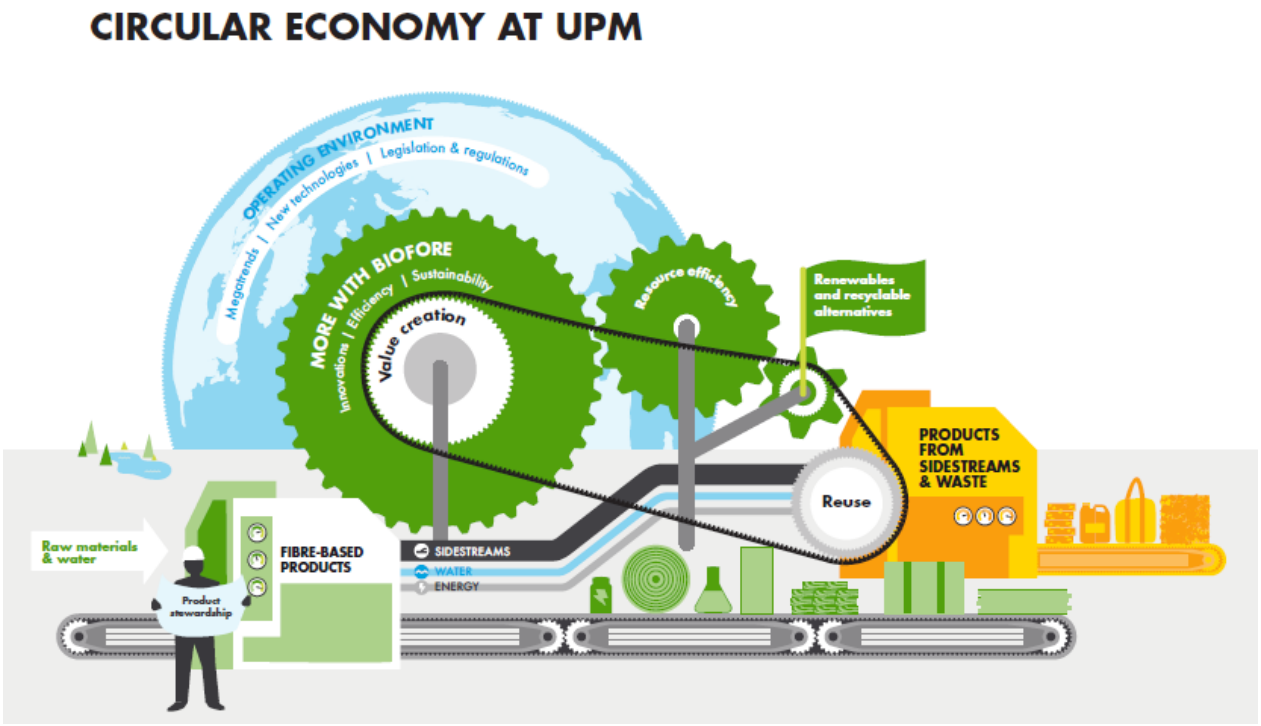

FIGURE 22: Circular economy at UPM (Ståhlberg 2016)

UPM Biofuels produces BioVerno, which is a wood-based renewable diesel. The biofuel is derived from forest industry residues, which allow the company to utilize wood materials with maximum efficiency. Also unlike the traditional biofuels, UPM BioVerno is derived from non-food materials instead of wasting food crops. (UPM Biofuels 2015.)

UPM ProFi wood plastic composite products are manufactured from the surplus paper and plastic left over from the production of self-adhesive label materials. So the business recovers the cellulose fibres and polymers found in label material waste and gives them a second life. (UPM 2016.)

UPM Elurit is a fly ash-based innovation which can be used at the pulping and bleaching stages of the papermaking industry. UPM Cinerit is a construction product, which is based on the fly ash that comes from the thermal recovery of waste materials. (UPM 2016.)

Zero Solid Waste at UPM

> *We have to find a sustainable solution for side streams, enabling us to reuse excess materials and generate added value for us. Our aim is to define the best operational practice in these areas and scale them up UPM-wide in Finland. The target is for UPM to become a Zero Solid Waste company in Finland. (Ståhlberg 2016.)*

Currently around 90% of the side streams produced at UPM mills are reused in other processes. UPM has set an ambitious target “zero solid waste” by 2030 which refers that any waste after that will be dumped at landfills and zero incineration of side streams unless the energy is re-harnessed and exploited. Moving towards this goal will require redesigning products and processes so that any residual material can serve as a potential resource. Zero waste is not just good for the environment but also for a business. (UPM 2016.)

