Bachelor's thesis

Energy and environmental technology

2020

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CIRCULAR ECONOMY STRATEGIES IN PLASTICS COMPANIES

– Evidence-based case studies from Finland

TURKU AMK
TURKU UNIVERSITY OF APPLIED SCIENCES

BACHELOR'S THESIS | ABSTRACT

TURKU UNIVERSITY OF APPLIED SCIENCES

Energy and environmental technology

2020 | 44 pages, 1 appendix

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CIRCULAR ECONOMY STRATEGIES IN PLASTICS COMPANIES

- Evidence-based case studies from Finland

The aim of this thesis is to give the reader a picture of the potential of the circular economy in business. The work examines the best circular economy strategies that companies can utilize in response to the plastics problem. The companies mentioned in this thesis are setting an example of reducing the use of raw materials and the amount of waste generated in their operations. This is done in accordance with the idealogy of circular economy on closing, slowing and narrowing resource loops.

The thesis was commissioned by the project Bioplastics Europe, which is working to find sustainable solutions for bio-based plastics in order to reduce the environmental problems caused by traditional plastics, for example in relation to end-of-life problems.The work defines the concept of circular economy and different circular business models, which will help to understand the possibilities of sustainable development in economic, social and environmental terms. The thesis mainly focuses on the strategies implemented in accordance with the EU definitions and studies their use in Finnish plastic companies.

The research part was carried out by designing a survey to support the information gathered online. It focused on the challenges, as well as the opportunities, different scenarios for the future and other sustainable development issues in the transition towards circular economy. Two Finnish companies in the circular economy, Sulapac Oy and Arctic Biomaterials Oy, were selected for the study. The companies operate in the Finnish industry, produce sustainable products and set a good example of sustainable development for other companies.

It was found that the cooperation between all the sectors during a product's whole value chain is key in order to make the most of circular economy. An increased pressure by consumers, companies and regulators drives the transition towards the circular economy. For companies that want to address the plastics problem, it is important to emphasize product design so that its entire value chain is sustainable and the product is easy to recycle and reuse.

Further actions are necessary in order to make it easier for companies to operate successfully in the circular economy. This means developing regulations that support circular economy actions, allocating more funding to circular economy research and pilots as well as raising public awareness of the benefits of the circular economy.

KEYWORDS:

bioplastics, circular economy, sustainable design, closed loops

OPINNÄYTETYÖ (AMK) | TIIVISTELMÄ

TURUN AMMATTIKORKEAKOULU

Energia- ja ympäristötekniikka

2020 | 44 sivua, 1 liitesivu

Ella Rasimus

KIERTOTALOUDEN STRATEGIAT MUOVIYRITYKSISSÄ

- Yritysesimerkkejä Suomesta

Työn tavoitteena on antaa lukijalle kuva kiertotalouden potentiaalista yritystoiminnassa. Opinnäytetyössä tarkastellaan parhaaksi todettuja kiertotaloden strategioita, joita yritykset voivat hyödyntää vastatakseen muovien aiheuttamiin ongelmiin. Työssä mainitut yritykset näyttävät esimerkkiä raaka-aineiden käytön ja syntyvän jätteen määrän vähentämisestä kiertotalouden idealogin mukaisesti sulkemalla, hidastamalla ja kaventamalla materiaalikiertoja.

Opinnäytetyön on teettänyt Bioplastics Europe -projekti, joka pyrkii löytämään kestäviä ratkaisuja biopohjaisille muoveille perinteisten muovien aiheuttamien ympäristöongelmien vähentämiseksi. Laajan tiedonhaun avulla määritellään kiertotalouden konsepti, joka auttaa lukijaa ymmärtämään kestävän kehityksen mahdollisuudet taloudellisessa, sosiaalisessa ja ympäristöllisessä mielessä. Opinnäytetyössä keskitytään pääasiassa EU:n määritelmien mukaisesti toteutettuihin strategioihin ja tutkitaan niiden käyttöä suomalaisissa muoviyrityksissä.

Tutkimusosa toteutettiin suunnittelemalla kysely tukemaan internetistä kerättyjä tietoja. Kyselyssä keskityttiin haasteisiin, mahdollisuuksiin, tulevaisuuden skenaarioihin ja muihin kestävän kehityksen kysymyksiin kiertotalouteen siirtymisessä. Valitut yritykset ovat Sulapac Oy ja Arctic Biomaterials Oy. Yritykset valittiin sen perusteella, että ne kuuluvat suomalaiseen teollisuuteen, tuottavat kestäviä tuotteita ja tarjoavat hyvän esimerkin kestävästä kehityksestä muille yrityksille.

Tutkimus paljasti, että alojen välinen yhteistyö tuotteiden koko arvoketjun aikana on avain kiertotalouden hyödyntämiseen. Kuluttajat, yritykset ja sääntelyviranomaiset lisäävät painetta kiertotalouteen siirryttäessä. Yrityksien, jotka haluavat vastata muoviongelmaan, on tärkeää painottaa tuotesuunnittelua, jotta tuotteen koko arvoketju on kestävä ja tuote on helppo kierrättää ja palauttaa takaisin kiertoon uudelleen hyödynnettäväksi.

Jotta yritysten olisi helpompi menestyä kiertotaloudessa, vaaditaan lisätoimia. Tämä tarkoittaa kiertotaloutta tukevien asetusten kehittämistä, tutkimukseen ja pilottihankkeisiin suunnatun suuremman rahoituksen jakamista ja yleisen tietoisuuden lisäämistä kiertotalouden hyödyistä.

ASIASANAT:

biomuovit, kiertotalous, kestävä suunnittelu, materiaalikierto

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1 INTRODUCTION

We currently live in a non-sustainable ‘’take-make-dispose’’ based linear economic model, which causes the earth’s limited resources to become oveburdened. The use of the world’s resources has increased exponentially as a result of technological and industrial developments over the last century (Ellen MacArthur Foundation 2015). Alongside with economic growth, people's well-being has improved and the need for ownership of goods has increased. This growth has allowed the plastic industry to increase their production to more and more applications. In 2018, the world’s plastic production reached almost 360 million tonnes (PlasticsEurope 2019). It is widely recognized that plastics plays an important role in delivering a more sustainable future, for example by reducing food loss and cutting CO2 emissions due to the light weight and innovative materials in cars and planes (European Comission 2018). However, the environmental problems caused by the production and use of plastic have been a recurring topic in various media. Challenges related to littering and end-of-life options for certain types of plastic waste, especially packaging waste, must be addressed (PlasticsEurope 2019).

The EU plays an important role as a pioneer in the circular economy. In January 2018, the EU released its first plastics strategy to respond to plastic waste, while promoting innovation and economic growth. Currently, the benefits of the circular economy are being missed as plastics are produced and inefficiently disposed of in the traditional linear economy way. The aim of this thesis was to review the strategies of circular economy that companies could use in the plastics industry and leverage it to make the entire product value chain more sustainable.

The report seeks, through online sources and publications and a survey, to provide an overview of the various circular economy practices and strategies currently being implemented by plastics companies. In order for companies to be able to move towards a circular economy and the EU circular economy strategy, the current situation must be known, challenges identified and a strategy developed to overcome them.

The aim was to give a clear picture and understanding of the potential of circular economy in plastics companies. Issues such as what the circular strategies are based on and why they are needed, and how the circular economy will play an ever increasing

role in plastics and in planning future business strategies are also discussed. If implemented, these strategies also play a major role as in climate change mitigation.

1.1 Progression of the thesis

The thesis begins by introducing the project Bioplastics Europe, which commissioned this thesis. Before the theoretical sections, some background information on plastics is presented. The theoretical part, chapters two and three, explain the basic idea of circular economy and circular economy business models. The chapters also present the EU's circular economy and plastics strategy which many of these strategies are based on. Furthermore, the concept of corporate strategy and its importance in changing traditional businesses from a linear economy to a circular approach is explained. Examples of different circular economy strategies in regard to slowing and closing material loops are presented through Finnish business examples.

The thesis concludes with a results section followed by a comprehensive discussion on the following matters:

- **What are the circular economy strategies based on?**
- **What are the best circular strategies according to the online sources and survey**?
- **What is the future of the circular economy?**

The collected data helped to get an idea of the role of the circular economy in the strategic planning of companies today and in the future. In order to plan for the future, the current situation must be clarified. When looking at the current situation, it is likely that the circular economy will play an increasingly important role in our society both as an economic growth and job creator and a mitigator of climate change.

