



The Circular Economy concept as the key to Sustainable Development: Finnish approach

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Bachelor's thesis

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| <p>Abstract</p> <p>This thesis is about the circular economy concept as a new industrial revolution that aims to reduce the input of raw materials and output of waste to the environment by closing economic and ecological loops of resources. The purpose of the research is to explore and to show the reader the path of the circular economy concept implementation into Finnish business and the contribution of this concept to the sustainable development.</p> <p>This work describes the sustainable development opportunities within the circular economy concept mainly in Finnish region, but some examples from European Union are taken into account. The theoretical part of the thesis clarifies the phenomenon of the circular economy, the history of the concept development, different applicable business models, and opportunities for the world's progress.</p> <p>The research part of the thesis explores the barriers, scenarios of possible transformation, and perspectives that companies meet in the circular economy implementation process for its potential strategic sustainable development. The central methodology for the research is the qualitative in-depth expert interviews. The five personal interviews were conducted with experts from Finnish companies such as Gasum Oy, EntoCube Oy, Ethica Oy, CLIC Innovation Oy, and Bionova Oy, which work and develop within the framework of this concept. These circular economy companies are leading in the Finnish industry. The experts were selected on the basis of their experience, implemented projects and scope of professional activities.</p> <p>The study revealed high prospects for the circular economy development both in Finland and throughout the world. For many experts, this concept is relatively new but has already been studied enough for its application. The main driving force for development was the correct cooperation of all sectors of the economy, such as society, business, and the public sector. Government regulations and the general public awareness is the driving factor for expanding the application of the concept. This study shows the possibilities for new or existing companies to move to the circular economy based on real examples.</p> | | | |
| <p>Keywords</p> <p>Circular Economy, sustainable development, business models, barriers, closed loop, regulations, awareness</p> | | | |

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1 INTRODUCTION

The transformation of the planet into a spontaneous dump of domestic and industrial waste continues for the last hundred years. Billions of tons of garbage, which are annually found in the environment, lead to visible, but not enough studied consequences. The statistics are impressive: 80% of consumer goods finish their lives in garbage cans within six months after manufacturing. In developed countries, citizens on average consume 800 kg of food and drinks a year, 120 kg of packaging and 20 kg of new clothes and shoes, and 80% of all this falls on incineration plants, landfills, and wastewater. (Ellen MacArthur Foundation 2013.)

The main reason for this is the linear economy: Extraction – Production – Distribution – Consumption – Waste. As the degradation of our ecological system is increasing, the need for finding the solution is becoming more and more urgent. The circular economy is created to change the linear model of production, concentrating on products and services to minimize waste, refuse and other types of pollution.

The basic principles of the circular economy are based on the resumption of resources, the processing of secondary raw materials, and the transition from fossil fuels to renewable energy sources. This is a whole philosophy of reuse and profit. Also, this type of economy is considered as part of the Fourth Industrial Revolution. As a result, the rationality of resource use will increase, the economy will become more transparent, predictable, and its development will be rapid and systemic. (Circulate 2017.)

When we talk about extracting the maximum from materials and minimizing the amount of waste, Finland can share a wealth of knowledge about the innovative technologies in key industries. Finland is a pioneer in the development of the circular economy and can be an example for most countries in the world. The concept of the circular economy has a huge value and has become a major goal in a world facing critical climate change and depletion of resources problems.

The goal of this thesis is to analyze Finnish industry experts' approach and relation to the sustainable development within the framework of the circular economy concept. This thesis will bring information about the principles of the organization's transition to the circular economy, the types, motives, benefits, barriers, advantages, and disadvantages of transformation from linear to the circular economy for both Finnish and foreign companies.

These results are obtained through five qualitative in-depth expert interviews with representatives of Finnish companies in the circular economy concerning their own experience and achievements. The research part includes the interview results analyzation and the general expert opinions on the most important issues of sustainable development. Authentic examples of the Finnish companies' transformation are also showed in the thesis.

This research includes a set of ideas for the modernization of core values that must be included in the development strategy of the economy: from the concept and production of products and services to their consumption and the time of their recycling.

The theoretical basis for this work was the work of specialists on the development of concepts for the development of a circular economy in shaping the strategies of organizations and countries around the world.

1.1 The emergence of the idea

Over the centuries, natural resources have been and continue to be the foundation of life and economic growth of our world. Against the backdrop of economic growth and the scale of production, the issue of the natural resources limitation is critical.

Economic growth is a prerequisite for meeting the needs of humanity. Economic growth should be a long-term trend in the sustainable development of the economic system, i.e., the process of progressive increase in real production of goods and services in the long-term prospects without disturbing the equilibrium state in short periods.

Ensuring economic growth is associated with the following problems:

1. Climate change and the surrounding atmosphere, such as the threat of global warming (the "greenhouse effect"), ozone layer depletion, and air pollution.
2. Pollution of fresh water and seas, which result in a deficit of clean drinking water, lack of water for industrial and agricultural needs in certain regions; increase in the amount of microplastics in seas and oceans with substantial environmental impact because their size (less than millimeters) makes them accessible to a wide range of organisms with potential for physical and toxicological harm; depletion of the world ocean as a regulator of natural processes and the source of biological resources. Thus, and this resource is not renewed in the natural state. (The Guardian 2012.)
3. Deforestation, reduction of forest areas, which lead to an imbalance of oxygen supply to the atmosphere. The process of extinction of many types of animals and plants is increasing. The animal and plant world of the planet is reduced (the problem of biodiversity). As a result of economic activity, 63% of the land was destroyed. (Stability of Life on Earth 2004, 102.) However, in high GDP-countries forest biomass has increased by 0.5 to 1.3 percent each year in recent decades. (Helsingin Sanomat 15.5.2018.)
4. Absolute overpopulation of the Earth: deterioration of living conditions in populated areas (villages, cities, etc.) from noise, and electromagnetic interference, loss of social ties between people and growth of general psychological fatigue. If by 1900 the world population had reached 1.6 billion people, by the end of 2017 there were already 7.6 billion people on

University of Washington claim that the population of the Earth by 2100 will be 11 billion people.

5. Environmental problems related to the health and living conditions of people: the niches of destroyed plant and animal species are usually filled with parasites and pests. The majority of industrial wastes are localized.
6. Risks associated with the use of traditional and new technologies (bio-, nano-, energy technologies) without a scientifically grounded expert assessment of their impact on the environment; production, transportation and use of toxic chemical materials; transfer of hazardous technologies and the export of major wastes to developing countries.

The problem is that mass consumption, improving living standards, increasing the world population and the linearity of our economic system lead to a shortage of natural resources, social inequality, and environmental pollution. Of course, over the past 50 years, the living standards of a part of the population have increased significantly, but environmental problems have also grown: global warming, air and water pollution, the disappearance of certain species of animals and plants, mass deforestation, desertification, etc. (Hinrichsen, D. and Robey, B. 2000.)

Thus, such fundamental questions become urgent: how can economic and social progress be established without threatening the natural balance of the planet? How to allocate resources between rich and developing countries? And the central question: how can we keep a healthy Earth for future generations?

1.2 Methodology

The aim of this study is to gain a better understanding of the Finnish business development within the framework of the circular economy. The ways of companies' transformation, the motives, the ideal model of sustainable development for a country, as well as the main barriers for companies' transformation and forecasts of the circular economy concept development have been explored. An analysis of the experts' opinions from Finnish companies in the sphere of the circular economy regarding the important issues is reflected in this thesis. The reader gets acquainted with the concept of a circular economy within the framework of sustainable development based on the theoretical part of the thesis.

The study is divided into several important stages. First, the research goal outlined above was formulated. The expert interview was chosen as a method of conducting a study. After selecting experts and appointing a meeting with them, five personal interviews were conducted. The results of the survey were agreed with the respondents. An analysis of the data was carried out, after which a conclusion was reached on the development of the circular economy in Finland and the world. The conclusion about the development of the circular economy in Finland and the world was obtained from the interviews' data.

Interviewing experts in the field of the circular economy was selected as a way for a research part of the thesis. An expert interview is a method of qualitative research, one of the varieties of in-depth interviews, a conversation with a competent specialist on the circular economy topic and a researcher. Experts are from various companies who know the specific aspects of the research subject of the thesis.

Five different Finnish companies were selected for the research, which either from the very beginning began to develop according to the principles of the circular economy concept, or came to this after a certain time of working. Companies were selected according to different principles. First, the company should be part of the Finnish industry and have experience in circular economy development. It has to have a business structure within the framework of this concept. Second, the scope of research was expanded and focused on manufacturing and service companies, as this helped to prepare useful research material for companies of different business types. Additionally, the size and age of the companies was an important point. The representatives of start-up companies were interviewed, as well as leaders of the Finnish market with many years of experience. Below the reader can see the companies selected for the thesis research.

1. Gasum Oy

Main Sector: Acquisition, transportation, distribution, and sale of natural gas, biogas and LNG.

Gasum offers renewable energy and organic nutrients from biodegradable secondary streams.

Net Sales: over €50 million

2. EntoCube Oy

Main Sector: Insect Growth Technology. Entocube's business is based on the sale of equipment and automation solutions associated with insect production.

Net sales: less than €1 million

3. CLIC Innovation Oy

Main Sector: Business Cluster. CLIC Innovation is an open innovation cluster with the mission of creating breakthrough solutions in bioeconomy, circular economy and energy systems.

Net sales: €1 – 50 million

4. Ethica Oy

Main Sector: Consultancy. Ethica provides a circular economy consultancy for private, public and third sectors to develop novel, sustainable and practical solutions.

Net sales: less than €1 million

5. Bionova Oy

Main Sector: Consulting. Bionova creates solutions and software to help organizations achieve their sustainability goals.