UPM Plywood

UPM Plywood manufactures high-quality WISA® plywood and veneer products mainly for construction and transport industries and the new thermo-formable UPM Grada® wood material for the form pressing industry (UPM 2015).

The sales of UPM Plywood in 2015 were EUR 439 million and it has around 2,400 employees. UPM Plywood has six plywood mills and a veneer mill in Finland, and plywood mills in Russia and Estonia. (UPM 2016.)

4.3 Instruments needed

Moving towards circular economy implies a full systematic change and innovation in technologies, society, finance methods and policies. It is not possible to only change UPM Plywood's business to more circular, the entire system around has to be changed as well. The interviews proved that new business models are essential. Product design, research and innovation activities play a key role in creating a circular economy.

> *Companies need to reconsider new parts of the value chain which have not traditionally been in response of that company. (Horttanainen 2016.)*

As discussed in Chapter 2.6, reverse logistics is the continuous process of moving products from the point of consumption back to the producer or recycling enterprises for possible reuse, recycling, remanufacturing, or disposal. The purpose of a reverse logistics process is to add value to the returned products or to provide the means for appropriate disposal. Researcher sees reverse logistics as one of the most important enabler for UPM Plywood to move towards more circular economy and that is why it is presented here in more detail.

The benefits of an extended producer responsibility scheme include improved utilization of resources and reduction/recycling of waste. Yet the

extended producer responsibility (Chapter 2.5) does not demand the plywood producers to take care of recycling its products. However, it is one of the EU's top schemes and is continuously under discussions.

The majority of plywood produced by UPM is exported (UPM 2016). Thus the markets for recycling would possibly be somewhere in the Europe where most of the plywood ends up. UPM has mastered organizing the international supplier networks and now the same sophistication needs to be applied to organizing post-usage value streams across different reverse cycle partners.

UPM needs to consider the subjects presented below.

1. Together with partners in the inbound and reverse supply cycles, need to carefully evaluate the arbitrage opportunities: what exactly are the costs involved, what control can the stakeholders exert
2. Sophisticated reverse network capabilities are another part of the puzzle, best fuelled by investments in hardware (e.g. sorting and manufacturing capabilities) and software.
3. High level of sophistication such as materials databases, methods for monitoring the condition of used components and inventory management tools to store information. (Crowther et al. 2016.)

4.4 Circular business models for UPM Plywood

Finland's wood products industry consists of several components that all have one thing in common – the renewable, recyclable and ecological raw material, wood. As woody biomass is a limited resource, its use and service life of wood fibres should be optimized. (Sokka, Koponen & Keränen 2015, 4.)

It is a well-known fact that forest industry should focus on the left so called biological wing of the butterfly presented in Chapter 2.3. The researcher thinks plywood industry should focus on both biological and technical wings of the butterfly. The wings should not be treated as distinct flows because in order to be successful both of them need to be interrelated. If not, it would

lead materials such as timber to be cascaded in the worst case straight into energy recovery, before its full potential has been realized. Only once the reuse and remanufacture cycles have been utilized, the material would be sent for recycling into products as chipboards. Only at the end of that cycle, the product would swap back to the biological cycle and be used for instance for energy recovery.

As mentioned in Chapter 4.1, all of the interviewees emphasized the need for new business models in order to move towards circular economy. It is understood that not all the business models fit to the plywood industry. All the business models are presented below with example cases.

Circular supplies

In circular supplies business model (Chapter 3.2), production is based on renewable, nontoxic materials and products which are biodegradable and easy to recycle.

The most important raw material for plywood is a renewable natural resource - wood. Wood products are typically considered to have lower environmental impacts than equivalent products made out of non-renewable raw materials. (Sokka et al. 2015, 4.) It is essential for the successful production of plywood that there is a strong glue bond between veneers. Glue used is phenol formaldehyde resin, which makes recycling the plywood challenging. Also the challenges in recycling can be found from phenolic films that are used to overlay plywood.

Nowadays eco-friendlier types of adhesives (formaldehyde-free) are being researched all over the world to counter this concern (Bruce 2009, 9). What if there was innovated a new kind of a glue in which the veneers could be separated from each other after their lifecycle. By doing so, the veneers could be remanufactured again, giving them a new lifecycle. The same should be considered in an overlaying perspective.