1.2 Bioplastics Europe

This thesis was devised for Bioplastics Europe, is a national project founded by the EU Research and Innovation programme called Horizon 2020. The goal of the project is to find sustainable solutions for bio-based plastics in land and sea environments while combining economic and environmental aspects through circular economy. This includes finding innovative strategies and solutions for bio-based products, such as packaging, marine and ship products, toys and kitchenware. By combining innovative product

design, environmental and economic assessments of products‘ life cycles and business models, efficient reuse and recycling solutions as well as the safety of materials for the environment and society, the project supports the EU plastics strategy and circular economy and therefore facilitates moving towards a plastics-free environment. (Bioplastics Europe 2020).

1.3 Aim and methodology

The aim of the work is to gain a better understanding of how plastics companies operate in accordance with the circular economy. The concept of the circular economy within the framework of sustainable development is introduced. The research part of the thesis is carried out by designing a survey of corporate circular economy issues and collecting responses from two companies specializing in bioplastics.

With the help of the survey, the thesis explores the motives, main barriers and different forecasts that the companies might have in regard to circular economy and sustainable development of their business. The work reviews the answers of the Finnish companies' circular economy experts and compares them with information gathered from different online sources. Keywords used for the online search included for example: circular economy, sustainable development, bioplastics, circular economy business models, material cycles, circular economy strategies. The materials used have been published between 2004-2019. The survey questions were designed to support the literature information in the theory section.

The goal was to understand in more detail the role of circular economy in the current and future business of companies working in the plastics sector. It is important to recognize the problems that a company faces when moving towards a circular economy and, on the other hand, why companies are ready to face these problems. The questions are designed so as to find out what the company thinks is the best circular economy strategy, and to provide a forecast of the future of the circular economy.

Two different Finnish companies were selected for the research part based on the following principles:

- Both companies started operating in a circular economy at an early stage
- Both companies are part of the Finnish industry and both have experience in sustainable development.

- Both companies produce biodegradable substitutes for plastic products, which is essential for the research part of the thesis.
- In addition, Arctic Biomaterials collaborates with the project Bioplastics Europe, which commissioned the thesis.

The companies that were selected for the thesis are:

1. **Sulapac Oy**
   Main business: Packaging. Sulapac is a completely degradable raw material, which is free of microplastics and made of wood and natural binders. It is a Finnish innovation that is used for various different applications, such as packaging and cosmetics.

2. **Arctic Biomaterials Oy**
   Main business: Manufacturing. Arctic Biomaterials Oy is a company producing biodegradable plastic solutions from bioresorbable glass fiber reinforced PLA materials for the medical and technical industries.

1.4 Research questions

The key research questions of the thesis "Will the circular economy displace the linear economy in the future" and "What is the future of plastics?" were formed after a detailed research and information search for the theorethical part of the thesis. In addition to the two key questions, more detailed questions arose. Below you will find a list of them, as well as an explanation of why these questions are important for the study. These questions formed the basis of the survey sent to the two Finnish bioplastics companies.

‘’**What is the best circular economy strategy for the company you are working for and why? Who should be the leading example when moving towards circular economy (e.g. companies, government, society)?’’**

The question shows the ‘’attitude’’ of the company when moving towards a circular economy from theory to practice. Many do not want to take the first step and take responsibility for whether the idea starts to work.

‘’Why did your company want to move towards circular economy? What was the path and how did it happen?’’

The question shows the sustainable development path of the company. Motive, task, vision – the importance of corporate strategy. The opportunities of sustainable development can be shown to other companies.

‘’How hard has it been moving towards a circular economy? What have been the greatest challenges (eg. investments, regulatons, attitudes)?’’

With this question, the problems a company can face when moving towards circular economy can be identified. By identifying the challenges, the company can develop the best strategy to deal with them and show other companies how to overcome barriers.

‘’How do you see the attitudes changing towards circular economy? How will companies apply the circular economy in their operations in the future?’’

It is important to have a forecast of the future to know where we are going, and why it is important to go in that direction. In other words, to predict what are the most important changes and challenges that may come up.

The results of the survey were analysed, after which a conclusion was reached on the development of the circular economy in plastic companies.

1.5 Backround about plastics and bioplastics

The common denominator of plastics is the so called polymer. Modern syntethic plastics were invented around 100 years ago. Since that, many new plastics, offering a huge range of different properties, have been developed. In Finland in 1955, the consumption of plastics was approximately 2.6 kg per capita per year. After a decade, the consumption was already at 34.5 kg per capita per year (Ekokumppanit 2020).

Different plastics are used for different applications and all plastics have their own sustainability issues. Plastics can be delivered from fossil-based or renewable raw materials. Even mineral-based materials, such as salt, have been used for producing plastics (PlasticsEurope 2019).

1.5.1 Plastics

Plastics are divided into two categories, thermoplastics and thermosets (PlasticsEurope 2018). Figure 1 below presents the division of these categories. The most important difference between these two categories is that thermoset is a material that strengthens when heated, but cannot be remolded or heated after the initial forming, while

thermoplastics can be reheated, remolded, and cooled without causing any chemical changes (PlasticsEurope 2019).

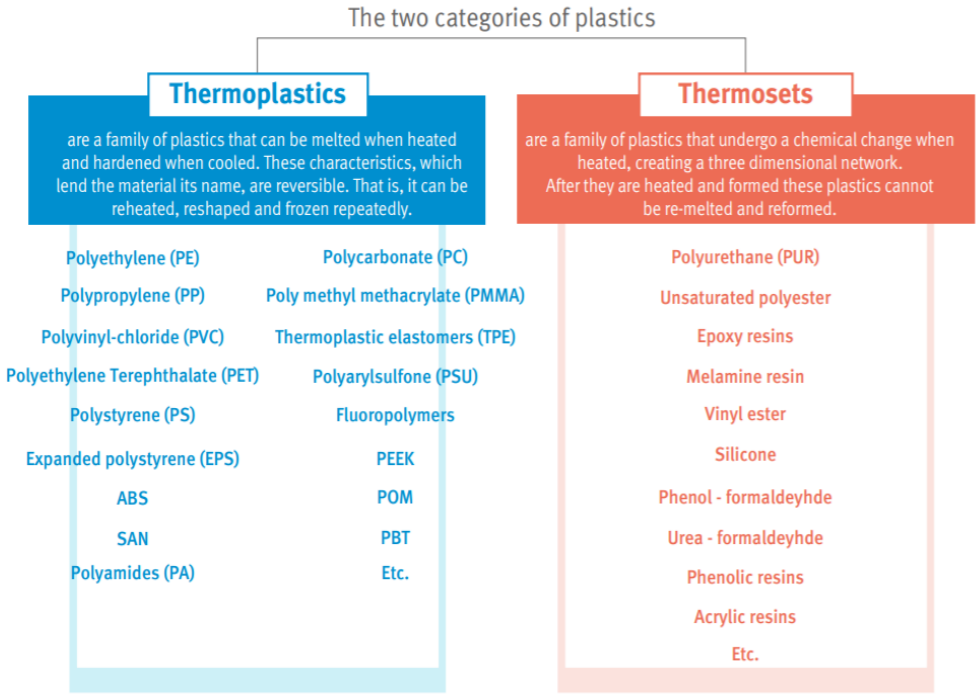


Figure 1 The wide family of plastics (Plastics Europe 2018).

The use of main types of plastics, i.e. polyethylene (PE), polypropylene (PP), polystyrene (PS), chloride (PVC), makes up about 80% of the total use of plastics in Finland. (Muoviteollisuus ry 2020). As in other parts of the world, the biggest demand for plastics in Finland is in packaging. As much as half of the plastics we use are so called single-use plastics that are thrown away after a short period of use. These plastics are rarely recycled and prone to end up in the environment as litter. Single-use plastics represents half of all the litter ending up in the oceans. (European Commission 2018.)

Despite the many good qualities plastics offer, various studies have shown that there are many problems with the end of life in plastics, especially when it comes to the single-use plastics. The world population is expected to increase by over 2 billion persons by 2050, which means that the consumption of goods will increase as well as the production of plastics (United Nations 2017).

Concerns about the environmental problems caused by high consumption of plastics, such as the littering of the seas and also the depletion of oil reserves, have led people

to come up with new solutions to replace traditional plastics. These concerns have contributed to the emergence and development of the bioeconomy.

The concept of the bioeconomy has gained considerable political popularity in the last ten years around the world. This popularity derives generally from the bioeconomy promise of economic growth and at the same time the solutions it offers to many environmental and social problems (de Besi & McCormick 2015; Birch 2016; Bugge, Hansen & Klitkou 2016). Using bioplastics instead of conventional plastics are an example of the transition from using non-renawble natural resources to using renewable resources and moving from a linear economy to a circular economy.

Many countries and businesses have already taken big steps towards bioeconomy. As Finland has a lot of high-quality forests, it is already one of the leading countries in the bioeconomy and circular economy. Finnish companies have already introduced many different innovations for wood-derived biomaterial as an alternative to products made of plastic, for example (Mundus International 2019).