Net sales: less than €1 million

1.3 Research questions

The formulation of research questions was carried out after a detailed study of the theoretical part, which is presented below in this thesis. After stating the central general question: "Can the Circular Economy replace Linear?" more specific issues were identified. A list of the five main research questions is given below, as well as the importance of those issues for the research.

"How new is the circular economy concept for you?" This question helps to get to know the respondent and to hear his personal history of meeting with the circular economy concept. It implies a free formulation of the answer with exact figures. The answers to this question draw a picture of how long experts are working with the research concept.

"Why did your company (the company represented by the respondent) start to develop in the circular economy direction?" Each of the studied companies has its history of sustainable development. To demonstrate the possibility of sustainable development in the frame of the circular economy concept to other companies in Finland and throughout the world, we need to learn the ways of development of the leading companies: motive, mission, and vision. What unites them within the whole market?

"What is the best model of the circular economy for the country, who should start: the state, companies or society?" Each new concept has a lot of difficulties. Someone should always start locally and globally. The issue of sustainable development is still very narrow throughout the world. Most people do not want to take responsibility for development and look at several steps forward in the future. This question is aimed to learn about experts' relationship to the transition from theory to practice, from just a concept to its implementation.

"How difficult is it for companies to move to the circular economy direction, what is the main barrier?" The transition to something new always has a lot of barriers. Based on the personal experience of experts and the experience of companies, this question is aimed to show to the reader for problems, which could be faced by companies and the world during the transformation from a linear to a circular economy. Very often it is enough to identify the main barriers and be prepared for them, and then the best strategy can be developed.

"Is there a future for the circular economy development?" It is essential to have a forecast. We need to know where we are going, why this concept is vital for us. If the world continues to consume so many resources as it has for now and grows at such a rapid pace, our future generation will not have the opportunity to live a full life. We need changes in the structure of behavior, in views, in the economy, in development. Experts in this question express their own opinion on the forecasts of the growth of the circular economy concept in Finland and the world.

These are the main five issues that were discussed during the interview. Respondents were notified in advance about them. Of course, during the meetings, additional questions arose, and they are included in the data analysis, which was carried out in Chapter 4.

1.4 Data Collection

The main criterion for selecting experts for interviews was their competence and credibility. Therefore, the size and representativeness of a group of respondents, in this case, are estimated not so much as quantitative, but as qualitative indicators. To identify the expert opinion, consistently conducted six interviews within three weeks. The choice of respondents was carried out by taking into account the websites of the most interesting company in the circular economy in Finland, or from professional qualification indicated in LinkedIn.com. (Sitra 2017.)

The expert interview, in this case, is an in-deep study of the opinions of professionals. During the interview, with the permission of the person being interviewed, an audio record was made, as well as the recording of the answers separately for each respondent. I got an agreement with each professional on the publication of his answers in this study. The information obtained was analyzed by correlation of opinions and statements of the respondents, on the similarity of forecasts in the development of the circular economy concept. After the interview, some respondents made corrections to their answers and sent it to the researcher.

Preparation for an expert interview was made on the basis of the theory of the concept under study. Based on this, five key issues for analysis were identified. The questions concerned both the personal opinion of the expert and the attitude of the company. The formulation of each question offered free statements and comments on the topic. Each respondent was contacted by e-mail with a research interview request. A copy of this email can be found in Appendix 1. All interviews were held in person at companies' offices and took around 30 - 40 minutes each of them. The researcher informed the interviewees about the study purpose and the way answers will be used within in this thesis. Interviews were structured with the list of the questions.

The interviewed experts are:

- Perttu Karjalainen, CEO&Co-Founder of EntoCube;
- Group interview: Jan Reiners, Manager, Circular Economy and Recycling at Gasum Oy; Juha-Matti Koskinen, Sales Manager at Gasum Oy;
- Anne Raudaskoski, Circular Economy Specialist, Co-founder & Principal Consultant in Ethica;
- Pirjo Kaivos, Portfolio Manager, Circular Economy at CLIC Innovation Ltd;
- Rodrigo Castro, LCA Sales Expert, Life-cycle performance expert at Bionova Oy, Community Coordinator at the Circular Economy Club (CEC).

As the reader can see in the list, respondents have different areas of activity in their companies and work in various departments, but they all directly or indirectly work with the idea of the circular economy concept. After a series of expert interviews, the decoding of audio records was carried out. An analysis was made according to the leading tendencies in statements, projections in the development of the concept, and emerging problems.

2 SUSTAINABLE DEVELOPMENT

The concept of sustainable development of the society was based on new strategies for the production of material goods based on the principle of nondestructive interaction with the environment. What it requires is the development of the relations between economic activity, human well-being, and preservation of natural resources.

Sustainable development includes three key criteria:

1. Meeting the needs of the present generation;
2. A threat to the ability of future generations to meet their own needs;
3. The ability of each person to develop themselves in freedom, in a well-balanced society and harmony with the environment.

The primary goal of sustainable development is the satisfaction of human needs and aspirations. It is important to emphasize that sustainable development requires meeting the most vital needs of all people and giving everyone the opportunity to satisfy their desires for a better life in equal measure. (United Nations 1987.) Sustainable development has three fundamental characteristics of change: economic, social, and ecological. The goals of sustainable development are reflected in Figure 1.



Figure 1. Scheme of sustainable development (Johann Dréo, 2007.)

Currently, economic aspects are the most significant, followed by social, and minimal attention is paid to environmental problems. The correlation of the main elements of sustainable development is demonstrated in Figures 2 and 3.

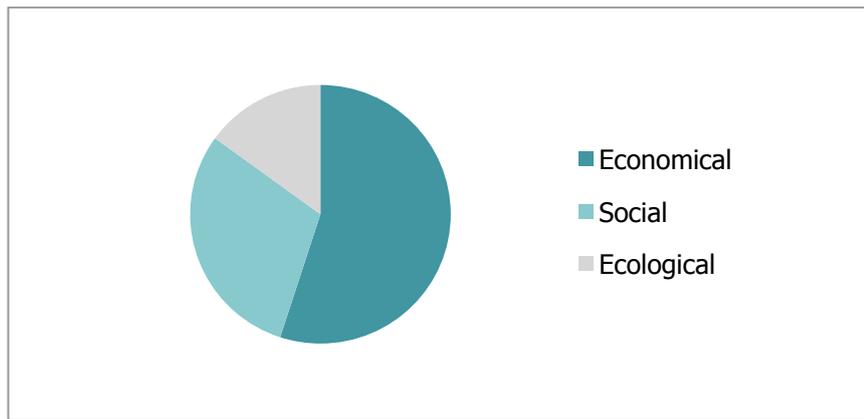


Figure 2. Correlation of the main aspects of the sustainable development today. (Adapted from: Wikipedia, 2018. Sustainability.)

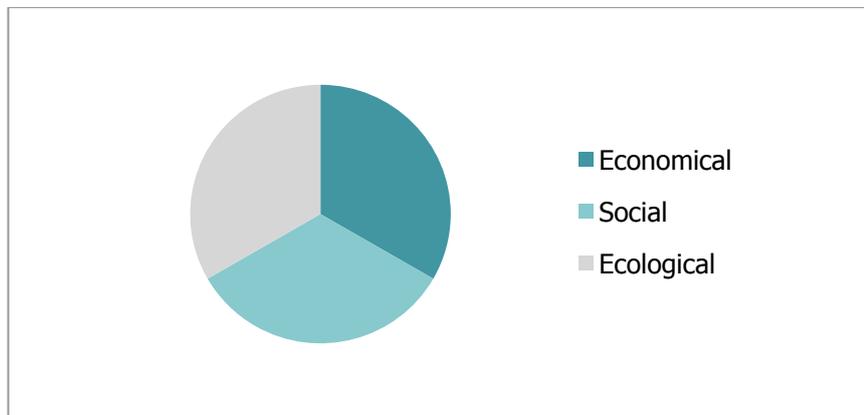


Figure 3. Target correlation of the main aspects of the sustainable development. (Adapted from: Wikipedia, 2018. Sustainability.)

These components change should be coordinated with each other and strengthen the current and future potential of human development.

Ten fundamental principles of the sustainable development (Jonathan M. Harris 2000.):

1. Humanity is capable of creating sustainable and long-term development, so that it meets the needs of living people, without depriving future generations of the opportunity to meet their needs.
2. The existing restrictions in the field of exploitation of natural resources are relative. They are related to the current state of technology and social organization.
3. It is necessary to satisfy the elementary needs of all people and give everyone an opportunity to realize their ambitions for a better life.
4. It is necessary to agree with the way of life of wealthy people (financially and materially) with the ecological capabilities of the planet, for example, regarding energy consumption.
5. The size and rate of population growth should be consistent with the changing productive potential of the global Earth ecosystem.
6. Economic priorities, social and environmental obligations should be balanced.

8. Integration of all socio-economic groups is necessary to lead to goals of the sustainable development
9. The economic potential of the southern and northern countries should be balanced: developing countries have a lot of debts, which makes their commercial transactions difficult. Therefore these countries cannot effectively implement the funds for education, health, and environmental projects.
10. To comply with all the terms of agreements on environmental protection, it is necessary to create an international institution that would be responsible for fulfilling the obligations of states. (Official Records of the General Assembly 1987, A/42/427.)

Thus, the concept of sustainable development was created to revise the modern system, which inefficiently or insufficiently uses earth resources in the long term. For this, it is necessary to coordinate the three spheres of human life: economy, ecology and social, to avoid irreversible processes in nature while providing the society with opportunities to meet their needs.