UPM Plywood has already example of this kind of an innovation. UPM Grada is a wood material, which can be formed with heat and pressure. It is

used in form pressing industry. The adhesive foil of UPM Grada does not contain any formaldehyde. At the end of its lifecycle the material can be safely recycled or burned. (UPM 2015.)

Biomimicry was introduced at the end of Chapter 3.2. A hardwood plywood manufacturer Columbia Forest Products from North America has found the way mussels adhere to rocks. A soy-based protein adhesive is used instead of formaldehyde to make a brand of plywood called Purebond. The plywood resin replaces more than 47 million pounds of formaldehyde-based adhesive annually. (Li 2016, 9.) Not only does it avoid toxic chemicals, it has enhanced durability and water-resistance as well (Isaacson 2006).

Resource recovery

As discussed in Chapter 3.3, resource efficiency and recycling are the foundation pillars of circular economy. The value is created from the side streams and wastes of the material flows and also from the products reversed from customers.

As plywood is an intermediate product which is used for manufacturing other products and therefore there is not existing systematic model for recycling plywood. Therefore, the plywood is recycled based on the recycling systems of the end product. (Pirhonen, Heräjärvi, Saukkola, Räty & Verkasalo 2011, 28.)

One of the highest volumes of waste type in Europe is from construction and demolition. Every year one ton of construction and demolition waste is produced per person, which makes 500 million tons in the whole European Union every year. Valuable materials are not always identified and recovered. Improving waste management in this sector is mandatory and has a significant impact on the circular economy. (European Commission 2010, 2.) As construction industry is one of the biggest clients for plywood industry, UPM should consider in which way to design and sell the plywood in order to keep the valuable material in cycle as long as possible.

Waste from the woodworking industry should be used first for recycling and only in a second instance for energy purposes as per waste hierarchy states. Optimizing the energy- and material efficiency have a key role in manufacturing processes, products and value chains. What enables this new approach is, in particular, new technologies and an efficient reverse logistics. (Arponen et al. 2014.) Plywood should consider taking its plywood back and thus maintaining the value of the wood for a longer period of time.

As highlighted on the theoretical and empirical part of the paper, new partners are needed in order to move towards circular economy. UPM should try to find new partners across Europe.

Päijät-Häme Waste Management Ltd continues being a forerunner of waste management in Finland by opening a mechanical sorting plant to Kujala waste center in October 2016. The plant will separate recyclable waste (plastic, carton, wood and metal) from mixed, energy and construction waste with the assistance of several screens and separators. It will have the capacity to treat 66,000 tons of waste per year. The aim of the plant is to increase recycling and ensuring the competitiveness of waste treatment services in the area. (Päijät-Hämeen Jätehuolto Oy 2016.) The plant is needed as the organic waste landfill ban (discussed in Chapter 2.5) came into operation in Finland beginning of year 2016.

Industrial symbiosis is a part of resource recovery business model. The plywood industry produces large quantities of different types of side streams, which could be used in manufacturing new products and increase the added value created in forests. Currently UPM utilizes the wood by-products, such as bark, sawdust and sawmill chips, for pulp and paper making, chipboard production and energy generation (UPM 2016).

Picture 1 presents the side streams from the plywood industry. Starting from the left corner: bark, pulp chip, microchip, sanding dust, glue contaminated chips, pulp chip and waste water sludge.

PICTURE 1: UPM Plywood side streams (Rouhiainen 2016)

Significant share of plywood produced in UPM's mills is exported thus UPM do not have control over the plywood recycling chain as a whole. For this reason, an interesting opportunity lies in production side streams.

The majority of Finnish wood residue ends up to energy (Arponen et al. 2014, 28). Speculation is needed if incineration is the action, which produces the highest economic value. It was discussed in Chapter 2.5 that this may not be the case. Morris claims that the use of wood waste biomass does not fit the sustainability criteria. As per waste hierarchy thinking, presented in Chapter 2.4, waste prevention, re-use and recycling go over energy recovery. It was also discussed in Chapter 2.5 that a waste incineration tax has been proposed. This would force the producers to utilize the side streams and materials in new innovative ways.

However, if side streams from wood processing are increasingly used as raw materials of bio-based products, UPM may become more dependent on external energy resources. The benefits of recycling should be weighed against its impacts.

