

TOWARDS CARBON NEUTRALITY WITH CIRCULAR ECONOMY AT SKI RESORTS

Improving Waste Management at Rukakeskus Group

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Ilmastonmuutoksella on äärimmäisiä vaikutuksia maailmanlaajuisesti ja sen on todettu johtuvan pääasiassa kasvihuonekaasupäästöistä. Päästöjen vähentäminen on tärkeää ihmisen aiheuttaman ilmastonmuutoksen rajoittamiseksi ja kiertotalous on mahdollinen ratkaisu hiilineutraaliuden saavuttamiseksi. Opinnäytetyön toimeksiantajana toimi Rukakeskus-konserni, joka on yksi Suomen johtavista hiihtokeskus toimijoista. Tämän opinnäytetyön tavoitteena oli löytää konkreettisia tapoja vähentää toimeksiantajan päästöjä kehittämällä jätehuoltoa ja kierrätystä.

Tutkimus toteutettiin monimenetelmällisenä tapaustutkimuksena, jossa yhdistettiin sekä määrällisiä että laadullisia tutkimusmenetelmiä. Aineisto kerättiin kirjallisuuskatsauksen, kyselyiden, havainnoinnin ja puolistrukturoitujen haastatteluiden avulla. Kyselyt toteutettiin verkossa ja niihin osallistuivat toimeksiantajan henkilöstö sekä liiketilojen vuokralaiset. Havainnoinnit ja haastattelut antoivat syvempää näkemystä toimeksiantajan jätehuoltoprosesseista. Aineiston analyysissä hyödynnettiin määrällisen ja laadullisen sisällönanalyysin yhdistelmää kokonaisvaltaisen käsityksen saamiseksi tuloksista.

Tulosten mukaan kyselyyn vastanneet henkilöt kokivat toimeksiantajan jätehuoltoprosessien olevan hyvällä tasolla, mutta myös parannuskohteita löydettiin. Jätehuollon ja kierrätyksen parantamiseksi tunnistettiin viisi osaluuetta, jotka olivat suunnittelu, tiedottaminen, lajittelu toimipisteissä, jätteiden keräyspisteet ja teknologiset ratkaisut. Lisäksi toimeksiantajan eri toimipisteiden välisissä jätehuoltoprosesseissa oli eroja, joiden yhtenäistäminen on välttämätöntä uudistetun jätelain vaatimusten täyttämiseksi.

Johtopäätöksenä voidaan todeta, että kiertotalouden avulla on mahdollista vähentää hiihtokeskusten toiminnassa syntyviä päästöjä ja edistää hiilineutraaliuden saavuttamista. Jatkotutkimusehdotuksena suositellaan tutkimaan konkreettisia tapoja toteuttaa kiertotalouden mallia hiilineutraaliuden saavuttamiseksi organisaatiotasolla.

Avainsanat hiilineutraalius, kiertotalous, jätehuolto

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Climate change has extreme effects on all regions across the planet in various ways, and it has been noted that it is mainly caused by greenhouse gas emissions. Therefore, it is crucial to limit human-caused climate change, which requires carbon neutrality, and one possible solution to strive towards this is circular economy. The commissioner of the thesis was Rukakeskus Group, which is one of the leading ski resort operators in Finland. The goal of the thesis was identifying concrete means to reduce the commissioner's emissions by improving its waste management and recycling.

The research was conducted as a case study using mixed methods approach, combining both quantitative and qualitative research methodologies. Data collection included literature review, surveys, site visits, and semi-structured interviews. Surveys were conducted as online questionnaires and included all employees and commercial tenants of the commissioner. Site visits and interviews provided deeper insights into the commissioner's waste management processes. A combination of quantitative and qualitative content analysis was used to gain a comprehensive understanding of the results.

According to the results, the commissioner's waste management processes were perceived to be at a good level. However, several improvement areas were identified. To improve waste management and recycling, five categories were identified, which were planning, informing, sorting in locations, waste collection points, and technological solutions. Furthermore, there were differences in the waste management processes between the departments, hence unification of processes is needed to make sure that waste management meets the requirements of the renewed Waste Act.

To conclude, circular economy principles can advance the transition towards carbon neutrality by reducing ski resort's emissions generated in operations. As a further research proposal, it would be beneficial to further inspect concrete ways to implement circular economy principles to achieve carbon neutrality on organizational level.