2.1 Measuring Sustainable Development

The sustainable development indicator is the indicator allowing to determine the state or change of economic, social or environmental variable. The system of environmental indicators of the Organization for Economic Cooperation and Development (OECD) has a comprehensive application:

- Environmental indicators for assessing the effectiveness of environmental protection activities;
- Sectoral indicators to ensure the integration of environmental issues into the industry;
- Ecological indicators to ensure the inclusion of the ecological problems in the industry, and the sustainability of management and use of resources.

The OECD indicator system explains the interrelations between the economy and the protection of the environment, reveals the economic-ecological and socio-ecological interrelations. The OECD indicators are based on the PSR model (Pressure-State-Response, Figure 4). The PSR model identifies the interrelationships between economic activity and environmental and social conditions. This model shows that human activity makes "pressure" on the environment, affects the quality and quantity of natural resources ("state"). The society responds to these changes through environmental, general economic and sectoral policies, as well as by changing public consciousness and behavior ("Response to pressure").

"Pressure" includes indirect and direct adverse impacts (use of resources, emissions of pollutants and accumulation of waste). Indicators of environmental pressures are closely related to the nature of production and consumption, and they often reflect the intensity of pollution or the use of re-

tivity and the environmental problems caused by it (waste generation, deforestation, discharge of pollutants, etc.).

The ecological "state" is related to the quality of the environment and the quantity and quality of natural resources. Indicators of the environmental state provide an overview of the environmental situation and its development over time. Impact indicators express the consequences of changes in the state of the environment for those who directly or indirectly use resources (indicators that influence health, the costs of wastewater treatment, changes in agricultural land productivity). Impact indicators also include indices of influence on aspects of human well-being (gross national product - GNP, human development index - HDI, etc.).

"Response" indicators reflect the public's response to environmental problems associated with collective and individual actions and reactions aimed at mitigating, adapting or preventing a negative impact on the environment (environmental protection costs, environmental taxes, price formation, market share attributable to environmentally friendly goods and services, the level of recycling, etc.).

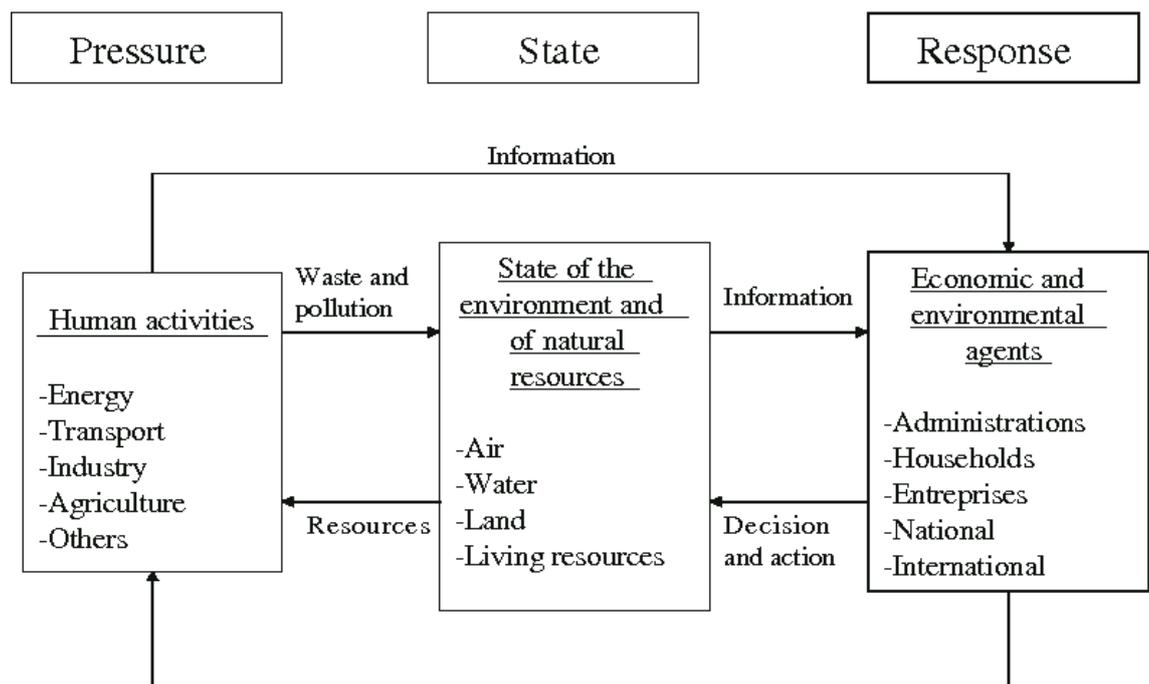


Figure 4. The pressure-state-response model. (OECD Environmental indicators 2003, 21.)

The ability of the model to identify relationships between economic activity, environmental and social conditions is a significant advantage. It provides a basis for decision-making in the field of ecological and economic policy and allows the public to see the interconnection of these areas and develop a plan for solving problems. However, such a system of indicators does not mean that we should limit ourselves to these indicators only when assessing sustainable development and ignore the study of more complex relationships in ecosystems, as well as economic, ecological and socio-ecological interrelationships. (OECD Environmental indicators 2003.)

2.2 The World Happiness Report

Here is one well-known example that shows the relationship of the spheres of sustainable development: The Happy Planet Index (HPI).

It is known that GDP is an indicator that does not reflect well-being in the world or any country. Therefore, the international community regularly makes attempts to develop a better indicator than the GDP, indicating the level of welfare of society. This indicator in 1990 was the Human Development Index (HDI), and in 2000 - The Happy Planet Index (HPI). A great addition to the HPI index is that it takes into account the ecological footprints. It classifies the countries of the world on the basis of 3 indicators: Subjective life satisfaction; Life expectancy; Ecological footprint.

As a result, the HPI shows entirely different pictures of the life satisfaction of people, sometimes not related to the level of wealth or poverty in different countries.

Table 1. Happy Planet Index: 2016 Results. (New Economics Foundation (NEF) 2016.)

| Rank | Country | HPI | Wellbeing (out of 10) | Life Expec- tancy | Ecological Footprint |
|------|--------------------------|------|--------------------------|----------------------|-------------------------|
| 1 | Costa Rica | 44.7 | 7.3 | 79.1 | 2.8 |
| 2 | Mexico | 40.7 | 7.3 | 76.4 | 2.9 |
| 3 | Colombia | 40.7 | 6.4 | 73.7 | 1.9 |
| 12 | Norway | 36.8 | 7.7 | 81.3 | 5.0 |
| 37 | Finland | 31.3 | 7.4 | 80.4 | 5.9 |
| 61 | Sweden | 28.0 | 7.6 | 81.8 | 7.3 |
| 108 | United States of America | 20.7 | 7.0 | 78.8 | 8.2 |

The HPI includes the Ecological footprint indicator, which is an index of the assessment of the human impact on the environment and accordingly takes into account the volume of land that provides food production, access to water and the creation of resources that the individual, population or any industries consume. The calculation of the ecological footprint helps to estimate the level of environmental impact, based on the hypothesis that the Earth's resources ability to recover can be a factor that limits the economic development.

The ultimate goal of measuring sustainable development is to measure the impact of all spheres of sustainable development on society at the same time. There is also the Green Gross Domestic Product (green GDP or GGDP) index. The idea has to adjust the primary indicator of GDP development. The point is that it is necessary to add environmental costs to GDP, including, for example, the polluting or consumption of natural resources.

Currently, green GDP is very often criticized because of the complexity of assigning values to certain

carried out indirectly, there is a possibility that the calculations can be based on hypothetical assumptions.

Thus, the measurement of sustainable development is a relatively complex process. Indeed, with the help of known methods, scientists are trying to measure the impact of three different spheres (ecological, economic, and social), in which many criteria are involved. Therefore, the current trend in measuring sustainable development is the creation of survey reports that regroup important sustainable development indicators and which are included in the Agenda. Therefore, the current trend in sustainable development measurement is the creation of survey reports that regroup key sustainable development indicators.

3 THE CIRCULAR ECONOMY CONCEPT

3.1 Linear vs. Circular Economy

The idea of the circular development is the complete reorganization of the principles of human existence. People always used a simple economic scheme, called the linear economy: Raw Materials – Production – Distribution – Consumption – Waste.

At the end of the 20th century, in 1989, two British environmental economists David W. Pearce and R. Kerry Turner proposed the circular economy idea, new principles of society's life. (David W. Pearce and R. Kerry Turner 1989.) They reported that the traditional linear economy was developed without a built-in recycling trend, which led to the environment to be a waste warehouse, but the circular economy is based on the study of nonlinear systems. A circular economy is a model that considers human society from the point of a system where development is based on technical (closed cycle innovations for production) and biological cycles (the organic material cycle). As a general concept, it is based on a number of more specific approaches, including "Cradle to cradle" concept, Biomimicry, Industrial Ecology, the "Blue Economy", and the "Biosphere Rules". (Domba, J. 2018)

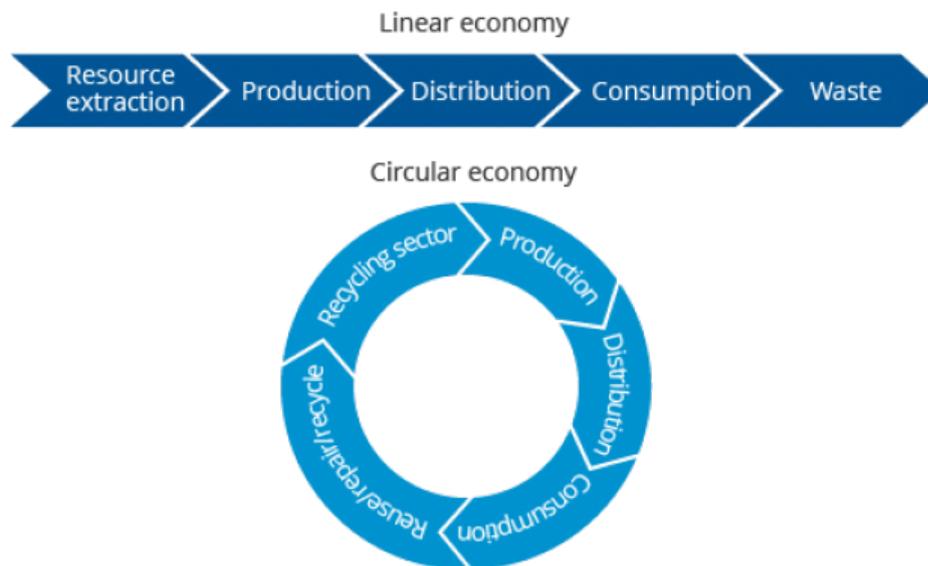


Figure 5. Linear vs. Circular Economy. (Zabaneh M. W. 2016.)