1.5.2 Bioplastics

Bioplastics are plastics that are partly or wholly made from polymers that originate from biological sources. According to European Bioplastics (2020), a plastic are defined as a bioplastic if it is bio-based, biodegradable or both. There is a variety of materials that have different properties and that can be used to produce different bioplastics for many applications.

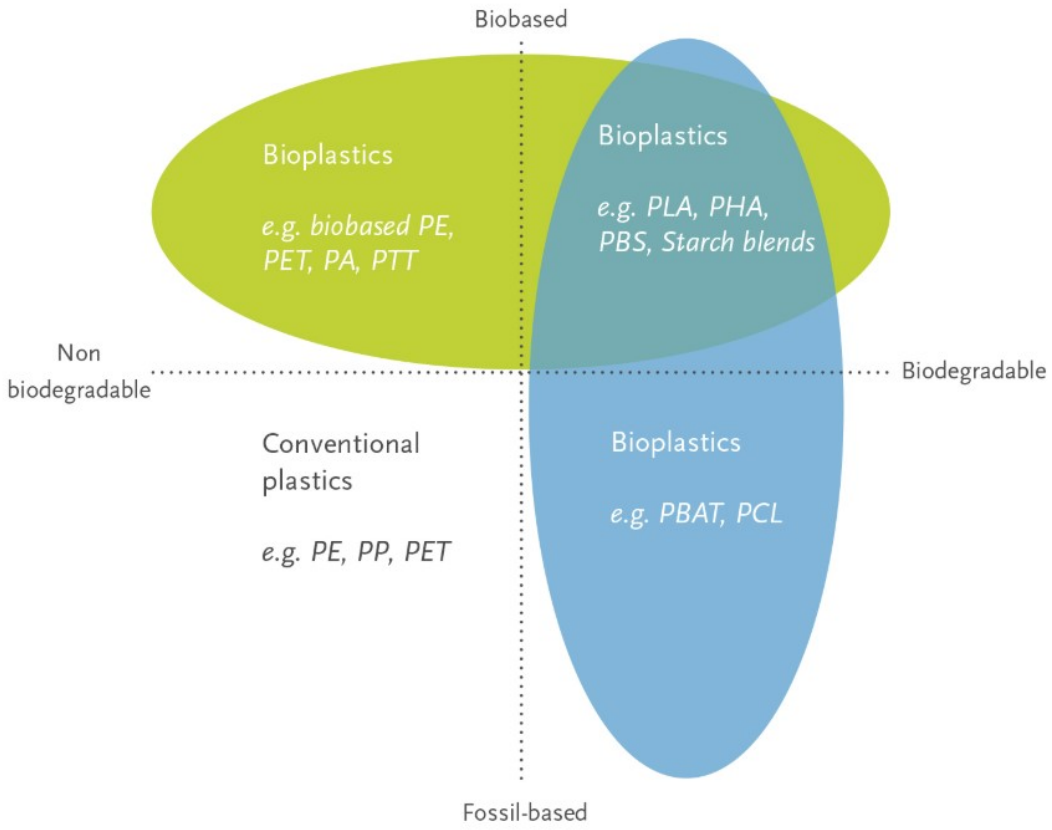


Figure 2 Understanding different categories of plastics (European bioplastics 2020)

Bio-based plastics are the hot potato of the 20th century. Although the markets of bio-based plastics are relatively small compared to traditional plastics, in 2016 only about 1%, the interest in bio-based alternatives is growing and their future looks bright. It has been estimated that the production of bio-based plastics will grow up to 50% in the first half of the 2020s. If the product has not specifically been made biodegradable, it will not degrade. In general, the share of bio-based materials in a product can be anything from 10% to 60%. However, any official body obligates the producer to mention how much of the product is made from renewable materials. (Ekokumppanit 2020)

Biodegradable plastics are designed to degrade if they are released into the environment or when exposed to the right conditions. In order to classify bioplastics, for example packaging products, as biodegradable, they must meet the EU biodegradability standards and decompose into organic compounds, water and carbon dioxide within 6 months. The standards specify, among other things, the conditions, such as temperature and pH, under which the plastic should decompose. Figure 3 below shows the biological

degradation process of polymers, which is also known as ultimate aerobic biodegradation (Systems 2012).

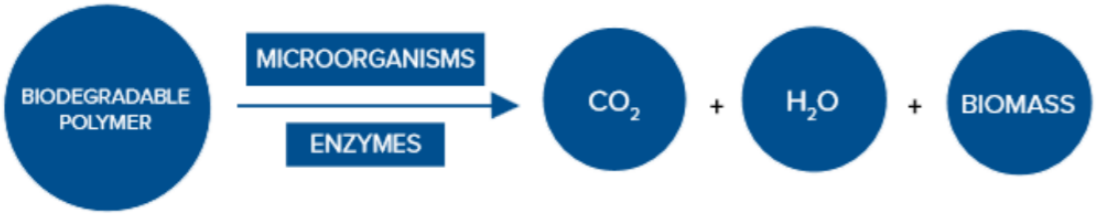


Figure 3 The process of biological degradation of bioplastics (Šprajcar 2012)

2 THE CIRCULAR ECONOMY CONCEPT

This chapter presents the definition and basis of the circular economy. Consumers often associate the word ‘’circular economy’’ with only recycling the generated waste, but it is much more than that. It is quite a novel economic model in which production and use are designed in such a way that a minimum amount of waste possible is generated and that materials and their value are kept in circulation for as long as possible. The circular economy concept is still considered relatively complex by many companies. Therefore, the model needs more easy-to-understand examples from companies in different industries.

2.1 Linear economy vs. Circular economy

To understand the concept of the circular economy, one must understand the current system. The present linear system is characterized by the destruction of the product at the end of its life. It is one of the biggest reasons for the severe depletion of natural resources (Michelini et.al. 2017). Currently, the linear economy is considered the dominant model for a product’s life. A linear economy deals with raw materials in an inefficient way because the goal is not to preserve the materials but to maximize profits.

When the goal is to achieve the cheapest product possible, the carbon footprint increases. No attention is paid to the energy efficiency of the equipment used in the manufacture of the products, and transports from the other side of the world cause a large carbon footprint. In addition, the linear economy is associated with significant societal problems. Not enough attention is paid to the working environment of workers and many companies use cheap labor, which facilitates illegal immigration and

employment. Workers are exploited in the hope of entering the country and are not offered the necessary worker rights.

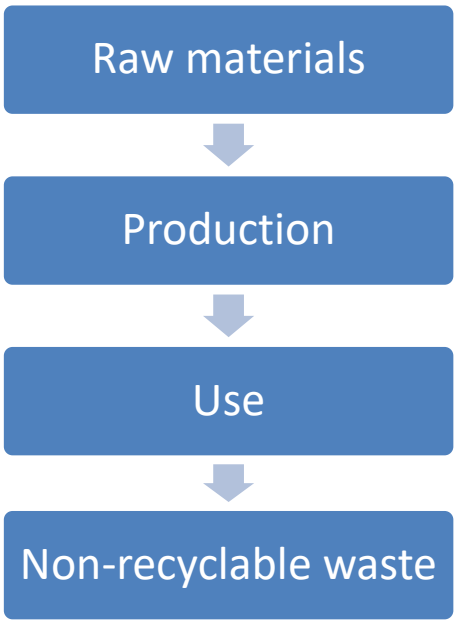


Figure 4 Linear economy

In a linear economic model, the value of the product collapses and is often destroyed when the product is sold. A linear model promotes non-reusable resource usage and usually the product design is neglected as the product is not designed to be long lasting or recyclable.

Circular economy (CE) is an alternative way of thinking from the current linear take-make-dispose economy. It aims to preserve and maximize the economic and environmental value of materials and to keep materials in the economic system for as long as possible. (Ellen MacArthur Foundation 2017). This is done either by extending their life cycle, for example by repairing a product, or by looping the materials back into the technical or biological loops for reuse. In other words, it replaces production with sufficiency. CE not only pays attention to extending the life cycle of products and materials but also seeks to contribute to social justice, i.e. the rights and well-being of workers.

Circular economy builds long-term sustainability and creates business and economic opportunities. In a report written in 2014 for the World Economic Forum, the EllenMacArthur Foundation and McKinsey concluded that the transition to a circular

economy could offer more than a trillion dollars to the global economy by 2025 (World Economic Forum 2014, 13). In general, circular economy is based on more specific approaches, including such models as cradle-to-cradle (C2C) design, biomimicry, industrial symbiosis, ecosystem services and already existing and new methods of waste recycling and recovery (Sustainability guide 2018).