Keywords carbon neutrality, circular economy, waste management

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ABBREVIATIONS

AI	Artificial Intelligence
CE	Circular Economy
CH ₄	Methane
CO ₂	Carbon Dioxide
EU	European Union
GHG	Greenhouse Gas
HFCs	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
IoT	Internet of Things
ML	Machine Learning
N ₂ O	Nitrous Oxide
OKR	Objectives and Key Results
PFCs	Perfluorocarbons
RFID	Radio Frequency Identification
ROA	Return on Assets
SDGs	Sustainable Development Goals
SF ₆	Sulphur Hexafluoride
UN	United Nations
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

1 INTRODUCTION

According to the Intergovernmental Panel on Climate Change (IPCC), human activities, primarily through greenhouse gas (GHG) emissions, have caused climate change, with global surface temperature increasing by 1.1 degrees celsius above the preindustrial average. This human-caused climate change affects various climate and weather extremes in all regions across the planet earth, which causes extensive adverse impacts, related losses and damages to nature, and society. Continued GHG emissions leads to increasing climate change effects, and every addition of global warming intensifies various and concurrent hazards. However, even though some future changes are unavoidable, they can be limited by rapid reduction of GHG emissions. Therefore, it is crucial to limit human-caused climate change, which requires carbon neutrality. Cumulative carbon dioxide (CO₂) emissions until reaching carbon neutrality, and the level of GHG emission reductions this decade mainly determine whether warming can be limited to 1.5 or 2 degrees celsius. (IPCC 2023)

The research context of this thesis is achieving carbon neutrality with circular economy (CE) at ski resorts. Carbon neutrality means according to Chen (2021, 1) net-zero CO₂ emissions, which are reached by balancing the CO₂ emissions with its removal to stop its increase in the atmosphere that causes climate change. CE is a concept where GHG emissions, waste and energy leaks are decreased by closing, slowing, and narrowing material and energy loops, which may be accomplished by design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling (Geissdoerfer, Savaget, Bocken & Hultink 2017, 766).

Sustainability and CE are currently high on the political agenda. International discourse on the requirement to shift to a CE from a linear is gaining increasing momentum, both in research and policy. (Medaglia, Rukanova & Zhang 2024, 11) Additionally, the European Union (EU) has set a goal to reach carbon neutrality by 2050, and to be able to achieve a carbon neutral CE it requires the full mobilization of the industry, and the decisions must be taken in the next few years (European Commission 2019, 7). Furthermore, the Finnish Government is

even more ambitious with its goals and has committed to reaching carbon neutrality already in 2035 (State Treasury, Finland 2024). Therefore, it seems that it would be wise to act sooner rather than later.

According to Zhao (2022, 1) GHG emissions have risen rapidly in recent years, and climate change has been a serious threat to society, since the industrial revolution. Climate change poses a challenge especially to the ski resorts, since they are dependent on snow. Therefore, there is a growing need and urgency for finding sustainable solutions to maintain their business and operations in the future. CE might offer a possible solution for ski resorts to strive towards carbon neutrality, since it aims towards using renewable energy, reducing waste, and improving recycling.

The commissioner of the thesis is Rukakeskus Group, which is the market leader in the ski resort industry, and one of the leading tourism businesses in Finland. The commissioner operates in Ruka ski resort and Pyhä ski resort, and its core competencies include lift/slope, rental, and store operations, accommodation services, and construction of holiday apartments. In addition, to Rukakeskus Ltd and Pyhätunturi Ltd, the Rukakeskus Group also includes Ski-Inn Hotels & Apartments Ltd, which operates in both ski resorts. The commissioner has operated the ski resort in Ruka since 1973 and in Pyhä since 1987. Together they are the market leader in the ski resort industry in Finland with approximately 20% share of lift ticket sales. Rukakeskus Group has been a pioneer in responsible ski resort operations and tourism since 2008, when it introduced its environmental program. In addition to environmental issues, its sustainability program also covers social sustainability and financial sustainability. (Ruka Ski Resort 2024b)

According to the Ruka Ski Resorts sustainability programme (2024a) the commissioner is currently carbon neutral according to the Greenhouse Gas Protocol (GHG Protocol) scope 1 and scope 2 standards, which include the direct GHG emissions of the commissioner, for example, from energy use and indirect emissions from purchased energy. However, according to the scope 3 standards also other indirect GHG emissions, for example, from waste generated in operations are included. Thus, to achieve carbon neutrality according to the new

standards there is a need for reducing the indirect GHG emissions of the commissioner, and a viable way to achieve this is with CE principles. The developmental task of the thesis is to find means to reduce the indirect GHG emissions of the commissioner by using the CE model. Therefore, the main research question is following:

- How can circular economy principles advance the transition towards carbon neutrality at ski resorts?

In addition, the goal of the thesis is to identify concrete ways to reduce the commissioner's GHG emissions by improving waste management. Thus, the research sub-questions are following:

- What is the status of waste management?
- How to reduce waste generated in operations?
- How to increase recycling rate?