Essential elements of the circular economy concept (European Parliamentary Research Service 2016.):

1. Waste is a resource. Materials should be recycled effectively and processed to maintain the maximum value as long as possible.
2. Society has a preference based on services. Materials are designed for recycling and durability.
3. The society welfare grows by sharing and cooperation.

5. Innovative business models.
6. Ideas are taken from ecology and living systems, where materials are used to restore the economic and ecological system.
7. The use of energy is reduced and entirely comes from renewable sources.
8. The circular economy system is flexible, adaptable due to design, diversification and risk reduction.
9. The ecological system improves by eliminating toxic materials.

Currently, the linear economic model is still dominant. It is due to the complexity of the concept of a circular economy, as well as the lack of description of indicators for different industries. For example, how could it be used in construction or the production of cars? All stakeholders, including business and politicians at all levels, need a better understanding of how this approach is applicable for different industry sectors. (Ghisellini P., Cialani C. and Ulgiati S. 2016.)

3.2 Reduce, Reuse and Recycle

To change the linear economy to the circular economy, we need to ensure maximum efficiency from each process in the life cycle of a product or service. The waste management becomes one of the most priority areas. The circular economy type is characterized by "3R" - Reduce, Reuse and Recycle. The transformation requires changes not only in technology, which should reduce to the minimum, but also in creative disciplines, such as design, advertising, and digital technologies. (McKinsey Center for Business and Environment 2016.)

Table 2. Reduce – Reuse - Recycle principles, goals, and methods. (Adapted from McKinsey Center for Business and Environment 2016.)

| Principles | Goals | Methods |
|------------|---|--|
| Reduce | Control and balance of renewable resources allow to save and to increase the natural capital. | Recycling; virtualization; sharing; renewal; renewable and finite resources inventory management. |
| Reuse | Looping processes and more efficient use of the goods, materials, and their separate components to optimize the production resources. | Reuse or sharing, optimization, looping. Four looping cycles: at the consumer level (sharing), at the service provider level (reuse), at the producer level (recovery and repair), at the component level (recycling). |
| Recycle | Identification and disposal of harmful tools and processes | Minimization of systematic losses and negative consequences of the economic activity. |

3.3 Tools for the circular economy realization

Based on the "3R" theory, it is also necessary to establish short chains between producers and consumers, to create shared networks and a system for exchanging data among various participants in the economic process. There are four basic concepts for the circular economy realization introduces in the following chapters:

3.3.1 Eco-design

At the beginning of the supply chain, when the product and packaging are being developed, innovative products and production processes should include as less as possible non-renewable resources in favor of renewable resources: maximizing their turnover, associated with the recovery of waste, i.e., utilization and recycling.

There is a very good example of the eco-design company "Sulapak" in Finland, which produces wood-based packaging for cosmetics.

Most modern manufacturers of products make packaging colorful, attractive and cheap. Polymer materials are used everywhere and not only for the packaging production. Used packaging and other wastes fall into the landfill and polluting the ground. In natural conditions, the paper decomposes for 2-5 months, cigarette butts from 1 to 12 years, polyethylene bags decompose for 10-20 years, and plastic packaging practically does not decompose at all.

The material of "Sulapak" is based on wood and natural adhesives, which makes it biodegradable. At the moment, the central target market segment is packaging for cosmetics, but the company aims to produce environmentally friendly packaging for food. The new eco-design for cosmetics packaging is shown in Figure 6.



Figure 6. Eco-design for cosmetics packaging. (Sulapak Oy, 2017.)

3.3.2 The Functional Economic

The Functional Economic is a part of the economy that focuses on selling a limited set of property rights to a product and services instead of completely transferring property rights to material goods. This is the concept of optimizing the use of products, knowledge, natural capital by extending the life of goods, reusing them, preventing waste generation, creating regional employment.

This new economic concept is based on two fundamental principles: the search for new ways to optimize the use of resources and the sale of services. To increase the wealth of society, it is not necessary to stimulate production growth. Optimizing the long-term use of goods will maximize profits and reduce dependence on increasing production of new products. (Stahel, W. and Giarini, O. 1986.)

The product life cycle can be extended by four additional stages: reutilization, repair, rehabilitation, and recycling. At the stage of reutilization, the product rights can be transferred to other persons for further use. At the repair stage, the product restores its properties. At the stage of rehabilitation, the product or its parts are modified to have new functions. And finally, at the recycling stage, the product is used as a resource for creating new products. (Stahel, W. and Giarini, O. 1986.)

The example of the Finnish company "Maas Global" illustrates this concept very well. This company provides a mobile application, which connects all types of public transport. The application positions itself as the best alternative to owning a car, as it helps you to get from point A to point B in a short time. You buy a subscription for a month and use any transport without restrictions. (Maas Global 2018.)

3.3.3 Industrial Symbiosis

Industrial Symbiosis is the voluntary cooperation of enterprises to optimize production costs by using by-products and wastes from some enterprises as raw materials by others, as well as joint consumption of information, energy, water and other resources. A lot of companies in a specific territory, in order to optimize production costs and reduce risks, cooperate in an extensive trading network. (Erkman S. 2004.)

The Kemi–Tornio region is the best-known Finnish case as the part of the Nordic Industrial Symbiosis Network program. Some ideas and activities between enterprises have been formed since 2013 in a small area in the north of Finland on the border with Sweden. The future potential of IS in this region is significant. The main motive for such actions is the desire to minimize the environmental impact of industry without losses for the region's economy. (Nordregio 2015.)

The key elements of the Industrial Symbiosis in the Kemi–Tornio region include forest mining and steel industries, service companies and educational organizations. The following companies are representing the main Industrial Symbiosis activities in the Kemi-Tornio region (Nordregio 2015.):

- Metsä Fibre's Kemi mill: utilization of wastes;
- StoraEnso Veitsiluoto mill: the ash from StoraEnso processes has been used to fill the open pits of the Outokumpu chrome mine;
- Co-operation between the SMA Mineral and the Outokumpu ferrochrome factories to reduce CO² emissions;
- Savaterra is using the thermal method for remediation of contaminated soil.

3.3.4 The "Green" economy

It is an economy aimed to save the well being of society through the efficient use of the natural resources, primarily through the economic consumption of exhaustible resources and the rational use of inexhaustible resources. "Green growth" is the stimulating economic growth and development, while ensuring the safety of natural assets. (Satbyul E. K., Kim H. and Chae Y. 2014.)

One of the most important steps towards the green economy in Finland is the inclusion of circular economy as a key policy priority in the Strategic Programme of the Finnish Government from 2016. (European Commission 2018.) The Finnish Ministry of Employment and the Economy also published the Strategy to Promote Cleantech Business in Finland in 2014, which continues to guide policymaking and business initiatives. Additional actions relevant to the green economy development include the Finnish Bioeconomy Strategy (2014), the Finnish Material Efficiency Programme (2014), and the new Circular Economy focus area (2016) in Sitra, the Finnish Innovation Fund. (Eco-innovation in Finland 2015.)

The recent trends in cleantech in Finland, especially when considering eco-innovations and the circular economy, can be divided into several areas. They include energy management products and services, renewable energy production technologies, recycled products and materials, waste management, and circular economy applications in agriculture and forestry. (Lahti-Nuuttila 2016 and Haaranen 2015.) The more traditional strengths in Finnish cleantech remain in industrial processes – e.g., energy, materials and water efficiency – as well as bioenergy and bio-based products. (TEM 2014a.)

Thus, there are several adapted ways to implement the Circular Economy model through various tools to achieve the goals of sustainable development. It should be noted that only with the participation of the state and the initiative of managers of companies we could expect significant results.

The transition to a circular economy has three undeniable advantages:

- 1) Environmental benefits, particularly concerning reduced impacts and reduced resource usage;
- 2) Cost savings from reduced natural resource needs;
- 3) The creation of new markets, providing additional economic benefits of circular economy practices, e.g., regarding jobs creation or wealth creation.

3.4 Cradle to cradle design

"The goal of the upcycle is a delightfully diverse, safe, healthy, and just world with clean air, water, soil, and power - economically, equitably, ecologically, and elegantly enjoyed." (McDonough & Braungart 2013, 12.)

Walter R. Stahel coined the term "Cradle-to-Cradle" in 1970. In 2002, it was popularized by German chemist Michael Braungart and American designer William McDonough in their book "Cradle-to-Cradle: Remaking the Way We Make Things". The book gives the instruction to achieve the C2C model. The term was registered as the trademark McDonough Braungart Design Chemistry (MBDC). MBDC has patented a product certification system based on the C2C principle, but in 2012 the patent was transferred to the Cradle-to-Cradle Product Innovation Institute to ensure the independence and openness of the certification process.

Cradle-to-Cradle (C2C) is a concept based on the idea of non-waste production systems that do not harm the environment. In other words, the Cradle-to-Cradle system offers the industrial sector to switch to non-waste operations. It is not only the most effective use of natural resources and materials already produced but also the maintenance of the continuity of their cycle. Such a system helps to protect and enrich the natural environment, reducing the ecological footprint.