UPM has organized UPM Side Stream Boot Camp with students from different fields of study to find new solutions to better utilize the side streams

of UPM's plywood mills production. The aim is to reduce costs and increase the value of side streams by finding new opportunities in industrial symbiosis. The students discovered many interesting utilizations for the side streams from earth-moving to agriculture. The researcher will not apply herself to the side streams as they already are under investigation.

As Aistrich (2016) stated in the interview;

> *Understanding, braveness and innovativeness are needed in order to move towards circular economy. Boot Camp organized by UPM is a good example that the company is eager to think the business from a whole new perspective.*

Product life extension

Product life extension business model presented in Chapter 3.4 aims to add value by extending the life cycle of a product for as long as economically and technically feasible. Value can be created by taking a product or component and diversify its reuse more widely across the value chain. By redistributing material, it can replace the inflows of virgin materials somewhere else. (Nguyen et al. 2014.)

As already mentioned plywood is an intermediate product and due that the researcher will focus on this model, how to extend the life cycle of plywood by using the method called cascading. Cascade use was shortly explained on Chapter 2.4 and here it will be covered more in detail from a wood industry's perspective.

From a technical perspective the cascading use of wood takes place when wood is processed into a product and this product is used at least once more either for material or energy purposes (Vis et al. 2016, 6). Figure 23 below demonstrates the distinction between single-stage and multi-stage cascading use of biomass.

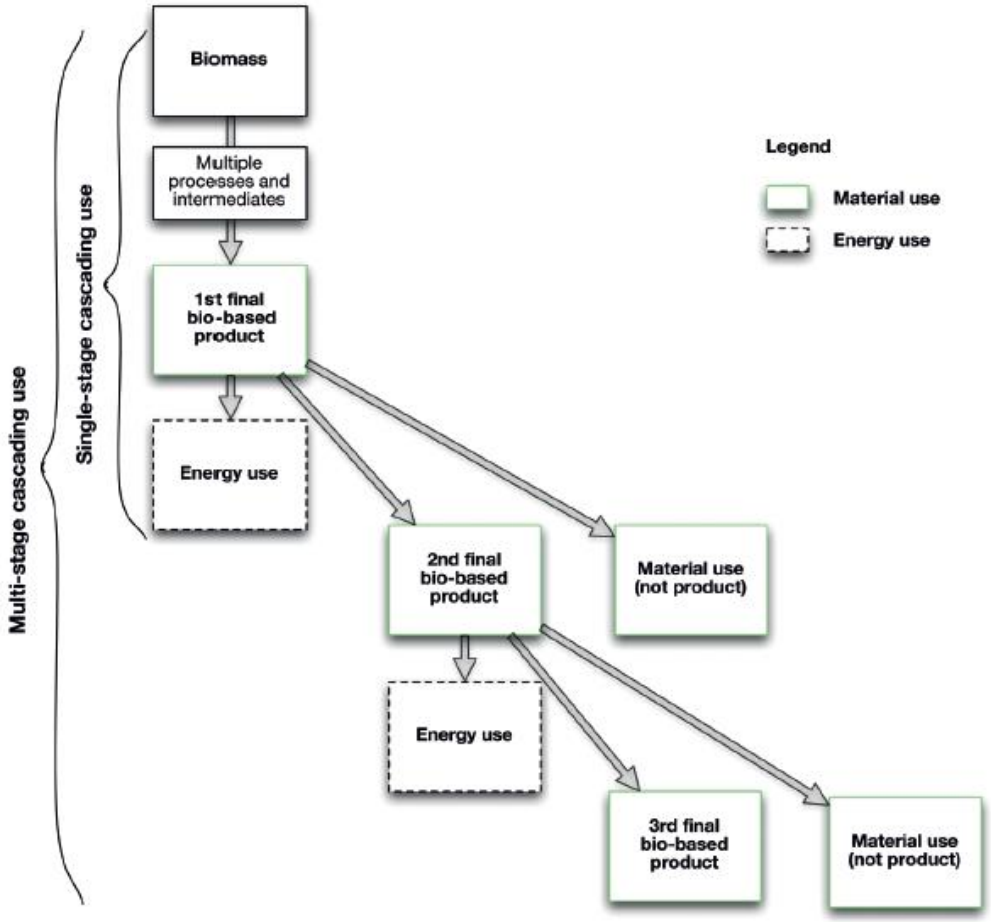

FIGURE 23: Distinction between single-stage and multi-stage cascading use of biomass (Vis et al. 2016, 6)