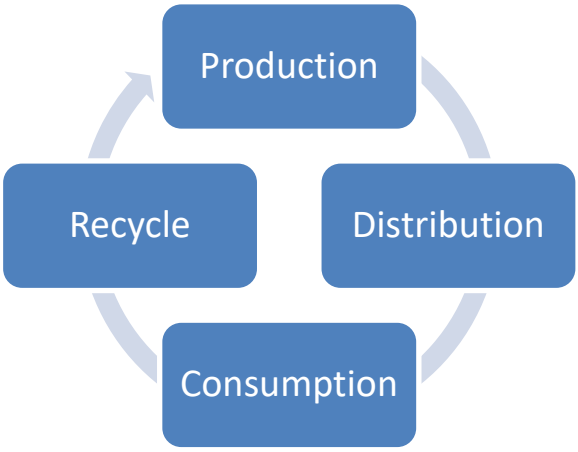


Figure 5 Circular economy

2.2 Cradle-to-cradle

The cradle-to-cradle (C2C) vision is a part of a circular economy design strategy where the technical design and especially the materials of the product are considered. The product is designed in such a way that, at the end of its life cycle, the materials from the discharged products are easily available as raw material for new products, rather than being waste that is hard tor recover (Sustainability guide 2018). Basically, the products are broken down either into basic components, which are used to make new products, or biological components that can be returned to the soil. C2C is the opposite of the traditional cradle-to-crave model, which follows the model of the traditional linear economy.

The C2C model is not only an efficient way to use resources but also improves the continuity of the materials in the value cycle. This way the system helps to protect the environment by reducing the ecological footprint. According to the C2C model, all components that are involved in the product process must have a continuous life cycle. As materials have different origins they are divided into two cycles, technical and

biological. Depending on where the materials of the product come from, the product can be designed to pass through the suitable cycle (McDonough & Braungart 2004).

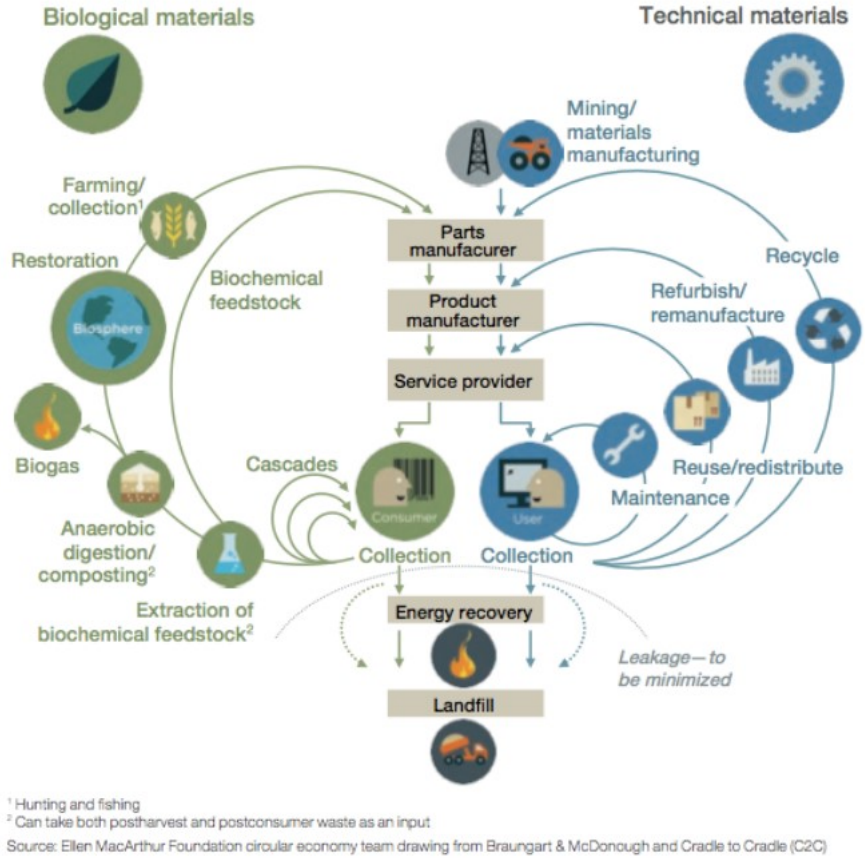


Figure 6 The continous flow of biological and technical materials through the value circle (Ellen MacArthur Foundation 2012)

In order to maintain the high quality of materials and to increase the efficiency of the movement of materials, technical and biological nutrients must be stored in different circuits. The Ellen MacArthur Foundation has designed a diagram (Figure 6) that presents how the technical and biological materials flow continuously through the value circle. When the loops shown in Figure 6 are smaller, the less energy and other resources are needed for circulation and the value of the resource remains higher.

2.2.1 Technical cycles

Technical cycles include technical materials such as metals, oil-based plastics and chemicals which are used, for example, as raw material for electronic devices and other

products. The original raw materials from nature have been processed in such a way that they can no longer be returned back into nature. That is why, from a circular economy perspective, managing the technical loops is important (Ellen MacArthur Foundation 2015).

Technical cycles seek to maximize the utilization of products, components, and materials through technical strategies such as reuse, repair, remanufacturing or, as a last resort, recycling. The materials mentioned above are great examples of materials that can be recycled or reused to produce the same or better quality in closed loops.

2.2.2 Biological cycles

Biological cycles enable bio-based materials to be recycled back into manufacturing processes and new applications. The biogas generated in the looping process can be used in energy production (European Commission 2020). Composting and anaerobic digestion are processes that are designed to feed the biological materials, such as wood, bioplastics and natural fibres back to the circular system. Through the biological cycles, materials return to the nature and renew living systems, such as soil, that provide renewable natural resources for the economy (Sustainability guide 2018).

Obtaining raw materials from the nature should happen in such a way that nature has the time and potential to recover. Continuous burning of fossil fuels releases carbon dioxide into the atmosphere, causing global warming and subsequently many other environmental problems (United Nations 2020). The biological cycle plays an important role when it comes to nature's recovery. By keeping the biological materials in the cycle, the production and use of non-renawbe materials can be considerably reduced. Several studies show that the transition from the use of non-renawble resources to renewables is important for the sake of reducing carbon dioxide emissions to the atmosphere, and that this move plays a key role in a fight against the global warming (Ellen MacArthur Foundation 2015).

3 CIRCULAR STRATEGIES FOR PLASTICS

The current plastics economy needs a complete shift towards a circular economy where research and innovation, as well as policy making, play a central role. When transitioning towards a circular economy, there is a better opportunity to utilize the benefits of plastics while achieving better environmental, economical and social results. This chapter presents the definition of a strategy, as well as the best circular strategies implemented in Europe for fighting the problems caused by plastics pollution and other plastic-related problems.

3.1 Definition of a strategy

Strategy as a concept is multidimensional and therefore difficult to define in one sentence. A strategy means a plan that is set for achieving a desired goal. Strategy is especially related to the management of organizations and companies and its goal is to gain a competitive advantage over competitors. A strategy is formed from multiple parts on the basis of which companies and organizations plan, implement and monitor their strategic activities. The strategy consists of the combined effect of business ideas, visions and values (Kamensky 2014, 53).

Without a strategy, the desired outcome is hard to achieve. A strategy can help to target expertise and resources correctly and to reflect on potential threats or opportunities. When considering a strategy, the weaknesses and strengths are also considered, as well as how to combine these to achieve competitiveness and a better outcome from the competitors. (Kamensky 2014, 18-20)

3.2 Circular strategies for plastics in Europe

Actions against plastics were identified as a key priority in the EU Circular economy action plan. On January 2018, the European Commission published *The European Strategy for Plastics in a Circular Economy.* The aim is to create a new plastics economy in which the 3 R's rule – reducing, reusing and recycling – are considered in the design, manufacture and afterlife of plastic products. To move towards a more sustainable plastics economy, the document proposes several circular economy strategies for plastic

producers, designers, retailers and recyclers, as well as for businesses, the civil society, national and regional governments. The vision is to create a smart, innovative and sustainable plastics industry, which increases economic growth and jobs in Europe and helps to decrease the EU's greenhouse gas emissions and dependence on imported fossil fuels (European Commission 2018).

In 2017, plastic production in Europe equalled 64.4 million tonnes. Out of this number, the total demand for plastic packaging alone was 39.7% (PlasticsEurope 2018). The EU's goal is for all plastic packaging on the market to be either recyclable or reusable by 2030. According to the report, this will be achieved through a variety of strategies. Particularly strategies to slow down and close resource loops through sustainable design, and considering the different business opportunities in the circular economy, as well as improving waste management making products easier to reuse, recycle and repair, will play a key role in the future.