There is a stable phrase "Cradle-to-Grave", used to characterize a process that develops linearly. Cradle-to-Cradle symbolizes the cycle of the process. A product cycle, for example, can exist by recycling its components when the product is disposed of. "Cradle" means nature, in which there is essentially no waste. (Braungart & McDonough, 2002.)

According to the C2C concept, all components involved in the creation and functioning of products must have a continuous life cycle. In view of the fact that the origin of substances and materials has a different nature, according to the principle of Cradle-to-Cradle, they are conditionally divided into two cycles: biological and technical. Depending on which group the substance belongs to it passes the appropriate path through a certain cycle.

Figure 7 illustrates how biological and technical nutrients should be stored in separate circuits to maintain high quality and ensure efficient circulation. The smaller the cascading loop, the higher the value kept in the resource and with less need for adding energy and other resources to keep it circulating. In order to make the maintenance of the products practically possible in loops, they must

return to the manufacturer. The product must be a service, since the ownership of resources is still retained by the manufacturer. (Ellen MacArthur Foundation 2012, p. 111.)

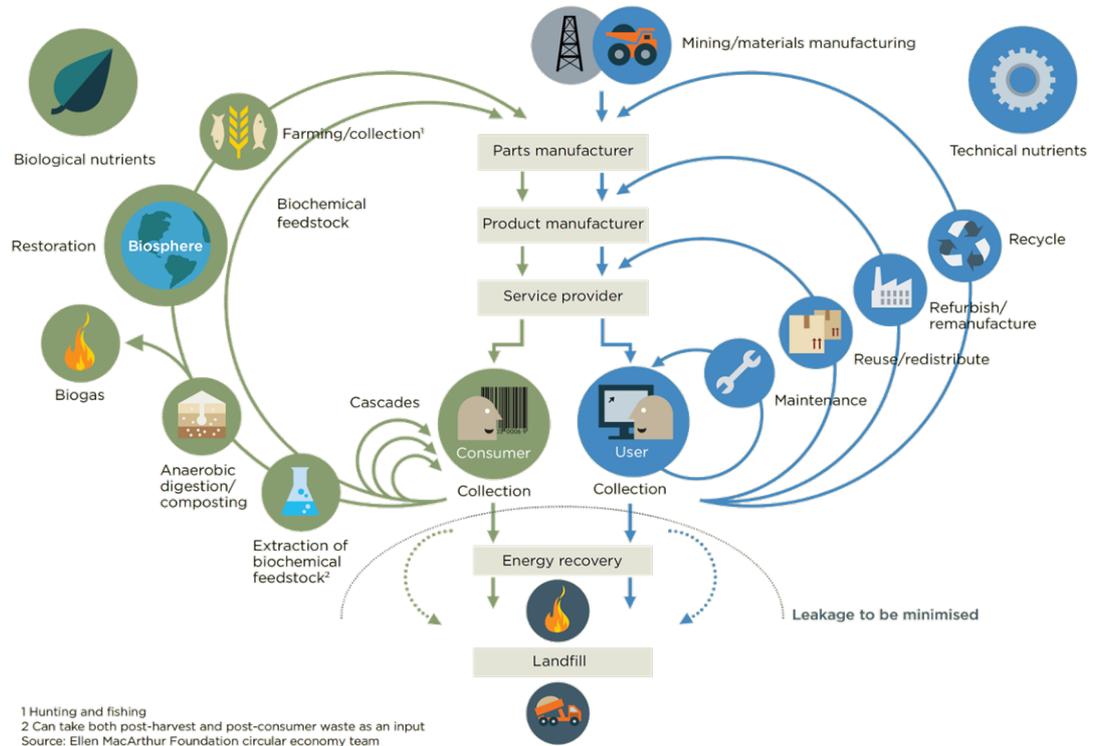


Figure 7. Biological and technical nutrients cycles. (Ellen MacArthur Foundation, 2012.)

Technical include non-toxic and harmless synthetic substances, which are subjected to reusable and continuous use without harming the environment. Technical substances are processed without loss of their quality and integrity, so they cannot be reduced and used to create simpler materials - this approach could lead to the waste production.

The cycle of organical nutrients looks different. Since they have a natural origin, their entry into the environment after an extended period of use a priori does not cause a negative impact. Organics can decompose in the soil and enter the food chain as a nutrient for bacteria. Therefore, as the usage of the product is completed, its organic components, according to the principle, again fall into a purely natural environment with a natural life cycle.

Products seeking to obtain a certificate of the concept "From cradle to cradle" are evaluated according to the criteria in the following five categories (Cradle to Cradle Products Innovation Institute 2017.):

1. Material Health

This category carefully assesses the ingredients of the goods and their impact on human health and the state of the environment. The ultimate goal is the elimination of all toxic and unidentified chemicals and the implementation of a continuous safe work cycle.

2. Material Reutilization

The manufacturer must know and understand what materials his product consists of. The list of substances that were used to create the goods is divided into two groups depending on the nature of origin: organic and technical. Organic substances in the recycling of the product return to the natural environment and the synthetic ingredient participate in the technical cycle and are used in the new products' manufacturing.

3. Renewable Energy

Nowadays technologies make it possible to include the use of renewable energy sources in the design of production systems.

4. Water Stewardship

This category considers water as a valuable resource and encourages manufacturers to manage water resources in the production processes efficiently.

5. Social Responsibility

Designers and manufacturers must prove that they carry out their activities with respecting the rights and interests of all people who have been involved in the production, use, and utilization of products.

A classic example of the implementation of C2C in practice can be the life cycle of shoes. The manufacturer creates shoes, the sole is made of organic material, and the rest of the shoes are made of synthetic material. Boots are sold in the stores. During the completion of the use of shoes, because of its deterioration, damage or other factors, the consumer returns it to the manufacturer. The further task of the manufacturer is to separate the sole of the shoe from the rest of the parts and send the components of both groups to biological and technical nutrients cycles. The sole, produced from an organic material, is returns to the environment and is disintegrated by bacteria, and parts made of synthetic substances are recycled and used to create new pairs of shoes. As a result, the manufacturer saves on resources and conducts non-waste activities. The consumer plays a key role in the system: he returned the goods to his "cradle" and contributed the realization of a continuous cycle.

3.5 Circular economy business models

Closed supply chains are forming the basis of the circular economy. They maximize added value throughout the life cycle of a product with recovery over a long period. Closed supply chains should lead to the zero waste production models in the significant part of the industries. The circular economy is not limited to solve the problem of waste recycling at the end of the product lifecycle. It gives impetus to technological, organizational and social innovations throughout the value chain, starting from the environmental design of products to preventing the waste generation. Thus, to improve public welfare based on the circular economy, new business models should be used. (The

In these circumstances, more and more companies recognize the need to develop and implement business models related to the reuse of products and materials that were previously turned into waste at the end of their life cycle. The use of circular business models in various industries leads to substantial environmental, economic and social benefits.

Following the circular economy business models, companies can extract the maximum profit at the stages of processing, updating, repairing of goods or services, on the internal loops of the cycle. It is more profitable to extend the product lifecycle, rather than throw it away and produce a new one. Thus, it is possible to save the efforts and energy expended during the production of the goods.

According to the Accenture company research, the circular economy offers five business models: 1) Circular Supplies. Use of renewable energy, bio- or fully recyclable materials; 2) Recourse recovery. Extraction of useful resources from materials, by-products and waste; 3) Product Life Extension. Increase the life cycle of goods by repairing, modernization and resale; 4) Sharing Platforms. Development of sharing platforms where people can exchange goods and services, or use them together; 5) Product as a Service. Customers use products through a lease or pay-for-use arrangement versus the conventional buy-to-own approach. (Circular Advantage – Accenture 2015, 12.) Production of any product or service passes through seven main stages: Sourcing, Manufacturing, Logistics, Marketing & Sales; Product use; End of disposal; Reverse logistics. The figure 8 below shows the application of the five business models of the circular economy for each stage of product realization.

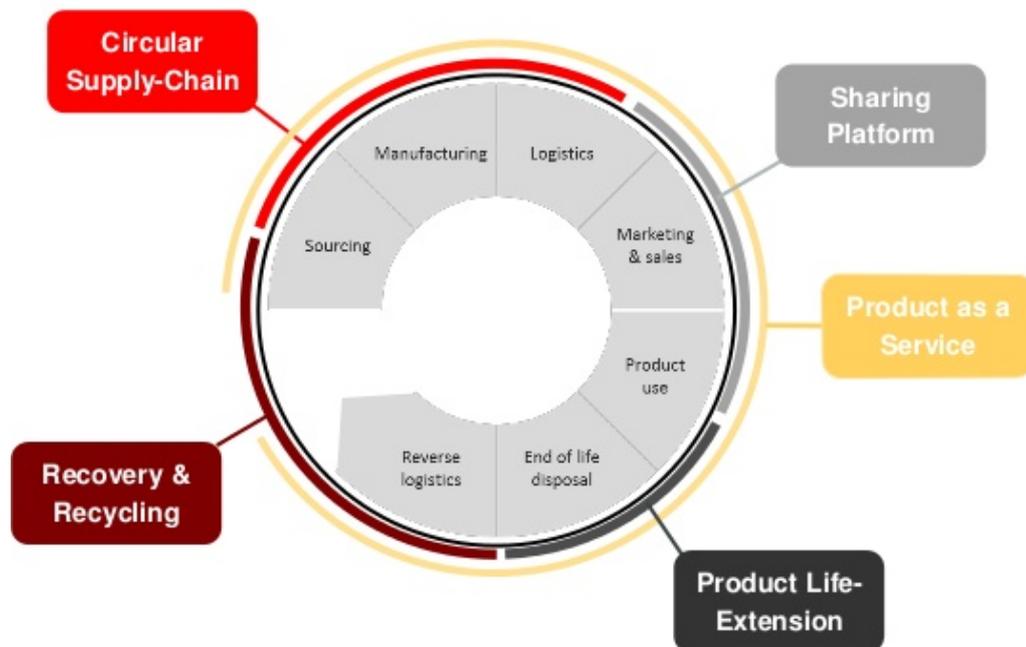


Figure 8. The circular economy business models. (Circular Advantage – Accenture 2015, 12.)