This thesis consists of theoretical background, a description of the research methodology, the results of the study, and discussion. The theoretical background discusses carbon neutrality, circular economy, and waste management. The research methodology section discusses research philosophy, strategy, data gathering, processing, and analysis methods. In the results section, the results obtained in the study are presented and illustrated with figures. In the discussion section, conclusions, development proposals to the commissioner, and further research proposals are presented. In addition, validity and reliability, ethical considerations of the study, and reflection of the thesis process are discussed.

2 CARBON NEUTRALITY AND CIRCULAR ECONOMY

One of the most important elements on earth, which contributes to life on earth is carbon. Carbon-based materials have been used, since the industrial revolution, in producing energy, food, and other assets, which affects the global ecosystem innumerable ways. The considerable burning of fossil fuels and deforestation are intertwined with climate change, which occurs due to the greenhouse effect connected with increased CO₂ and other GHG emissions. Therefore, the global community is encountered with a need to develop sustainable methods for minimizing GHG emissions. (Wang et al. 2021, 15-16)

2.1 Carbon neutrality

Carbon neutrality is the balance between emitting CO₂ and absorbing CO₂ from the atmosphere in carbon sinks, which are systems that absorb more CO₂ than they emit. Soil, oceans, and forests are the primary natural carbon sinks. Additionally, to achieve carbon neutrality, global GHG emissions need to be balanced by carbon sequestration, which means removing CO₂ from the atmosphere and storing it. However, artificial carbon sinks are not able to remove CO₂ from the atmosphere at the required extent to battle climate change. In addition, through logging, forest fires, and changes in land use, the CO₂ captured in natural sinks is released into the atmosphere. Thus, reducing CO₂ emissions is crucial, in order to reach carbon neutrality. (European Parliament 2023b) Furthermore, to meet the globally agreed plans for sustainable development and carbon neutrality, it requires a significant change in the progress on reducing GHG emissions, and companies, as considerable emitters, must find ways to expedite progress on reducing their GHG emissions (Dahlmann, Branicki & Brammeer 2019, 22).

Achieving carbon neutrality promotes global sustainable development by benefitting the environment, society, and economy (Chen et al. 2022, 2306). Additionally, other benefits of carbon neutrality are reduction in environmental pollution, creation of green jobs, improvements in human health, and increased economic growth, better food security, reduction in biodiversity loss as well as

advancement in the condition of the oceans (Das, Bhujel, Laha & Mishra 2022, 40). Furthermore, reducing CO₂ emissions improves profitability, as reflected by increase in return on assets (ROA). Therefore, it is profitable for businesses to make sure that their CO₂ emission reduction and financial performance goals are aligned. (Ibishova, Misund & Tveterås 2024, 10)

2.2 Greenhouse gas emissions reporting

The most widely used framework for reporting GHG emissions is GHG Protocol. (Kasperzak, Kureljusic, Reisch & Thies 2023, 13). It provides global standards for organizations to measure and manage their GHG emissions. World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) created GHG Protocol as a global standard for corporate accounting and reporting GHG emissions, categorizing GHGs into scope 1, scope 2, and scope 3 based on the source of emissions (Figure 1).

The six main GHGs covered are CO₂, methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF₆). Scope 1 includes reporting company's direct GHG emissions from company facilities and company vehicles. In addition, scope 2 includes indirect GHG emissions from purchased electricity, steam, heating, and cooling for own use. Furthermore, scope 3 includes other indirect GHG emissions from the reporting company's whole value chain, which are further divided into 15 different categories that include upstream and downstream activities. The upstream activities included in scope 3 are leased assets, employee commuting, business travel, waste generated in operations, transportation and distribution, fuel and energy related activities, capital goods, and purchased goods and services. The downstream activities included in scope 3 are investments, franchises, leased assets, end-of-life treatment of sold products, use of sold products, processing of sold products, and transportation and distribution. (World Resources Institute 2024)