Cascades in the wood sector usually end with energy generation. This ignores the recommended option to hold the bio based, carbon-storing wooden materials at their maximum quality by reuse in solid form and recycling the reclaimed wood in as many steps of material cascade as possible. (Environmental Implications of Recycling and Recycled Products p 3). However, when wood is kept in the cascade, the energy generation step will be postponed (Vis, Reumerman & Gärtner 2014, 7). Therefore, cascading of wood does not contribute to short term renewable energy targets but instead leads to a sustainable supply of wood for energy generation in a long term. Cascading use is the efficient utilization of

resources. Both industry's side streams and recycled materials can be used for different materials uses to extend total biomass availability. (Vis et al. 2016, 81.)

Recycling wood has wide range of advantages; recycling a ton of wood waste takes 54 manpower hours whereas incineration of one ton requires only two manpower hours. Also when recycling, the service life of the timber is extended thus the need for a new product is eliminated. Furthermore, the carbon contained within the recycled timber is stored for the life of the new product. (European Panel Federation 2016, 221.)

Recent studies have been criticized the use of long-rotating forest biomass for products with short life cycles or energy due to their climate impacts. These studies argue that if using wood for such purposes, it is not carbon neutral because of the time lag between the carbon released through harvesting and incineration of wood, and its sequestration back into new biomass (Cherubini, Peters, Berntsen, Stromman & Hertwich, 2011; Holtsmark 2013; Morris 2016.)

The majority of plywood produced by UPM is exported. Thus, the cascading cycles commonly take place outside Finland. Therefore, the role of UPM in Finland, who is supplying the virgin fiber, differs significantly from the consumer countries for instance Germany and the Netherlands with more recycling, which creates challenges for creation of common cascading concept. (Sokka et al. 2015, 4.) This surfaced during the interviews also, when Ståhlberg stated that for instance in Austria and in some UPM factories in Germany, they have reached the target of UPM's "Zero Solid Waste to landfill" status as they have been forced to innovate new applications as the legislation is strict. The strict legislation may hinder or help the cascade use when UPM looks for partners across Europe.

As a barrier one can see that so called waste wood is still considered in the incentive systems for the production of energy from biomass. This will create market distortions, which, if not corrected in the short term are likely to affect to the evolution of European industry towards more sustainable

economy. (European Panel Federation 2016, 220.) Also other barriers still may occur for instance, technical barriers such as cleaning of recovered waste wood and market barriers such as the dependence on upstream products. Overcoming these barriers requires strong efforts to address the current imbalance between material and energy uses of industrial residues where more significant potential for cascading exists. (Vis et al. 2016, 65.)

For example, UPM sells WISA-Form plywood panels to serve as a concrete formwork system. The good quality base panel could be utilized by removing the damaged overlay and replacing the new surface film. This would be one way to lengthen the lifecycle of the plywood.

Sharing platforms

Sharing platforms business model was presented in Chapter 3.5. The model is centered on sharing of products and assets through an online platform which enables the profitable use of resources and product life extension.

As mentioned earlier in this paper, plywood is an intermediate product, which is used for manufacturing other products. UPM Plywood products are sold through the company's sales offices for industrial customers. Smaller quantities of plywood can be bought from local distributors. (UPM 2016.) Sharing platform do not necessarily fit for selling straight the manufactured plywood.

What if instead for the plywood, there would be a platform for the plywood industry's side streams or reversed plywood, someone would control. There would be a plywood industry's side which offers the materials and the consumer side who needs the material. Matching the material from one facility with potential users at another facility would create new revenues or savings with potential social and environmental benefits. Turning waste output from one company into a product stream for another reduces waste, greenhouse gas emissions, and the need-for virgin-stream materials. Additionally, it creates new opportunities for innovating new products and processes.

For example, The United States Material Marketplace has launched a pilot project to test the feasibility of a national exchange where traditional and non-traditional industrial waste streams could be matched with new products and revenue opportunities. It is a secure cloud-based marketplace software platform, through which project members share materials data, review recommended materials from the project team, negotiate trades, and receive notifications of potential obstacles. Participating companies will find opportunities to lower operational costs and waste disposal expenses while reducing energy consumption and greenhouse gas emissions. Also less raw materials are spent and new business opportunities are created. (US Business Council for Sustainable Development, World Business Council for Sustainable Development & Corporate Eco Forum 2015.)