Accenture clarifies that the creation and use of sturdy materials, which can almost always be recycled and returned to production, can bring 40% of the added value; extension of the product life cycle due to its improvement, repair, recovery - 30%; recycling - 20%; sharing of resources - 10%.

The models presented by Accenture are just recommendations for businesses, in which directions they can look for solutions for the circular economy development. To understand and see which specific aspects can be improved with maximum profit in their business, the company can analyze its own work and correlate it with possible options for maximizing the value. (Ellen McArthur Foundation 2013, 54.)

3.6 World circular economic development

Attention to the circular economy is increasing throughout the world. Many countries, including Finland, Germany, Canada, Japan, are actively implementing public policies for the development of the circular economy. They create a good legal, financial and institutional environment to support growth in circular production and management.

Including in the design of the product its reuse and recovery components, or switching to business models based on the exchange, rental, leasing, rather than ownership, only European manufacturers could save \$630 billion by 2025. The circular economy can bring \$1 trillion to the world economy annually by 2025, and to create 100 thousand new jobs, saving \$ 500 million on materials and preventing the emergence of 100 million tons of waste. (Ellen MacArthur Foundation and McKinsey & Company 2014.) For example, biogas or agricultural nutrients can be obtained from food waste. Brewing products can be converted into animal feed. It is possible to manufacture insulating materials or to process it into yarn for making new clothes from old clothes. The packaging can be regenerated for reuse and recycled for other applications.

The transition to this economic model implies a multidimensional approach: new technologies, financing and business management, and the willingness of society as a whole to change their habits. In Finland alone circular solutions could provide EUR 1.5 – 2.5 billion added value annually. (Sitra Studies 100, 3.)

Asia is also rapidly moving towards the Circular Economy development. China has developed the law on the Circular Economy promotion - an economy based on the renewable resources; South Korea adopted The National Strategy for Green Growth, 2009-2050; Japan has developed a Fundamental Plan for Establishing the Sound Material-Cycle Society. The common thing that unites these countries are the new concepts of national development, which, in particular, provide for a radical change in the waste management systems, aiming at maximum extraction of secondary resources from waste and their use in industrial production instead of natural mineral raw materials.

According to some reports, by 2050 there will be more than three billion new consumers in the world, this will greatly increase the level of competition for economic resources. Also, re-

als. Many of these materials are essential for manufacturing high-tech products that are important for economic growth. (How to Feed the World in 2050, 2009.)

In 2014, The EU published the tasks towards a circular economy:

- Increase recycling to 75% of waste by 2030;
- Boost reuse and recycling of municipal waste to a minimum of 70% by 2030;
- Reduce the underground disposal of garbage up to 10% of the current volume;
- Ban the disposal of sorted waste.

Thus, the circular economy as a part of the Fourth Industrial Revolution is a way of developing the world economy. As a result, the rationality of using resources, including natural resources, will increase, the economy will become more transparent, predictable, and its development will become rapid and systemic.

The theoretical part of this thesis is the basis for the study research. Now the reader can understand the sustainable development and the circular economy concept. Further, the thesis will focus on the relation and approach of the Finnish circular economy companies regarding this concept.

4 ANALYSIS OF THE RESEARCH QUESTIONS

This chapter answers the question "Can the world develop steadily within the circular economy concept?" based on the theoretical part of the thesis and expert interviews. This part combines the answers of the experts on topics and is supplemented by world research on sustainable development in a circular economic. After presenting the interviews' data in the thesis, the general expert opinion of the Finnish specialists on the research topics is given. Topics that are included in the research: Acquaintance with the circular economy concept; Transformation of companies; Local and global changes; Problems related to the sustainable development; Forecast.

4.1 Acquaintance with the circular economy concept

The circular economy got its development quite recently, despite the fact that it was raised in 1989 by David W. Pearce and R. Kerry Turner. At the moment, just a small amount of researches concerning this concept have been done and published. One of the main is a report "Towards the Circular Economy: Economic and business rationale for an accelerated transition." commissioned by the Ellen MacArthur Foundation and developed by McKinsey & Company. Many people are still not familiar with this concept, and it is only at its development stage.

Perttu Karjalainen, CEO&Co-Founder of EntoCube Oy, heard about this concept first time two or three years ago, it's relatively fresh for him as a concept. Permaculture is one of his favorite word today, to farm something in the circulars, permanent way, he thinks it is a fascinating angle. EntoCube wanted to farm crickets, they wanted to farm insects, and the circular economy is very tight for the whole idea of the insects' industry as a food source, they have not had a point to be the circular economy company. And EntoCube has a long way to go to realize that potential like they don't use a lot of those side streams right now. Mr. Karjalainen believes that there is a big potential in the insect industry for the circular economy.

As an idea for Jan Reiners, Circular Economy and Recycling Manager at Gasum Oy, it is 2008, ten years ago. He supposes that it is not so bright when environmental recycling business turns to the circular economy. It depends actually on materials. The idea of converting biowaste to biogas began to grow only the last couple of years massively, before it was just a small biogas plant in farms, just for some tractors or small lorries. He thinks there is no right answer when the circular economy started in Finland.

Juha-Matti Koskinen, Sales Manager at Gasum Oy, has been working for 1,5 years in Gasum. Basically, he got to know the circular economy concept starting from that point but has been partly involved in some circular economy projects before. In total it is three years from now.

Anne Raudaskoski, Circular Economy Specialist, Co-founder & Principal Consultant in Ethica, heard

Ellen MacArthur Foundation website. And when at that time Mrs Raudaskoski was writing her blog site before she set up Ethica. Her blog is about the Circular Economy because it very much counts with different aspects of sustainability and we had much more kind of business-oriented focus than sustainability.

Pirjo Kaivos, Portfolio Manager, Circular Economy Specialist at CLIC Innovation Ltd, heard about it for the first time around 2014, when she joined CLIC Innovation. Before it, she was working with sustainability and environment issues in The Federation of Finnish Technology Industries, there they were talking about materials' efficiency. Many companies had recycled for ages, for example, the paper companies. They utilized their waste. That says that the circular economy concept is not new for Finland.

It was 2015, when Rodrigo Castro, LCA Sales and Life-cycle performance expert at Bionova Ltd, Community Coordinator at the Circular Economy Club, learned about the circular economy for the first time before he joined Bionova Ltd. It is a concept that can benefit from design thinking as an iterative process that explores new ways of developing products. This process led him to start thinking how to reduce environmental impacts by reusing materials and redesigning the supply chain. That's how Mr. Castro first approached and understood the circular economy as an idea.

Is the circular economy an entirely new concept or is it just a generalization of many directions related to processing, utilization, services, and protection of the environment? Is this direction new in Finland? In the living world, there is no landfill. Materials flow. One species waste is another's food. (Ellen MacArthur Foundation 2011) This concept is quite new for both the majority of the population and experts. Many experts met it only 5 - 7 years ago, and some of them just 2 - 3 years. We, from year to year, had always the prerequisites to abandon the linear economy, because only humanity uses it, but it is not a form of our nature. We need awareness. Even in Finland, which is the leader in sustainable development, most people are not familiar with the circular economy concept but are familiar with the lifestyle that implies this economy. But what is about the whole world? We need the dissemination of information, lifestyle, and views on the sustainability of the economy. This is one of the most urgent topics now.

4.2 The transformation from linear to the circular economy

The Finnish industry keeps the leading position in the world in the field of development of the circular economy. More and more companies are transforming from linear to the circular economy. Sitra Management Oy has created a list of 100 most interesting companies in the field of the Circular Economy in Finland. It shows Finland's most inspiring examples of the circular economy and gives all Finnish companies the opportunity to be among the first in the world to switch to a circular economy. (Sitra 2017.)

The question " Why did your company start to develop in the circular economy direction?" explores the motives of the transformation of Finnish companies. This study shows how and why companies change their business strategy: Are they initially developed as a circular economy company or are they transformed? The mission of the company is the sense of its existence in addition to making money. It shapes the values, conduct, and principles of business, reflects the intention of the company, its position, determines the role that the company wants to play in society. It makes strategic sense in the company's activities. What is the mission of the Finnish circular economy companies?

EntoCube Oy wants to save the world from their part. That is a very big motivation for them. They want to do something that makes sense, and they also want to go to Mars. EntoCube is collaborating with NASA and the European Space Agency. It is the big circular economy challenge to go there.

Jan Reiners recounts that Gasum saw that the circular economy is the future and there is a lot of business to do. If you look at the whole Nordic, Gasum needs to be a forerunner for a clean environment and clean traffic. They saw a business in the circular economy. Before the companies, which were in biogas, took the biowaste, turn it into biogas, and they used just the CHP engine to make power. It was only the way to use biogas. It was just three or four years ago. Gasum worked pretty hard to get biogas in a car sector as a fuel, and it did it. It was their goal. Juha-Matti Koskinen added that Gasum wants to be the leader in the circular economy. And the time is quite good now. They started to be the circular economy company two years ago when green possibilities for biogas and customers were required on the market. The business was the reason for them to be the circular economy company. Gasum is the leader of in biogas production in Nordic countries.