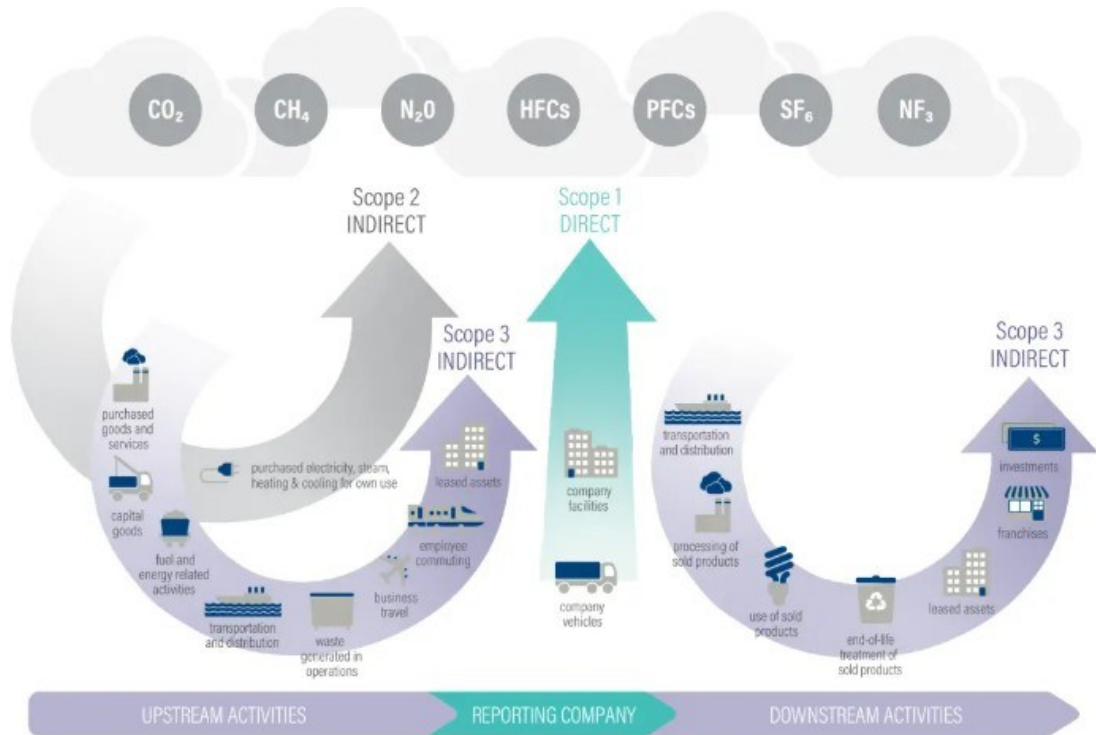


Figure 1. Overview of GHG Protocol scopes and emissions (World Resources Institute 2024)

The carbon neutrality plans for ski resorts mainly focus on reducing GHG emissions from snow grooming machines and ski lifts. However, the plans do not fully address scope 3 GHG emissions, which can account for up to 80% of a ski resort's tourism related emissions. Therefore, to achieve true sustainability and carbon neutrality in the ski resorts, a more comprehensive approach that addresses scope 3 GHG emissions is needed. (Salim, Loloum & Bonnemains 2024)

2.3 Circular economy

CE is central in hindering climate change and in the revolution of renewable energy. It aims to maximize the circulation of products, components, materials, and the value bound to them as much as possible in the economy. (Sitra 2016, 6-9.) In addition, according to D'Adamo (2019, 4) to keep up the worth of goods and materials for as long as possible, it is necessary to develop a CE model as an alternative to the linear model. Furthermore, according to the European Commission (2020, 1), CE is key for global sustainable consumption and

production. Additionally, global development towards a carbon neutral CE enables organizations to create sustainable growth, expand into new markets, and develop new business (Sitra 2022, 2).

Sustainable growth can be obtained through the CE business models, which are circular inputs, sharing platforms, product as a service, product life extension, and resource recovery. Circular inputs include using recycled, bio-based materials, and renewable energy. Sharing platforms enable to increase the utilisation of goods and resources. Product as a service includes offering access to products instead of owning them, through services such as renting. Product life extension includes making products last longer through maintenance, repair, and resale services. Resource recovery includes recovering materials and resources from products that are no longer functional in their current application. (Sitra 2022, 12)

According to Rodríguez-Antón, Rubio-Andrada, Celemín-Pedroche & Ruíz-Peñalver (2022, 85) the relationship between CE and achieving the Sustainable Development Goals (SDGs) in the EU has been shown. In 2015, the United Nations (UN) approved the SDGs as a global call to action on protecting the planet, ending poverty, and guaranteeing that by 2030, all people enjoy prosperity and peace. Additionally, the 17 SDGs are intertwined, in other words, action in one area affects outcomes in others. In addition, they recognize that development needs to balance environmental, social, and economic sustainability. (United Nations Development Programme 2024) Many SDGs are connected to the orientation towards CE at the EU level, hence it seems like concrete actions towards transitioning from linear economy into circular might facilitate complying with the UNs 2030 Agenda. Furthermore, the interconnectedness of nearly all the 17 SDGs confirms that CE might allow these goals to be achieved in the EU by 2030. Therefore, there seems to be a significant relation between implementing CE in the EU and reaching the SDGs. (Rodríguez-Antón et al. 2022, 85)