UPM Plywood could take advantage of the platform by offering either its production side streams or returned plywood. Side streams could be used in new products and plywood for instance in less demanding construction and architectural applications, as there are smaller workshops who prioritize use of recovered wood.

Product as a service

When a product is served as a service, the customer pays for a specific function or performance as discussed in Chapter 3.6. Some of the UPM Plywood's customers have used this kind of a business model for the end-users.

> *With who are you operating and where? What is your business? Are you producing mobile phones or is your business to sell the best and most efficient communication? Are you selling houses or is your aim to take care that a person has a place to stay? (Pietikäinen 2016.)*

In Chapter 3.6 there was an example of product as a service model, where company called Desso leased its carpets. So what if, rather than simply selling a plywood, UPM could instead contract to provide for instance vehicle flooring to the customer. Under the product as a service model, UPM

could replace the portions of plywood that need replacement, and leave the rest of the plywood. UPM still owns the plywood and just replaces the needed parts periodically. This is more sustainable in several ways. First less plywood is being replaced. Second, UPM is now incentivized to design plywood, which can be refurbished or recycled. Third, as UPM is owner of the plywood through its lifetime, UPM is in response of recycling it.

As mentioned, in this model, the customer is seen as a user rather than consumer thus the interaction with the customer is closer. Often the added value is created with digital solutions. In order for UPM to track its plywood, it may add some smart memory chips to the plywood. By doing so, the company would be aware when it is time to replace the plywood.

The machinery used in plywood industry is an expensive investment. UPM should also reconsider instead of buying the machinery, leasing it from the manufacturer. Through leasing model, UPM would have all the time the most modern and efficient machines as the company providing the machinery is in response of the maintenance and the level of the performance considering also the high raw-material utilization. For example, the offering of a smaller Finnish operator in the machinery and equipment sector, Kemppi, has the HumanWeld service, based on which Kemppi hires out capacity, contributing both the machines and skilled users (Arponen et al 2014, 10).

4.5 Conclusions

This chapter reflects on the research questions, points out the main inferences drawn from the theoretical part and interviews and makes suggestions what the researcher sees as most interesting circular business models for plywood industry. First, answers are provided to the three sub-questions. The answers given to the sub-questions enables the ability to answer the overarching research question; “How can UPM Plywood implement different circular business models?”

What is the concept of circular economy?

Circular economy is an economic model which has recently gained a lot of awareness as people have started to realize that our traditional linear economy model is not sustainable. Unlike the linear “take-make-dispose” model, circular economy aims to keep products, components and materials at their highest utility and value at all times. It aims to eradicate waste – not just from the manufacturing processes but systematically throughout the life cycles and uses of products and their components.

Circular economy requires a transformational change at all levels – from government policy to business models, and from technological systems to individual consumer choices. The change is not possible without brave businesses and also it cannot happen overnight.

What is a circular business model?

Circular business model differs from traditional models by concentrating on creating value for a broader range of stakeholders and taking into consideration benefits not only from the ecological perspective but also societal and environmental.

Accenture’s five circular business models were used as a base for this research: circular supplies, resource recovery, product life extension, sharing platforms and product as a service. The characteristics of these business models includes longevity, renewability, reuse, repair, upgrade, refurbishment, capacity sharing and dematerialization

What does it take for a company to implement a functional circular business model?

The information gained from the theoretical and empirical parts of the study shows that within a company product design, research and innovation activities play a key role in creating a circular economy. The importance of new business models was highlighted among all the interviewees.

The company's management needs to be willing to change the company's strategy to be more circular. Braveness and innovativeness are important drivers towards circular economy. Company cannot move towards circular economy without close collaboration with other actor of the value chain.

How can UPM Plywood implement different circular business models?

From a plywood industry perspective, the interesting opportunities lies in the side streams. Keeping or even increasing the value of the side streams by utilizing different industrial symbiosis is important. Also different sharing platforms were pointed out. Most likely, the quickest way for UPM Plywood to move towards circular economy is to start by utilizing its side streams.

But UPM Plywood can do better than that. In fact, also the sales of the bulk commodities should be thought from the circular economy point of view: How to keep plywood in circulation and at its highest value for as long as possible?