Ethica Oy saw that the world needs to make the transition towards the circular economy not only as kind of operational model but also as an economic model. They have done a lot of work around sustainability and corporate social responsibility, but when they started, the circular economy was the big goal. At the time then Ethica team started, which is nearly now five years ago, there was a little discussion about the circular economy. But now the time is with us, and it is moving in the right direction. Now it is easier to talk about the circular economy and use the term, much more projects are going around it. Ethica saw this as the big vision. Also, there are still many unresolved questions, which is probably a different time and different topic in sustainability. Anne Raudaskoski believes that the circular economy framework has managed to tackle those unresolved questions. So kind of paving foundations in an economy is much more powerful when talking about sustainability issues and then trying to bring economy within that framework.

When Pirjo Kaivos started in CLIC Innovation Ltd to coordinate one big project, it was around four years ago. They did not speak about the circular economy. They just talked about recycling. But when that project ended, the team understood that it was about the circular economy. Mrs. Kaivos approves that many companies are still talking about recycling, not about the circular economy, but they are moving in the right direction.

Bionova is a software and consulting company. It works with the methodology of life-cycle assessment for the built environment. Bionova's team managed the data related to the environmental impacts or the embodied impacts of buildings. When calculating a life-cycle assessment, they access the material quantities found in buildings and can calculate the embodied environmental impacts along a building's lifecycle, from material extraction to end of life. It is at the end of life stages that they can see what can be recycled or reused. It was a natural continuation for them to make this information available through our tool, Mr. Castro tells so that stakeholders can understand the consequences of material choices and construction methods on the reuse of materials and the future reduction of material extraction. So, people can start thinking how to improve the processes within a circular economy.

Finnish circular economy companies demonstrate the corporate social responsibility to society. Organizations take into account the interests of society, assuming responsibility for the impact of their activities on firms and other stakeholders in the public sphere. This commitment implies that organizations take additional measures to improve the quality of life of workers and their families, as well as the local community and society as a whole.

There is no one model or a common history of the companies' transformation from linear to circular economy business development. Some companies initially developed in this direction, some followed and follow the circular principles, but do not position themselves as such, and some companies have been purposefully transformed. But all companies share a common mission: to save the world and make life better for us and future generations. Companies can choose their development path, based on the successful examples of many Finnish companies.

4.3 Moving from theory to practice

Breaking out of old models and letting go of time-tested approaches is challenging. But the lessons of the circular economy are accumulating— and they show that the gains from making the transition outweigh the effort and the risk. (McKinsey & Company, 2016.) This study aims to show the reader that everyone can contribute to the sustainable development of the country and the world as a whole. Every company, person or regulation has its contribution. Experts were interviewed with the question: "What is the best model of the circular economy for a country, who should start: the public sector, the private sector or society?"

Most people think that they alone cannot start or that they cannot bring a contribution. If there is a government, then they should deal with issues of development and economy. Also, most small companies in the world do not take responsibility. They only pursue profit. The opinion of experts below draws a picture of the best model of economic development within the circular economy concept.

Mr. Karjalainen approves that there are a few ways to do that. The reason why we have problems is

ciated with a product or not. The staff is too cheap. That's why we eat too much meat. We buy too much plastic. What could the public sector do? They could internalize externalities: carbon tax, waste tax, or substitutes, which is much more difficult to do than the other. In private sector, we can try to accelerate the development and the adaptation of new technologies that can replace some of the old staff. He thinks it will be tough to change the society without intervention from the public sector: "I do not believe in people, I believe in politics". Again, internalizing externalities is the most important thing. It should be more expensive to do bad things. That would be a sense to try to make it greener or to find the new ways of doing that. Counting that is hard. This is the reason why it will take some time to do that. Cause we do not really know how much carbon went when we are making this pen or this coffee cup. But something should be done!

Jan Reiners personally thinks that you cannot go on the orbit, watch some countries from the international space station and tell that this circular economy model works exactly there. Some big city, for example, Helsinki could be the forerunner in the Helsinki region because it has a lot of cars, buses, and waste collecting tracks. Big cities and municipalities can make the decision to start to move to the circular economy development. For example, Vaasa city did it. Now they use only the biogas buses. Big companies or factories could make this decision to start. It is the cooperation. Also if you live in your private house, you usually have a lot of mixed waste. If you take different bins for different waste, you have to pay more for recycling. In most of Finland, the difference is quite significant. We should make the mixed waste recycling more expensive than sorted waste. The bio-waste should be relatively cheaper. About the public sector, Mr. Reiners thinks that all of the regulations should be made not with dictating, it should be done with supporting and motivation.

There is no the straight way to go to the circular economy development, Mr. Koskinen tells. We need to take all participate: cities, local people and especially companies. Companies have a big issue to reduce the emissions from the logistic or their factories. So, all this together is a puzzle. For example, for the household people can start the circular economy by themselves, they will put the plastics and mixed garbage into the different places because basically the circular economy starts from the end-users.

Anne Raudaskoski believes that we really need all parties. We need to share the sufficiently similar vision where we want to go. It is not only about regulations, but it is also very much about businesses and customers really requiring and demanding circular solutions. And also us, as individuals, are doing that we can and are inspired to do. This is the biggest challenge: "how to move the whole society in the same direction?" There are such fast opportunities that the circular economy approach, the mindset, the thinking provide us with. We need to start exploring those. That's why she always talks about the importance of design. There are a lot of side streams that companies produce, we can take those and produce the new things, but the existing model is still linear. If you want the transition into the circular model, we need to rethink the whole production line and supply chain.

Pirjo Kaivos and Rodrigo Castro think that it is really important that all stakeholders should be involved, it has to be from all directions. Cities should be involved much more. There is a direct relationship between the cooperation of companies and municipalities. The main driver of development will be the regulations. Those regulations need to make sense for the industry and the public to get on board as active stakeholders. Regulation creates the demand to account for and reduce environmental impacts. That part of the regulation will come from the government and cities. However, it has to make business sense to the industry and engage society, so all players can see the value that they can get from developing in the circular economy direction.

Based on the expert opinions, all participants should be involved in sustainable development within the circular economy: the public sector, the private sector, and society. Everyone can bring the value. Perttu Karjalainen, Jan Reiners, Pirjo Kaivos, and Rodrigo Castro believe that government can accelerate the sustainable development in the right direction and after the society and business will continue based on the right and wise regulations. If the state does not work in this direction, then public organizations can contribute to the introduction of the special regulations. As well as a special state organization should be created, to inform people, to expand the boundaries of the circular economy development and to monitor the implementation of those regulations.

Only if we are united, we can transform our world for the better. Even if just a little attention is paid to the issue of sustainable development in your country, everyone can take the first steps to save the world for our future generations, society, business and government should start.

4.4 Challenges for business

Five experts share the barriers for businesses standing in the way of the circular economy development. Now is the time to change the business strategy from a linear to a circular economy. There is no concept, which is perfect, there are always pros and cons, winning and losing. To meet the barriers and overcome them, the business must be ready. Since the experts in this study have extensive experience working with the circular economy, they share their views by discussing the issue: "How is it difficult for companies to move to the circular economy direction, what are the main barriers?"

Perttu Karjalainen informs that the EU is spending some billions of euros a year for different kinds of innovation funds or research projects, a lot of that is about the circular economy, but there is the gap between the prototypes and startups and when 'changing the world'. It is challenging to go to the market because the playground is set up in a way that it is hard to compete. The externalities are not allocated properly. If your product is more environmentally friendly, it will cost more to the consumers. One thing that Mr. Karjalainen learned during working with EntoCube Oy is that in the circular economy more than one player is required. When they collaborate with different companies, often they need either transport, this costs money to somebody, or they need to change the pro-

another. But always there is a cost element involved, and somebody needs to pay for the logistics as well. Another problem is the experts, how to change and process this CE system. There are the responsibilities that fall between companies that nobody is good at. There are integration points between companies. There is often a little bit difference between the companies' operating systems.

Jan Reiners as an expert from Gasum Oy believes that the easiest way for companies to move to the circular economy direction is to start to use the biogas as a fuel: for standard cars, for big lorries, for logistic. It doesn't have to be your bio waste that is converted to biogas, because there are a lot of tones of bio waste in Finland. Gasum has one of the best circular economy examples - Hämeenlinna Osuusmeijeri. It is the dairy company that makes all the organic products for Arla Foods Company. They produce a big amount of different side products. Gasum takes those side products to the Riihimäki Plant and makes biogas out of it. Then Gasum is transporting the biogas to Hämeenlinna by pipelines. Then Arla Foods Company uses a certain amount of biogas in their production. After the calculation, it was the right amount of energy to produce Arla Organic Milk. Now Alra Organic Milk is produced with Finnish biogas. They have the circular economy in use.

Juha-Matti Koskinen from Gasum Oy tells that almost every building, office or factory creates bio-waste. If people start to put the garbage into the right bins and have partners like L&T or Remeo Company who collect their bio waste or mixed waste, so all companies can be the part of the circular economy. The knowledge is also the problem. People have to know why they have to collect the waste, where it goes. If something costs more, people will not do it. But if the waste collection will cost just slightly more, people will have an opportunity to choose the best option.

Mrs. Raudaskoski doesn't think it is difficult, because at first all the company needs to do is to start exploring the circular economy concept, and the second thing is to explore and understand that is the most relevant principles for them. We are talking about the new economic model. There are quite a few things that describe the circular economy, but not all of them are relevant to each company. In the first sound, it is like we need to change everything and no one can do it, but it is not the case. Companies can plan their path and get the roadmap, step by step. It is much more about planning than facing huge challenges.