CE is at present promoted not only by the EU but by multiple national governments and in addition, by multiple business organizations around the world (Korhonen, Honkasalo & Seppälä 2018, 45). Even though, different parties are

working across many disciplines to link together and promote key ideas of the CE, the field is still relatively new. There are many definitions for CE and some of them take a holistic view and bring forth a systems level perspective. Other focus on waste and material flows. (Alexander 2023, 19)

The European Parliaments (2023a) CE model (Figure 2) aims to reduce the use of raw materials, hence reducing waste and lowering GHG emissions. It includes the following stages in specific order: the input of raw materials, sustainable design, production, distribution, consumption, reuse, repair, collection, and finally through proper waste management, residual waste is minimized by keeping the materials in a closed-loop cycle.

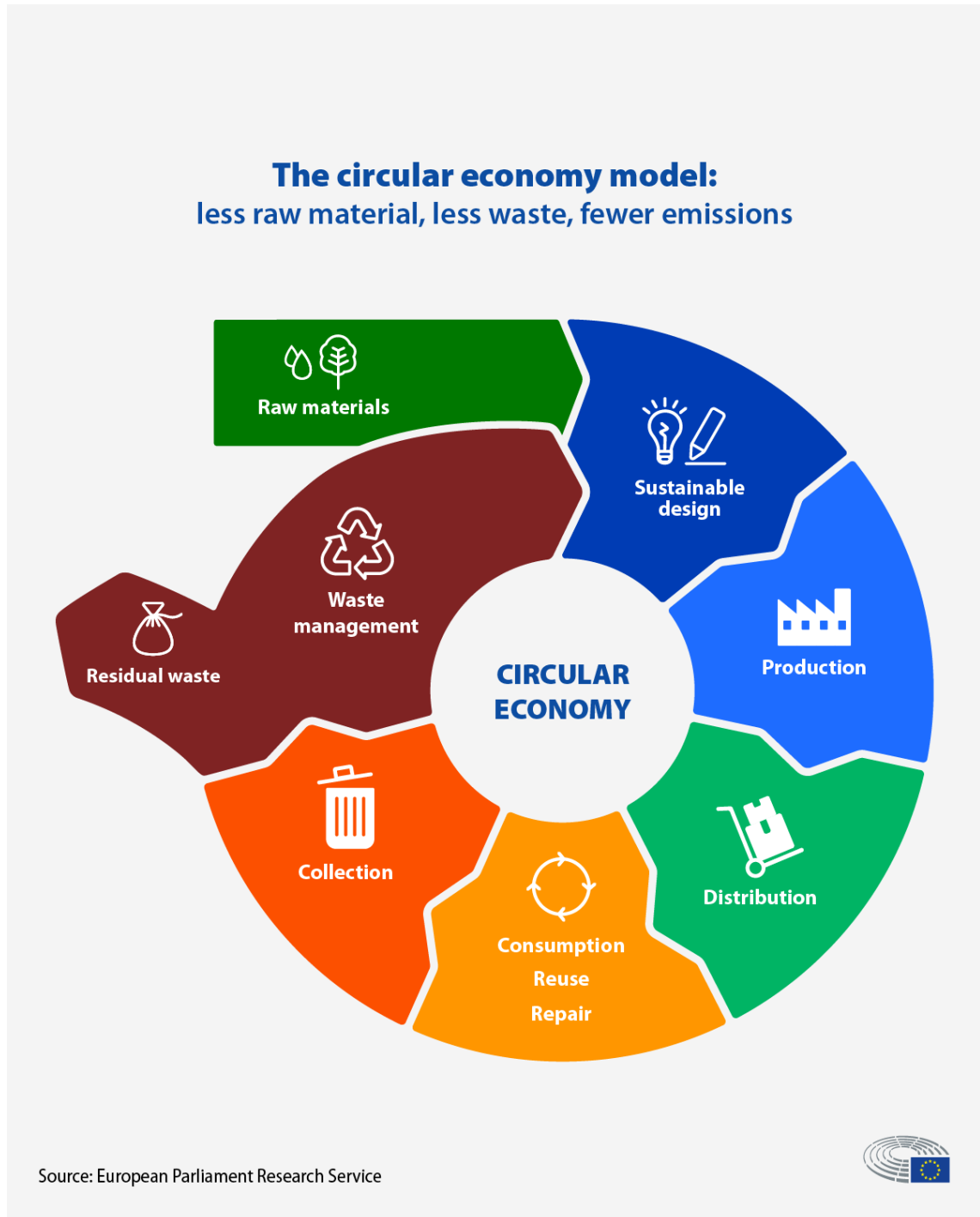


Figure 2. Infographic explaining the circular economy model (European Parliament 2023a)