3.2.1 Waste hierarchy

The move from a linear economy to a circular economy requires maximum efficiency in the life cycle process of each product or service. Here, waste management is one of the most important things to consider. The transition to a circular economy cannot take place without systematic change in all sectors. It requires a change in technology, as well as creative industries such as design and advertising (McKinsey Center for Business and Environment 2016).

Waste hierarchy shows the order of priority according to which the necessary actions must be taken to reduce the amount of waste generated. It helps to improve waste management processes and programs. The waste hierarchy consists of 3 R’s as follows:

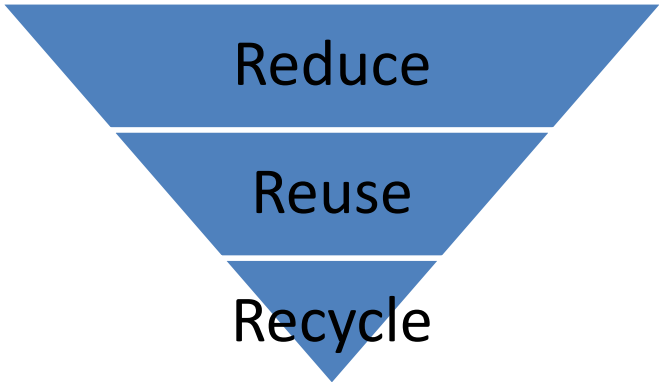


Figure 7 3 R's Reduce, Reuse, Recycle

As mentioned earlier, one of the key strategies commonly adopted in Europe is to improve waste management by designing products sustainably and thus making it easier to follow the waste hierarchy. Methods that help to achieve the goals of the 3 R's are presented in table 1 below.

Principles	Goals	Methods
Reduce	Preservation of natural balance and natural resources, increasing natural capital	Recycling, using renewables, sharing, monitoring of renewable resources, delivering utility virtually
Reuse	More efficient use of goods, optimizing of production resources and materials	Sharing and reusing, looping (four looping levels); consumer level, service provider level, producer level, component level
Recycle	Identification and disposal of harmful production tools and processes	Minimizing the losses of the value of the materials, minimizing the consequences of economic activity

Table 1 Principles, Goals and Methods for 3 R's (Adapted from McKinsey Center special edition 2016.)

Reducing is the first part of the waste prevention hierarchy as it reduces the use of production materials and therefore the waste generated. By reducing material use, the environment has more time to recover. In practice, this could mean for example reading virtual books instead of buying. Reusing means an extension of the product utilization period through the design of long-life products. The products can be designed to be repairable and long-lasting by using durable materials. Recycling means closing the loop between post-use waste and production. It means that the value remains through recycling the material back into the manufacturing process and to new products and applications.

These guidelines have been adapted widely across the EU and are also used as a guideline in the plastics sector to get rid of disposable plastics and other plastics problems. However, it is important to understand that not all plastic products are the same and not all have the same service life. Some plastic products have a lifespan of less than 1 year and some more than 50, depending on the intended use (Plastics Europe 2018). Plastics are very durable and therefore part of a more sustainable future in areas such as architecture, healthcare and medicine sector. However, disposable plastics, such as packaging, are a problem especially when they reach the end of their service life.

3.2.2 Finland as pioneer in circular economy and bioeconomy

Finland has also identified numerous plastic challenges and has come up with a plastics ‘’road map’’ to help steer the activities of companies, producers and consumers in a more sustainable direction, while moving towards the common European plastic goal and the circular goals of the Paris Climate Agreement.

As in the *European strategy for plastics in a circular economy*, Finland has also recognized the importance of product design, sustainable resource usage and the circular business models as a premise for the sustainable development of the plastics economy. In addition, solutions such as replacing conventional plastics with biomaterials and coming up with new and improved recycling technologies, as well as more efficient recycling and waste collection, have been acknowledged as an important way to make the plastic value chain a part of the circular economy (Ympäristöministeriö 2019).

In recent years, the circular economy model has received more and more attention in Finland, and the transition to a circular economy, bio economy and cleantech has been one of the government's main goals (Mundus International 2019).

3.3 Sustainable design strategies to slowing and closing material loops

Remaking the plastics economy will require sustainable product design. Product design plays a very important role as the use of resources and energy, transportation and basically all activity and decisions are defined around it. According to *A new Circular Economy Action Plan*, released in 2020, up to 80% of the products' environmental impacts are determined in the designing phase (European Comission 2020). Once the product specifications have been made, it is hard to make any changes. A circular approach must happen both on the technical and biological levels. The aim of designing for the technical cycle is to minimize the energy and material inputs, as well as emission outputs, throughout the whole lifecycle of a product. Designing for the biological cycle aims take advantage of the decomposition of materials. The intention is that biomaterials can be recycled back to the process or a new application.

There are multiple circular product design strategies that are based on the following (Mestre & Cooper 2017):

- Design to slow and narrow the loops
- Design to close the loops
- Design for bio-inspired and biobased loops

Strategies to design to slow the loops include designing for durability and product-life extension, so that the material flows would slow in each phase of the life cycle. Strategies such as product design for recycling and easy disassembly are used to close the loops. Attention is also paid to materials. Bio-based loop strategies aim to utilize biological materials in a way that, at the end of their life cycles, they can be returned safely to the nature (Vezzoli & Manzini 2008).

Product design can be used to promote reuse, repair and recycling. It is easier for companies to build long-lasting customer relationships when products are made durable. Innovative product designs can encourage people to reuse the products in contrast to the current ‘’take-make-dispose’’ way of thinking. Sustainable design gives a company

the possibility to maximize their turnover, associated with the recovery of waste, utilization and recycling (European Commission 2014). Sustainable design enables slowing the resource loops by designing products with a long life span and designing for product life extension.

Recycling is the first option for plastic packaging waste (PlasticsEurope 2018), but most of the products are made from a variety of polymers and additives, which makes the recycling process difficult and products non-degradable. Fortunately, there are already a large number of companies that produce sustainable packaging and other products using sustainable design. One good example is a Finnish company called Sulapac that produces packaging products made of wood-based materials that, unlike plastic products, are completely biodegradable and leave no microplastics behind. In the product design process the production includes only renewable materials and the product is designed to be visually appealing and recyclable.

3.4 Circular business models

Circular business model strategies, together with circular product design, have been considered a contributor to moving towards a circular economy. There can be many definitions of what business models are, but most agree that a business model describes how a company captures, delivers and creates value in an economic, cultural or other context (Kavadias, S. et.al. 2016; Lahti, T. et.al. 2018).

A circular business model (CBM) is designed to create and capture value while helping to achieve an ideal state of resource usage. CBMs are based on three principles, which are to design the product out of waste and pollution, to keep the products and materials in use, and to regenerate natural systems. CBMs utilize technical and biological cycles to keep the materials and products in use for as long as possible (Ellen MacArthur Foundation 2020).

By encouraging a long product life and reuse of products, CBMs contribute to the slowing and narrowing of resource loops. This is done by capturing the residual value from by-products or ‘’waste’’ through business model innovation, product design and manufacturing efficiency. The commonly accepted five circular economy business models are (OECD 2018, 4; Sitra 2019):

- Circular supply chain

- Product as a service
- Product life-extension
- Recovery & recycling
- Sharing platform

Circular business models operate in different parts of the product value chain and some can operate in many parts. Many of the CBMs can be utilized at the same time, so it is common for companies to plan their activities and strategies around many of the circular business models (Accenture 2015).

The goal is to maximize the product value and keep the materials in the cycle for as long as possible. In other words, to lengthen the life of the product. So, in practice the circular business models can work through multiple stages, which include reutilization, repair, rehabilitation and recycling. During the reutilizing phase, product rights may be transferred to other persons for further use. During the repair phase, the product properties are restored. During the rehabilitation phase, the product or its parts are modified to obtain new functions. And, in the recycling phase, the materials from the product are used as a resource to create new products.