Also as discussed, the producer responsibility is becoming more and more important thus UPM should also consider taking back its plywood. Cascade use of plywood was introduced, which supports the European Union waste hierarchy. In order to implement the cascade use, reverse logistics need to be included to the business.

As Pietikäinen (2016) stated, if you only keep doing things a bit better, you only end up walking more instead of running a marathon. The game-changers in each business sector will reap the greatest rewards.

Reliability and validity

When conducting a qualitative study, it is worth taking reliability and validity of the research result into account. Reliability refers to the trustworthiness of the research. (Ritchie & Spencer 1994, 601.) Reliability is considered high if the result of the study, in this case interview, can be repeated at other occasions using the same methods. Validity concerns whether a method describes or measures what it is supposed to describe or measure. Validity relates to the proficiency of the research; how rigorous the study is and how

well does it correspond to the research questions (Hirsjärvi, Remes & Sajavaara 2004, 216-218).

It needs to be noted that the levels of familiarity with the concept of circular economy varies between people. However, the interviewees experience and professional interest towards circular economy were important factors when considering the reliability of the interviews. They had extensive knowledge and experience of circular economy for providing reliable information on the topic. For a better improvement of the reliability, the interviews were recorded and transcribed carefully.

The high number of conducted interviews, as well as the variety of backgrounds and experiences of the interviewees can be seen as a strength, and positively contributed to the overall validity of the results. However, it is important to acknowledge that the implementation of the concept, and therefore the related barriers and enablers companies experience, might vary based on geographical and cultural contexts. The suggestions of how UPM could change its business models to more circular were the author's proposals.

Suggestion for further research

The thesis generated topics for further research. Since the topic of circular economy is not researched yet that much, especially circular business models are rather new, it seems that the companies who are actually implementing the circular economy have not reported on the change and business impact yet.

However, the case study of UPM Plywood was useful to increase the understanding of the circular business models and how they can be applied to plywood industry. The case study aimed to bring new ideas to each of the business models. However, further analysis and research is required to determine how UPM could implement a specific business model.

To conclude, the research brought up a variety of study options that require a deeper reflection at a later stage. Suggestions for further research could be the following; revenue models for circular economy business models, the impact of legislation when moving towards circular economy in a plywood industry, reverse supply chains in a circular economy and overall impact of circular business models in a plywood industry beyond economic and environmental variables.

5 SUMMARY

The overriding purpose of this study was to provide a better understanding of the main characteristics and purposes of circular economy and its business models in a plywood industry. To accomplish that goal, it became necessary to reach some prerequisite goals. Those goals were for example, theoretical framework of circular economy and circular economy business models and expert interviews of how a company can move towards circular economy.

The wood industry in general has a huge potential to close the loops in the economy. This fact was confirmed by the presentation of possible circular business models for UPM Plywood. Both, technical and biological cycles need to be involved when moving towards circular economy.

This study acts as a vanguard for UPM Plywood in direction of more circular business. Possible future directions from here requires understanding different revenue and incentive models of each circular economy business models.

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APPENDICES

Appendix 1: Interview structure

1. Please briefly introduce yourself and/or your company.
2. What is circular economy?
3. How circular economy can be seen in your company/ Finland?
4. What does it take for a company to implement a functional circular business system?
    a. intrinsic factors
    b. extrinsic factors
5. What motivates a company to move towards circular economy?
6. Do you find regulations as a barrier moving towards circular economy?

APPENDIX 2: Interviewees

Interviewee	Company	Title
Mika Aho	ST1 Nordic Oy	Director in Public Affairs & Communications
Timo Huhtisaari	North European Oil Trade Oy	Sustainability and Biofuels expert
Esa Parkko	Gasum Oy	Production Planning Engineer
Matti Aistrich	Sitra	Senior Lead, Business Development
Ernesto Hartikainen	Sitra	Circular Economy specialist
Anne Raudaskoski	Ethica	Circular Economy expert
Mika Horttanainen	Lappeenranta University of Technology	Professor
Pirjo Kaivos	CLIC Innovation LTD	Cleantech and Sustainability professional and program manager
Riina Antikainen	Finnish Environment Institute	Specialist in Circular Green Economy and Senior Researcher
Sirpa Pietikäinen	European Parliament	Member of European Parliament
Esa Laurinsilta	UPM	Director, Strategic Partnerships and Technology