Even though the aim of CE is clear, a consistent definition for CE has not been established. Thus, the implementation remains unclear. Especially, a significant source of uncertainty is to which degree CE should focus on the circularity of materials or include usual metrics of sustainability. Additionally, many case studies regarding CE are driven by organizations that need to present they have

advanced their circularity. This is questionable, since inconsistent indicators of circularity are being used. Therefore, the ambiguity associated with CE has led to some criticism and scepticism. (Torres 2024, 577)

However, as traditional linear economy faces critical examination because of unsustainable resource use and environmental impact, CE presents a viable alternative that promotes resource efficiency, waste reduction, and sustainable economic growth. In addition, one of the key benefits of CE is its potential to significantly reduce environmental impact. Through minimizing waste and promoting reuse, repair, and recycling, businesses can decrease their reliance on finite resources and reduce their GHG emissions. Furthermore, CE offers considerable economic advantages, and by using CE business models, businesses can gain new revenue streams, reduce costs, and improve their competitiveness. (Tuboalabo, Buinwi, Okatta, Johnson & Buinwi 2024, 1106-1107) Therefore, CE might offer a possible solution for ski resorts to strive towards carbon neutrality. Particularly since it focuses on using renewable energy, reducing the use of raw materials, and minimizing waste, hence reducing GHG emissions. Nevertheless, according to Alexander (2023, 19) the field is still close to infancy, thus further research on the topic would be beneficial.

2.4 Waste management

Waste is a result of human action, and there are various views as to what constitutes as waste. However, many researchers agree that waste is material whose owner no longer has a need for it. Thus, the meaning of waste is subjective, since the term can be interpreted in various ways and is influenced by personal opinions. Nonetheless, it is crucial to define waste and to provide a guide for policies and legislations, which is crucial since the understanding of what particularly constitutes as waste and the different categories of waste types concludes the way waste is managed. Waste management contains a process by which waste is collected, transported, and disposed of in the best possible way of limiting or eliminating the harmful effects of waste. (Amasuomo & Baird 2016, 94) Furthermore, prevention and minimization of waste, recovery of materials, recycling and re-use represent an increasing potential for reducing

GHG emissions through decreased generation of waste, lesser consumption of raw materials, reduced demand of energy and usage of fossil fuels (Bogner et al. 2008, 12-13).

2.5 Waste policy in Finland

The aim of waste policy in Finland is to advance the use of natural resources in a sustainable way and to guarantee that health and environmental harm is not caused by waste. Waste management is guided by the order of priority. First and foremost, generation of waste must be prevented. In case that waste is produced, it needs to be reused. If that is not possible, waste must be primarily recycled and secondarily used as energy. Finally, if recovery of waste is not technically or financially possible, waste can be disposed of in landfills. The order of priority can be deviated from, if there is another option that is more environmentally sound. While choosing a waste management option, life cycle effects of waste, environmental preservation, the technical and financial requirements of the waste operator responsible for waste management are considered. (Ministry of the Environment 2024c)

According to the renewed waste directive 55% of municipal waste must be recycled in 2025, 60% in 2030, and 65% in 2035. In addition, the goals for recycling packaging waste are raised: 65% of all packaging waste must be recycled by 2025 and 70% by 2035. Furthermore, there are specific material-based goals set for recycling different packaging materials. The goals set for recycling plastic and wood packaging materials are the most challenging for Finland. (Ministry of the Environment 2024b)

The intention of the Waste Act is to promote CE and sustainable use of natural resources, to reduce the amount of waste and its harmfulness, to prevent harm and danger caused by waste and waste management to health and the environment, to prevent littering, and to secure functioning waste management (Jätelaki 646/2011 § 1:1). According to the Waste Act, waste means a substance or object that its owner has removed from use or intends to remove from use or is obliged to remove from use (Jätelaki 646/2011 § 1:5). The owner of the

property must organize waste management, if the owner of the waste does not take care of his obligation, or this is not achieved, and if the owner of the property has allowed waste producing activities on the property or the bringing of waste to the property (Jätelaki 646/2011 § 4:28).

According to the Ministry of the Environment (2024a), starting in July 2022, the operator of business activities, in other words, the waste holder, must organize separate collection of municipal waste generated in their operations, if the property is in a service, tourism or workplace area, and if the operation generates waste on average at least as follows: paper and cardboard packaging waste 5 kg per week, plastic packaging waste 5 kg per week, biowaste 10 kg per week, metal packaging waste and other small sized metal waste 2 kg per week, and glass packaging waste 2 kg per week.