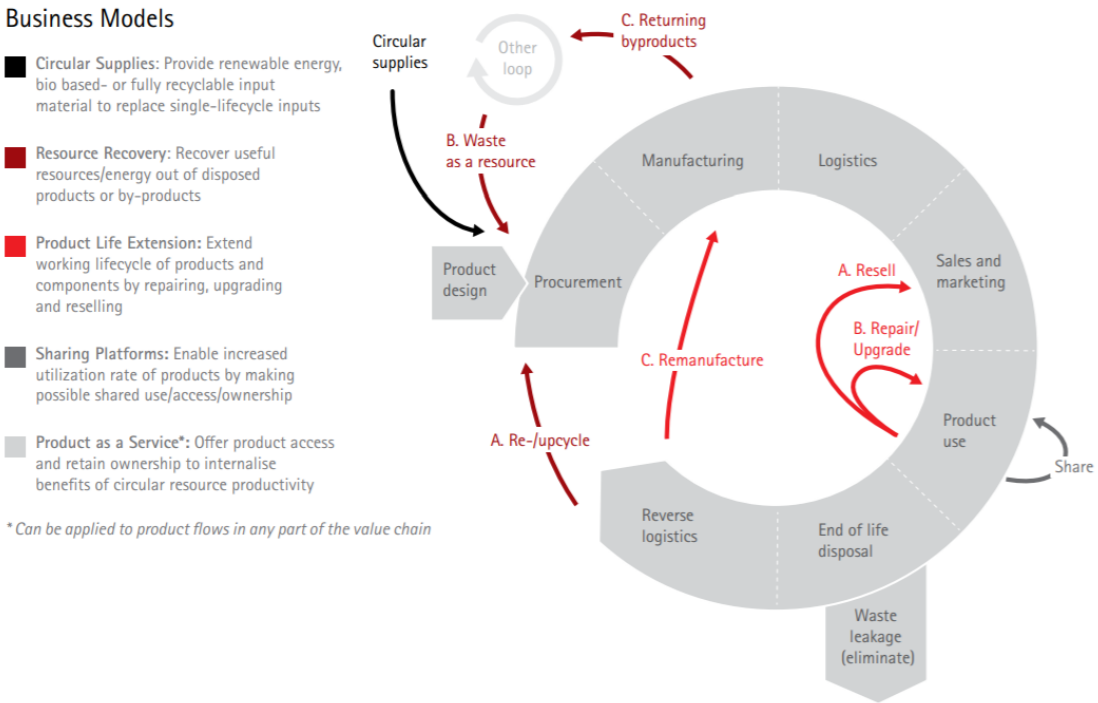


Figure 8 The five circular business models (Circular Advantage - Accenture 2014, 12)

Production of any service or product goes through the seven main stages, which are: material procurement, manufacturing, logistics, sales & marketing; use of the product; disposal; reverse logistics. Figure 8 above shows the different stages of product production and how the circular business models can be utilized in different stages of the process.

3.5 From theory to practice

In this chapter different Finnish companies that work to fight plastics pollution through circular business models are presented. Also, the business model's execution and purpose are defined in more detail. As a challenge for Finnish companies to meet the changing needs of the world, Sitra has listed over 100 most interesting companies in the field of circular economy. The list is intended to inspire companies to develop their business in the direction of the circular economy and to be part of the more sustainable world of the future (Sitra 2017). The following business examples are listed among these companies.

Circular supply chain is a business model that encourages manufacturers and sellers to use sustainable materials and energy sources, such as renewable energy, bio-based or potentially completely recycled materials in the sourcing, manufacturing and logistics of the products. As mentioned in chapter 3.3, up to 80% of a products' environmental impacts are formed in the early stages of a product's life cycle.

The textile industy is one of world's most polluting industries. Oil-based plastic fibres, used in textiles, release microfibres into waterways when they are washed and end up harming aquatic environments and organisms. **The Infinited Fiber Company** uses textile, paper and cardboard waste to produce a cotton-like, soft textile fibre that can be used as a more sustainable substitude for plastic fibre.

Product as a service system & Product life extension are strongly associated with the slowing of the resource loops, as seen in the Ellen MacArthur Foundation diagram in Figure 6. The product as a service system is based on the idea that instead of owning things, user rights for products are provided to the customer and the growing product range will then be used as a service. Renting or leasing is an example of a product as a service activity. The main idea behind extending the product's life is to keep the product in use as long as possible. This prevents waste from ending up in final disposal and

thereby slows the flow of materials and reduces the need for new raw materials. For example, repairing, refurbishing or selling products can extend their life cycle.

The Finnish company called **RePack** manufactures reusable mailing packages and offers them as a service to companies as a more sustainable alternative for disposable packages. The packages are made from recycled, durable, easily recyclable materials, such as polythene or polypropylene. RePack utilizes the usable materials from the packages into new products, such as backpacks, and the rest is recycled. RePack is designed to last from 20 to 50 using times, which is an enormous improvement for the single-use basic mailing package. As a result, the product's life is extended, the production volumes decreases and producers are able to focus their resources on the product's quality and longevity. With an efficient use of resources, the environmental pollution and the growing scarcity of natural resources can be minimized.

The purpose of **resource efficiency & recycling** business models is to keep the materials in the material loops as long as possible. By recycling materials into new raw materials for new products, for example as recycled plastics, the production of virgin plastics can be reduced. This, as a result, will save natural resources, prevent littering and reduce harmful emissions to the atmosphere.

It was estimated that about 130 tonnes of plastic packaging ended up in the Finnish markets in 2017 (Lassi & Tikanoja 2020). The Finnish company **Armerplast** tackles the problems against packaging plastics by producing sustainable ESSI plastic bags. 90% of the materials used in the bags come from recycled plastic waste, half of which is plastic from consumers, collected separately, and half is packaging plastic from Kesko's warehouse. Used plastic bags can be recycled again into new raw material. (Sitra 2017)

Sharing platform business models help people to increase usage rates and extend products' and materials' life cycle on digital platforms through leasing, selling, and reusing. **Zadaa** is a mobile application that encourages people to sell unused clothing in an online marketplace. The company wants to tackle the problem of unnecessary discarding of clothes and the constant purchasing of new ones, which causes overuse of materials, such as plastics and other resources, such as water.

4 EVIDENCE-BASED CASE STUDIES FROM FINLAND

This chapter presents two Finnish plastics companies that have implemented circular economy strategies in their operations. In addition, the section provides answers to survey questions which have been used to obtain more detailed information about what has driven these companies to act in a way that promotes the transition to a circular economy. Topics included in this research are: The best circular strategies for companies, the transformation to the circular economy, the challenges a company might face during the change and the forecast for circular economy.

4.1 Introducing the companies

Sulapac Ltd. is a Finnish company founded in 2016. The company produces wood-based products, such as cosmetic packaging and straws, as well as food packaging. The key features of the products that Sulapac produces are:

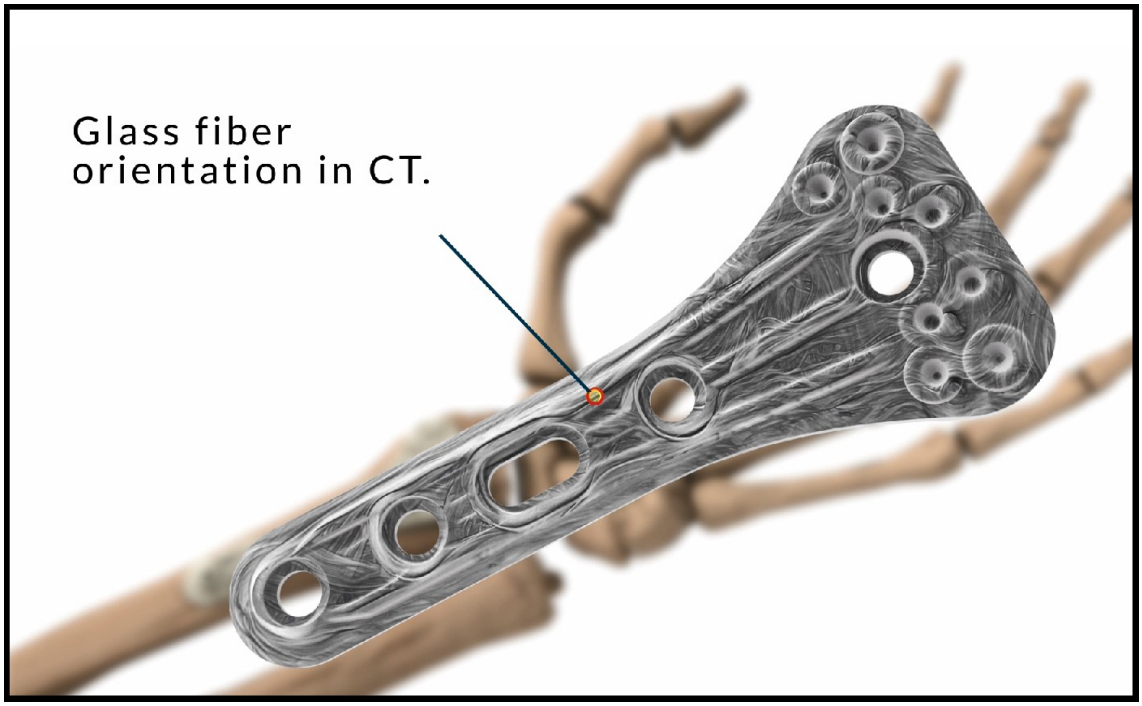
- Microplastic-free
- Compostable
- Sustainable raw materials
- Safe by design
- Mass producible

The company's actions are driven by the idea of respecting the environment. The products are manufactured sustainably and attention is paid to sustainability throughout the whole product value chain. When looking at the company’s products, it can be seen that sustainable design is at the heart of the company. The products are durable, beautiful and timeless. The company co-operates extensively with companies in various fields, such as cosmetics and food packaging (Sulapac Ltd., 2020).