One significant barrier could be that it is the totally new model to do business, Mrs. Kaivos shares with us. And at the first stage, there will be winners and losers because some companies could lose their existing business. They have to move to another kind of concept. It is good to start with small steps and when to find the best way for them. The companies have to think about these issues in a strategic direction. One problem is also that they cannot do the circular economy by themselves. They need a network, an ecosystem. This requires faith in their partners. One thing is also the value distribution in the circular economy: who can get and what? It needs totally new business model.

Circular economy expert Rodrigo Castro points out that from the product perspective of companies, we are able to recover the resource to do something else with it. The problem is how efficient it is

they are making savings by recovering that or keeping customers engaged. This is the barrier. For example, clothing is a very different industry than the building. Buildings have a much longer lifespan than clothing. Recovering the initial materials investment has a different time perspective for building industry than for clothing companies. They have very different business models.

To conclude, the circular economy requires a restructuring of the business model, but this should not be done at a time, this should happen gradually, step by step. The first step is the concept research. Companies can also use the services of other circular companies to help to introduce the concept into their work and to make better use of their resources. It is necessary to build a system of companies' relations with each other to build up the right circular business model.

4.5 The future of the circular economy

The circular economy is a real opportunity to initiate a global transition toward a more sustainable economy that combines growth with environmental sustainability. (OECD 2012.) Finland and whole Europe are focusing now on the circular solutions. The linear model of the economy leads to a dead-lock due to limited resources, a bouquet of problems associated with the delivery of materials and the instability of raw material prices. The situation is changing. At the beginning of the work on creating any stuff, novelties, the designer understands how it will be used after, how it will circulate in the economic system. This applies to all materials, structural elements, and packaging. Many countries, from China to the EU, create regulations to support the circular production.

In this chapter, experts answer the question: "What do they think about the future of the circular economy: in Finland and in the world?" This shows the reader the opportunities for work and growth. The circular economy concept is new, but more and more people see it as a future.

Mr. Karjalainen assumes that there has always been the circular economy. Every water molecule, you have even drunk, has also been drunk by another. We have one planet, and we have our resources. We need to know the logic of nature a little bit better. Everything is very circular for billions of years. And when around maybe 1950s we got confused. Now we are relearning because we have started to make materials that do not degrade anymore and producing a lot of problems. In more developed countries, we have access to the best technologies, but we live in the most inorganic way. And in the poorest countries, life is very much circular still. Shorter loops, this is the thing that we can learn from nature. He believes that we have to make this problem relevant and change the world.

Mr. Reiners and Mr. Koskinen tell that now Gasum Oy is making like 0,0001% of fuel used in Finland and most of the fuel used in Finland is imported. Now we are talking a lot about the food production, but we can also produce the energy locally and from local raw materials. There is the future of the circular economy, and it is there, definitely.

We are still at the door, and most of the world is not yet on the path, Anne Raudaskoski points out. Europe is leading. The US has some movement. We need an awareness rising in the understanding of the human vision. Time is with us, on our side. There is not another way. She cannot see that we can do without the circular economy approach. We are still on the way, but it is the best way. It is the positive challenge. It is more about the matter of how quickly our transition. We can find so much smarter way to live, work, and do business. The future looks bright. It is not just an economic model; it is also our connection with nature, the environment, and the future.

Pirjo Kaivos believes that there is the future of the circular economy as well. The world is more and more global. We cannot be circular only inside the Finnish border. Big companies have customers outside. Other countries are moving. Finland can be the forerunner and show the way of the best circular business model to the world.

The circular economy is the future, Rodrigo Castro is sure as other experts. It will have a great impact in the way that businesses will work on from now on. It creates the opportunities for businesses that they will try to close the loop. It used to be the linear way of working like you build something, and you don't care much about it. The circular economy is an opportunity to save materials and to add new value to things that have met their end of life. Also, the circular economy concept is a way to put all ideas that have been developing for many years about recycling and material use efficiency into the consumption framework. It is the paradigm shift in the way society thinks about the resources. The cradle-to-cradle design is a good example of the application of this concept. We need to find more information that allows us to make better decisions.

The transition to the circular economy is one of the topics that today has a severe impact on the formation of the working agenda of many companies. We have opportunities for this. We must use our time, knowledge, strength, and see the direction of our development. Everything starts with small steps, but the world is ready and will change. The circular economy is a positive future, and this is already here, in our world.

5 CONCLUSION

The aim of this research was to provide the better understanding and the contribution of the circular economy to strategic sustainable development in Finnish industry. Additionally, the real examples of companies' transformation from the linear to the circular economy model and their transformation motives and barriers were explored and showed in the thesis. The research questions are summarized, and recommendations for future research and conclusions are presented.

5.1 Research summary

A large amount of practical information was obtained during the thesis research, which led to a better understanding of the circular economy concept.

The research showed that, despite the novelty of the concept, the implementation of the circular economy in business has economical, social and ecological advantages. The theoretical part of the thesis explored the phenomenon of the circular economic concept, as well as different applicable business models.

The research found out that most companies did not follow the goal of being a circular business. High social responsibility and the desire to make the world better were the main motives for their transformation. Everyone can take a step on the path of abandoning the linear economy. All participants together such as private sector, public sector, and society can bring the world to the sustainable development. The things that we need are the right regulations, general awareness and high level of the corporate social responsibility. People need to change their mindset from linear to circular economic, consumption model. Moreover, certain barriers to the transformation of companies were explored. The main ones are the issue of building cooperation between companies, the question of profit and the lack of relevant, up-to-date information.

The thesis confirmed that there are great opportunities for world economic development within the circular economy concept both locally and globally. There are needs to improve the approach and to find solutions for many emerging problems. We can create and maintain a better future for us and our future generations.

The circular economy focuses on the reuse of materials and the creation of value-added products through services and intelligent solutions, which opens up great business opportunities. The strategy for the Finnish circular economy development attracts the considerable interest at the international level. Finland has everything necessary to be a leading country with the circular economy and share experience with others.

5.2 Strengths and Limitations of the Research

The contribution to this study is limited to information and time frames. The research was carried out on the basis of generally available literary information at the time of writing the thesis.

The research part of the thesis included expert interviews, which always have a number of limitations. The selected experts had impressive industry information, accumulated from their own experience and conducted earlier studies. However, the expert interviews did not have a clear structure, unlike, for example, various quantitative surveys, when the same questions are asked of all respondents. The limitation of this study was the subjectivism of the perception of the research data, limited by the framework of the theoretical information obtained during the study. Different circumstances such as the time frame may also influence the research result, and it may vary from the human factor in a positive and negative direction.

5.3 Areas for future research

The circular economy concept is at the stage of its development, and nowadays it has an insufficient range of researchers. Future valuable research should consider advantages for different types of business implementation within this concept, as well as ways of mutually beneficial cooperation between companies from various sectors of the economy, including methods of increasing economic, environmental and social well-being.

The impact of models of a circular economy and sustainability should be understood by creating value for all stakeholders. The question of future research is to find the "win-to-win" parameter, which balances the interests of stakeholders and the sustainability of development. It is necessary to explore the cooperation of companies globally, not only within one country. Also, the questions of organizing the correct logistics for closing the loop are relevant.

Nowadays, the circular economy is finding more support both in the public and in the private sphere. Thus, the need for future circular economy research is topical and has a lot of prospects. We have many hypotheses and patterns of transformation from the linear to the circular economy, but all of them are very extensive, we need more real applicable examples. So far, we are talking about separate closed processes. An attempt to make the idea a general line for the development of the world economy in the future, but we have every opportunity to make the idea as a general line for the world economy development in the future.

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APPENDICES

Appendix 1. Interview guide: List of questions for the Circular Economy assessment

| Part | Goal | Question(s) |
|-----------------------------|--|--|
| Practical Information | <i>Collect the basic information about the experts' circular economy working (projects) experience.</i> | <ul style="list-style-type: none"> - Is the circular economy concept new for you? - When did you first get acquainted with this concept? - Under what circumstances? |
| Transformation of companies | <i>Show the real examples of the Finnish companies' transformation and their motivation behind it.</i> | <ul style="list-style-type: none"> - Why did you decide to develop and lead your business in the circular economy direction? - Why did your organization started to develop in the circular economy direction? How was it? |
| Strategic | <i>Collect expert opinion on the way of transformation of the country's overall economy from linear to circular.</i> | <ul style="list-style-type: none"> - What is the perfect model of the circular economy for country? - Who should start: the public sector, private sector or society? |
| Barriers | <i>Find out the main barriers that faced by companies in the circular economy implementation process.</i> | <ul style="list-style-type: none"> - How difficult for company to move to the circular economy direction? - What is the main circular economy barrier for businesses now? |
| Forecast | <i>Understand the expert forecast and the future of this type of economy in Finland and in the world.</i> | <ul style="list-style-type: none"> - Is there the future for the circular economy development? - Is there anything important for the research that you could add? |

Appendix 2. List of interviewed experts

| Name | Organization | Industry | Position | Website |
|---------------------|-----------------|---|---|--|
| Perttu Karjalainen | EntoCube | Insect Growth Technology | CEO&Co-Founder | www.entocube.com |
| Juha-Matti Koskinen | Gasum | Oil and gas | Sales Manager | www.gasum.com |
| Jan Reiners | Gasum | Oil and gas | Manager, Circular Economy and Recycling | www.gasum.com |
| Anne Raudaskoski | Ethica | Consulting | Co-founder & Principal Consultant | www.ethica.fi |
| Pirjo Kaivos | CLIC Innovation | Innovation cluster, R&D&I project coordinator | Portfolio Manager, Circular Economy Specialist | www.clicinnovation.fi |
| Rodrigo Castro | Bionova Ltd | Ecological Consulting | LCA Sales Expert, Life-cycle performance expert; Community Coordinator at the Circular Economy Club (CEC) | www.oneclicklca.com |