2.6 Technological solutions for waste management

Implementing Industry 4.0 technologies, such as smart automation, internet of things (IoT), system integration, and cloud computing brings encouraging opportunities for developing waste management because of new generation of real-time data, which improves decision making and management. Additionally, wireless communications and radio frequency identification (RFID) allow to trace materials in order to understand better the opportunities in CE. (Cheah et al. 2022, 9)

In addition, Artificial Intelligence (AI) can be used in many aspects of waste management, for example, in recycling, organic waste processing, and reducing GHG emissions. In recycling, different technologies, for example, automated sorting and machine learning (ML) can improve efficiency and accuracy. However, they might encounter technological limitations and high initial investments. In organic waste processing, data analysis and IoT sensors can aid in reducing the amount of waste and to produce compost, but they might be limited by high data and device costs. In reducing GHG emissions, emissions prediction and optimization algorithms can aid in reducing GHG emissions and improving energy efficiency. However, they might encounter implementation

complexity and regulatory mistakes. (Hernandez, Pasha, Yusuf, Nurfaizi & Julianingsih 2024, 153)

Nevertheless, smart waste monitoring systems do not necessarily have to be expensive. Yusof, Jidin, and Rahim has described development of a smart waste monitoring system that is based on inexpensive Arduino Uno microcontroller. The system is useful in developing the efficiency of waste management due to its ability to measure the waste level in the waste container and alerting the waste handler for immediate collection. The system is applicable because it is practical, reliable, and inexpensive. (Yusof, Jidin & Rahim 2017, 5)

3 RESEARCH METHODOLOGY

Saunders et al. (2023, 131) describes the research process as an onion, which has six layers (Figure 3), and each layer leads to another. The first layer (the outer layer) represents research philosophies, such as pragmatism, postmodernism, interpretivism, critical realism, and positivism. The second layer represents approaches to theory development, such as induction, abduction, and deduction. The third layer represents methodological choices, such as mixed method complex, mixed method simple, multi-method qualitative, multi-method quantitative, mono-method qualitative, and mono-method quantitative. The fourth layer represents research strategies, such as action research, case study, archival research, narrative inquiry, grounded theory, ethnography, survey, and experiment. The fifth layer represents time horizons, such as longitudinal and cross-sectional. Finally, the sixth layer, which is the centre of the onion, represents data collection and analysis procedures and techniques.

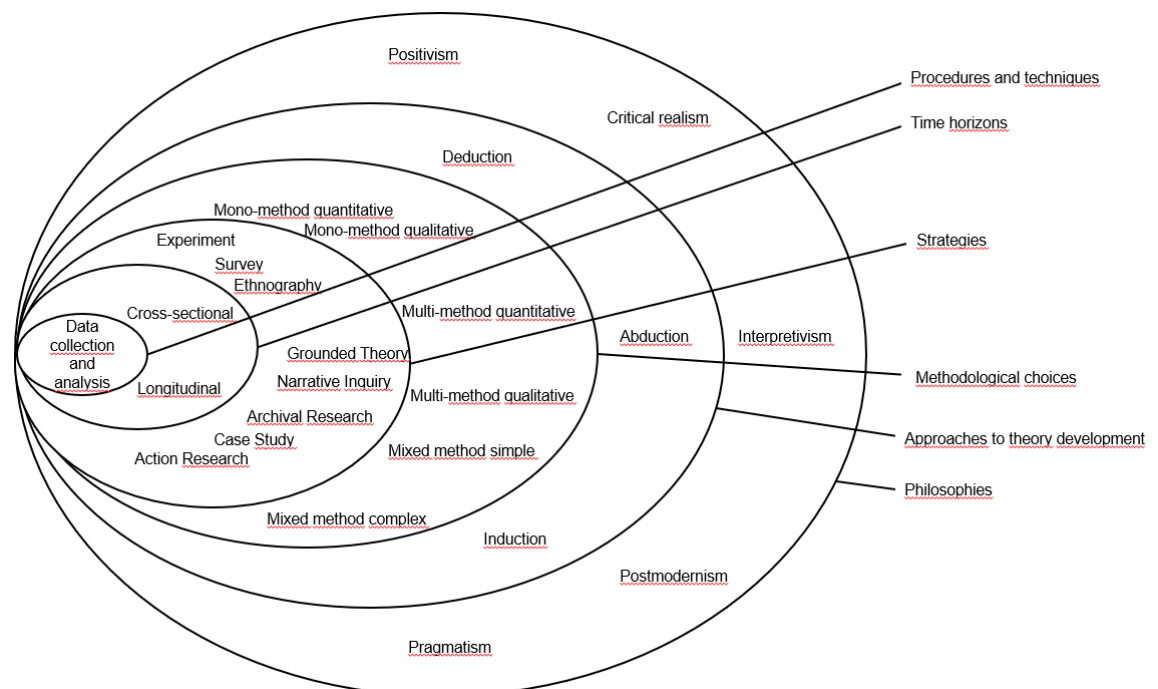


Figure 3. The research onion (adapted from Saunders et al. 2023, 131)