Picture 1 Sustainable design - a box made of Sulapac's material containing Fazer's traditional handmade pralines (Sulapac Oy 2019)

Arctic Biomaterials Ltd. is a Finnish company founded in 2014. The company uses the ABMcomposite technology to produce for example bioresorbable implants for medical use and biodegradable composite solutions for demanding technical applications. The target industries for ABMcomposite technology are automotive, consumer electronics and furniture. According to the company, their ABMcomposite technology has properties that can be used in various new application areas in the field where traditional fossil-based plastics are normally used. The key features that the products have are:

- Compostable
- Reusable
- Sustainable raw materials



Picture 2 ABMcomposite in medicine - Traditional metal based plates can be replaced with load-bearing bioabsorbable plates (Arctic Biomaterials Ltd. 2020)

The values that drive the company's operating methods are to be a reliable partner by investing in design, technology and customer relationships. The company constantly pays attention to environmental challenges and strives to meet them through continuous product development and research. The company notes that in some cases the use of ABMcomposite has been able to reduce greenhouse gas emissions and the use of non-renewable energy (per kg of polymer produced) by 60% to 80% when comparing the use of traditional plastics (Arctic Biomaterials Ltd. 2020).

4.2 Analysis of the research questions

Based on the theoretical part of this thesis and the research questions sent to the two Finnish companies, this part of the thesis answers the questions ‘’Can the circular economy displace the linear economy in the future" and "What is the future of plastics and circular economy?". Experts' responses to circular economy issues will be complemented by an online research and the companies’ website information on the sustainable development of the circular economy and bioplastics. Questions were

answered by Ms Maija Pohjakallio, Sustainability Director ar Sulapac Ltd. and Marjo Ketonen, Circular Economy Expert at Arctic Biomaterials Ltd.

4.2.1 Moving from a linear economy to a circular economy

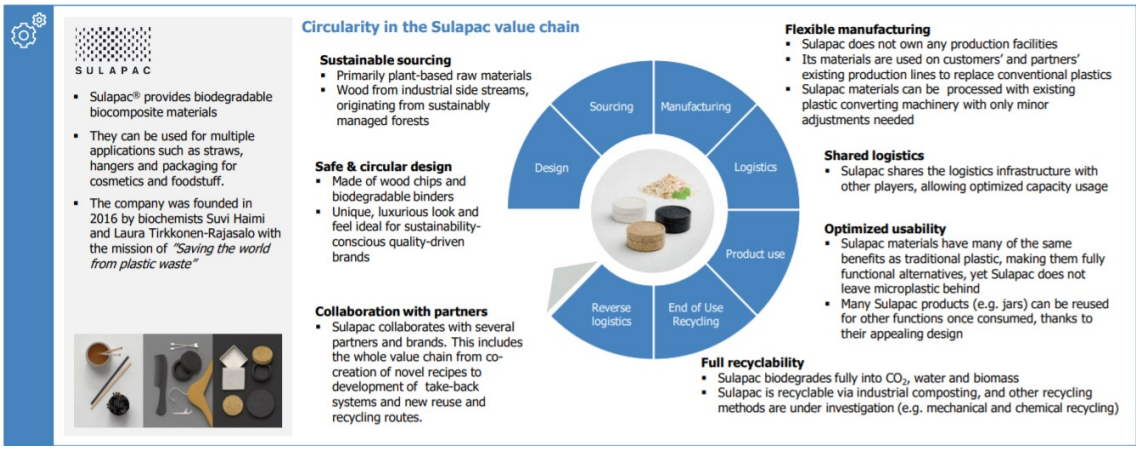
More and more companies are moving from the linear model to a circular model. Finland aims to become the leading country in circular economy. This is done by for example developing roadmaps, providing public financing to innovative experiments in the field of circular economy and drafting legislative reforms to support the preservation of environment (World Circular Economy Forum 2019). Both of the companies were mentioned on Sitra's ''The most interesting companies in the circular economy in Finland'' list.

The questions ''What is the best circular economy strategy for the company you are working for and why?'' and ''Who should be the leading example when moving towards circular economy, e.g. companies, government or society?'' were asked of the experts. The answers to these questions give an example of the strategies the two companies have used to succeed in the field of circular economy in their own sector. Many companies aim to make a profit, and small companies are often reluctant to take the initiative because of too much risk. In addition, many think that the government should take responsibility for the economy and development. The experts who responded to the survey provided their views on these matters.

Maija Pohjakallio from Sulapac answered that:

> *''Cooperation is key to the development of a circular economy, companies have a big role to play, but the input of government and society is also needed, because it is a systemic change. Although Sulapac is a small company, we also invest in cooperation with the public sector and participate in cooperation groups related to the circular economy (including the Ellen Mac Arthur Foundation) and communications. Our own circular economy strategy is therefore holistic and covers more than just the development of sustainable materials and their recycling.''*

Maija describes the company's circular economy mindset with a picture, which she sent to support her answers.



Picture 3 Circularity is rooted deep in Sulapac's operations - From R&D to end-of-life recycling (Sitra 2020)

The picture shows that Sulapac takes sustainability into account throughout the whole product value chain. Maija Pohjakallio also points out problems associated with circular economy strategies like this:

> *''A society's circular economy strategy should be technology-neutral, e.g. the materials sector should equally promote the development and markets of all forms of sustainable carbon (bio-based carbon, recycled fossil carbon, carbon captured directly from CO2). At present, the situation is not equitable but recycled fossil carbon has been a priority in political choices.''*

Marjo Ketonen tells about the sustainability strategies of Arctic Biomaterials like this:

> *''Our company's business is based on sustainability. The products manufactured are targeted and designed to replace fossil-based options or enable new product categories that embody renewable carbon. ABM production is part of the transition from linear to circular material flows with the use of renewable carbon and biodegradability as one of the optional end-of-life options.''*

She continues by pointing out important factors and enablers in the transition to circular economy:

> *''Legislation is a major driver when transitioning towards sustainable materials: Avoiding the use of fossil-based plastic materials or their incineration. Extended producer responsibility for the material life cycle*

> *from cradle-to-grave increases interest and demand towards ABM products. Also, consumer awareness is crucial but that entails only an indirect effect as ABM is serving OEMS by a business to business (B2B) business model. The awareness of our customers is probably a combination of societal pressure, demand and legislation.''*

4.2.2 Motive and development path

The questions ‘’What was the reason your company wanted to move towards circular economy?'' and ‘’What was the development path and how did it happen?'' examined the motives of the companies to move towards a circular economy. It also shows whether the company has initially started to develop its business in accordance with the circular economy, or whether the company has changed its operations from a linear to a circular economy.

Ever since the establishment of Sulapac, the company's goal has been to promote sustainable development. As a specific environmental problem, the company has identified the plastics problem and has taken being involved in saving the world from plastic waste mountains as its mission.

For Arctic Biomaterials Oy, the choice to make sustainable products was done during the establishment of the technical site. Marjo Ketonen told about the company's history of moving to a circular economy like this:

> *‘’The vision was that in the future there will be a growing demand for durable bio-based plastic glass fiber composite materials and compounds that can be part of the circular material flow. The support came from the privately held company owners who enabled financing for production investments and R&D infrastructure as shifting towards circular economy can be considered risk management. The know-how the company already had was seen as an asset that could be targeted in the development of novel sustainable material products.''*

4.2.3 Challenges

The experts shared their challenges in circular economy development and gave views on different problems that any company could face on the way to a circular economy. Meeting the challenges related to implementing the circular economy strategies requires companies put the whole value chain on the table. It will take time and investments, but will likely be worth it.

Maija Pohjakallio from Sulapac identified four key challenges for the circular economy development:

1. The circular economic development in a society is not technology neutral, eg. the materials sector does not equally promote the development and markets of all forms of sustainable carbon. As mentioned before, recycled fossil carbon has been a priority in political choices.
2. Producer responsibility for packaging is evolving in a direction that favors traditional high-volume production.
3. Waste management legislation and infrastructure is fragmented, i.e. there are differences between countries and regions.
4. There are no comprehensive indicators (or indicators under development) to measure the development of the circular economy. For example, LCA is a good starting point, but does not take into account systemic developments or the latest identified environmental impacts (eg. microplastic emissions).

Marjo Ketonen from Arctic Biomaterials recognizes also many challenges in regard to different regulations and product design, for example:

> *‘’The challenge could be to combine new product development with regulations that may be behind the development. Missing regulations on new material combinations can cause uncertainty and hesitation during marketing and targeting applications for new products.’’*
>
> *‘’The engagement of the customers to develop truly sustainable options in their final products and their will and capability to use materials with higher cost than original cheap fossil based plastics is important. One challenge is that we are missing recycling technologies for bio-based plastics that are not chemically equivalent to fossil versions. That leads to emphasizing*

> c*omposting as an end-of life option, and that is a challenge if material should be simultaneously designed to last for a long life span.''*

> ''*The public debate should be, instead of de-carbonization, focused on the terms of using the "right carbon", meaning materials formed from renewable material flows, biomass, waste and side streams to help embody the atmospheric carbon. It is problematic that the public (consumer) attitude and language aims for de-carbonization, even though the demand and consumption of plastic products keep increasing. There can be also misconceptions on land-use or idea of competition between human feed and material production when bio based plastics are discussed.''*

4.2.4 Forecast for circular economy

Transition to a circular economy plays a key role in making the future wealthier and more sustainable. The change could provide responses to many issues in terms of job creation and economic growth and offer solutions to environmental problems (Sitra 2015). The two circular economy experts from Sulapac and Arctic Biomaterials answer questions about the future of the circular economy: ''How do you see the attitudes changing towards circular economy?'' and ''How will companies apply circular economy in their operations in the future?''. The answers indicate the potential of the circular economy and the work that needs to be done to achieve the whole potential of the model. Although circular economy is a relatively new concept, many companies see it as a part of their future.

Maija Pohjakallio from Sulapac shares her thoughts of the future of the circular economy like this:

> *''The coronavirus has concretely shown how the well-being of people, businesses, society and nature are all connected. The transition to a circular economy is a systemic change that promotes sustainable development holistically, and with the corona, this has become increasingly clear. Companies that do not take the circular economy into account cannot succeed in the future. The circular economy means not only new*

technologies and products, but also new models of cooperation and new business models.''

Marjo Ketonen from Arctic Biomaterials sees the future of circular economy like this:

''Meeting the growing demand for plastic products with renewable sustainable materials needs the support of regulation and tax credits for using renewable carbon. The emergence of new products and products as services business models are seen as new industrial end-of-life options for plastics, especially via biodegradation of renewable carbon-based plastics products.''

''The growing producer responsibility and the need to track, record and proof the material life cycle in many cycles will hopefully increase together with the reduction of single-use, non-biodegradable or recyclable plastic (packaging), and drive towards new solutions and new businesses. New technologies around material circulations will come with high employment potential. Circular economy will increase collaboration and strengthen resource management. The digital and material business world will need to collaborate more tightly as material will move in new directions. Circular economy will be seen and set as a default mode. The old linear poor resource handling will be left to history and the lessons will be learned.''

5 SUMMARY AND CONCLUSION

The aim of this thesis was to gain a better understanding of the potential of the circular economy in plastics companies. Additionally, real-life examples of the transition of two Finnish bioplastics companies to the circular economy and the motives and challenges identified during the process were examined through a survey answered by experts in the field of bioplastics and circular economy.

5.1 Research summary

During the theoretical research, a vast array of information was obtained through online materials, which led to a better understanding of the circular economy concept.

The research concluded, through varios sources, that despite the circular economy concept being relatively novel, the implementation of the concept has economical, social and environmental advantages. The theorethical part of the thesis examined the circular economy concept and how the concept can be utilized in plastics through various different strategies such as designing sustainably or using different circular business models. Bioplastics played a major role when it came to the circular economy of plastics.

Circular economy strategies are based on guidelines and good practices developed by the EU, as well as research results and experiments developed in collaboration with many companies and researchers. Many strategies follow the instructions of the 3 R's; Reduce, Reuse, Recycle. Bioplastics circulate in a biological cycle, where biomaterials can be released into nature, while conventional plastics, when released into nature, cause great environmental damage.

The study did not reveal a clear "best strategy" as it is affected by many things, such as which environmental problem the company wants to focus on the most. However, it became clear, both through theoretical research as well as through survey responses, that product design is considered one of the most important strategies as it can have a major impact on the sustainability of the entire value chain. It can reduce the use of fossil-based plastics and water, as well as reduce the waste generated. It was agreed by both companies that cooperation between different companies and stakeholders is key when

it comes to the strategies of the companies, and that the whole life cycle of a product must be taken into account.

The thesis confirmed that circular economy will play an ever increasing role in plastics and bioplastics and it has a major role as a climate change mitigator. High social responsibility and the urge to make the world a better place are the main motives why companies plan their strategies towards circular economy.

The results of the survey showed that both companies placed great importance on cooperation. The circular economy is a systemic change that needs initiatives from companies, the state and society. Right regulations, tax supports and increased general awareness are needed. In addition, the importance of developing waste management was mentioned in European and Finnish strategies, as well as in both companies.

To reap the full benefits of the circular economy in the plastics sector, the first step is to understand the motives to abandoning the current linear model and the benefits that circular business models offer. The thesis proved that for plastics companies, circular business models can be profitable. Companies have identified environmental benefits from the use of biomaterials, such as the reduction of greenhouse gases in the process. Sustainability is also an important part of shaping a company's image, and by moving towards it, many customers can be reached. Finnish know-how in the field of biotechnology and the circular economy attracts the attention of companies internationally, and therefore the development of the field opens up great opportunities globally.

However, certain difficulties in the companies were noticed when moving towards circular economy. The main ones were regulations regarding product design and waste management, the lack of proper technologies to recycle bio-based plastics and comprehensive indicators to measure the development of the circular economy. Still, the future of circular economy and bioplastics is considered bright and there will be new solutions for the emerging plastics problems. Circular economy will open great business opportunities with the reuse of materials and the creation of value-added products through services and innovative solutions.

5.2 How to turn challenges into opportunities

Businesses are under more and more pressure from the public and private sectors. Circular economy is seen as a future for businesses, but the transition is not always easy. For a business to move from the current dominative linear model to a circular model more easily, a change is needed. This means that the need for research and development is a relevant topic. Also, more research is necessary in all sectors on the advantages that implementing different circular business models offers. Consumers need policies that promote the reuse and repair of products, as well as a variety of services such as rental. Businesses and consumers should be encouraged to co-owning, as well as sharing. In this way, the life cycle of products can be extended.

The circular economy is still such a new model that it lacks examples of how to act in many areas. The general debate on the circular economy and bioplastics needs to be made more positive. Terms in the circular economy need to be defined in order to avoid misunderstandings, for example in relation to land use. This must happen at an early stage by increasing training and education on sustainability within cities, companies and schools.

In order to make it easier for businesses and consumers to implement sustainable development strategies, various tax incentives and legal reforms related to renewable raw materials and carbon need to be implemented. The public sector can promote the circular economy through its own actions for example by removing obstacles from the transition to a circular economy and strengthening existing incentives for material efficiency. Instead of using virgin raw materials to produce a new product, it should be more profitable for companies to use materials already circulating in the economy. This way the economic value of the materials are increased and environmental impacts reduced.

Today, some regulations are seen as a challenge to the progress of the circular economy, but by developing them, for example in the context of product manufacturing, they can be contributing to a more sustainable future. Products need to have requirements regarding the use of materials used in the products, the energy efficiency and durability of the machines used in the manufacture of prodcuts, and the reusability of the products. For example, new standards could guarantee the same quality of all

products in terms of sustainability. Attention should be paid to the labeling of products to make it easier for consumers to recycle them.

More of mutually beneficial cooperation between companies from all sectors of the economy is needed. As for important future research topics, we should consider the importance of creating value for all stakeholders, including creating different methods of increasing economic, social and environmental well-being where the interests of different stakeholders and sustainable development are in balance. We have everything we need to implement the idea of a sustainable society and environment.

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List of survey questions

Goal	Questions
To show the ‘’attitude’’ of the company when moving from theory to practice in circular economy. -Many do not want to take the first step and take responsibility for whether the idea starts to work.	-What is the best circular economy strategy for the company you are working for and why? -Who should be the leading example when moving towards circular economy (e.g. companies, government or society)?
-To show real examples from Finnish companies -To show the companies’ motivation behind the transition to circular economy	-What was the reason your company wanted to move towards a circular economy? -What was the development path and how did it happen?
To find out the challenges companies have faced when implementing circular economy process	How hard has it been moving towards circular economy? -What have been the greatest challenges (e.g. investments, regulatons attitudes)?
-To have a forecast about the future made by a field expert -To predict what are the most important changes and challenges that may come up -To understand the future of this kind of economy in Finland	-How do you see the attitudes changing towards circular economy? -How will companies apply circular economy in their operations in the future?