3.1 Research philosophy

Research philosophy refers to beliefs and assumptions about the development of knowledge, and it constructs the worldview within which the research is

conducted. In addition, the assumptions of the worldview within which research is undertaken are significant, impacting which data is favoured and the way data is interpreted. Furthermore, it will underpin the methodological choice, research strategy, data collection and analysis methods. (Saunders, Lewis & Thornhill 2023, 131-132) Therefore, understanding of the philosophical, such as ontological (the nature of reality) and epistemological (the nature of knowledge) orientations may guide researchers to conduct their research (Al-Ababneh 2020, 90). This thesis leans more on positivism and objectivism. According to Park, Konge & Artino (2020, 690-692) positivism leans on objectivity, and thus disregards the importance of individual subjective experiences and values. However, positivist research does not always rely just on quantitative research methods.

3.2 Research strategy and methods

In general, research methodologies are divided into two main categories, which are quantitative research and qualitative research. Quantitative research is based on positivist paradigm, and qualitative research is based on interpretivist paradigm. In addition, quantitative research is concerned with measuring phenomena by collecting and analysing data, and qualitative research is concerned with understanding the meaning of phenomena. (Al-Ababneh 2020, 90)

This thesis is a research-based case study including literature review, surveys, site visits, and interviews. Case study is a research strategy, which is widely used in organizational studies, and it is especially suited for research questions, which require detailed understanding of organizational processes. In general, case studies include multiple research methods, often combining both quantitative and qualitative research methodologies. (Hartley 2004, 323-324) In addition, using multiple sources of data, also known as triangulation, adds depth to the data that is collected. Furthermore, triangulation is important to ensure validity and reliability of the data and results. (Fusch, Fusch & Ness 2018, 20-21)

According to Knopf (2006, 127) literature review summarizes and evaluates a body of writings about specific topics. Surveys are one of the most common types of quantitative research strategies. In surveys, the researcher usually selects a sample of respondents from a population and conducts a questionnaire to the sample. However, if the survey population is small, it is possible to survey the entire population. The questionnaire can be a written document, an online questionnaire, or an interview. It is possible to collect data from different sized populations by using surveys. Different kinds of surveys consist of various research techniques, developed by various field of studies. Therefore, survey research does not belong to only one field, and it can be employed by almost any field of study. (Barribeau et al. 2005) Survey research method was chosen to be able to study the whole staff of the commissioner and the commercial tenants, in other words, the study was conducted as a population study.

In addition, according to Patton (2015, 1) the understanding of programs is enriched when evaluators go into the field, pay attention to what is going on, systematically document what they see, and report what they learn. Thus, site visits to the waste collection points were conducted, additionally to the survey research. This was done to get a deeper understanding of the waste management processes of the commissioner.

Furthermore, interviewing is a typical research method, and the various kinds of interviewing, such as structured, unstructured, and semi-structured, give researchers options to choose the appropriate method for their needs. In semi-structured interviews the questions are preplanned before the interviews, but the interviewer gives the interviewee a chance to elaborate and explain issues using open-ended questions. (Alsaawi 2014, 150-155) Hence, semi-structured interviews were conducted to get a clear understanding of the waste management process in certain areas in which the information gathered from the surveys and site visits was inadequate.

3.3 Data gathering, processing, and analysis

Data was gathered with two separate online questionnaires (Appendix 1. Employee questionnaire & Appendix 2. Commercial tenant's questionnaire), which were conducted in Finnish with Microsoft Forms software. Employee questionnaire was shared with the entire population of the study, which was the whole staff of Rukakeskus Ltd, Pyhätunturi Ltd, and Ski-Inn Hotels & Apartments Ltd, which was approximately 250 employees during the time of the study. The questionnaire was shared with the staff through a mutual Microsoft Teams channel and on mutual weekly memos. Questionnaire for the commercial tenants was shared with the entire population of the study as well, and this was sent to the tenants contact person via email. This included all the commercial tenants of Rukakeskus Ltd and Pyhätunturi Ltd, which was 26 tenants. Both questionnaires included close-ended and open-ended questions. The results were processed and analysed anonymously with Microsoft Forms and Microsoft Excel software.

Quantitative content analysis is mainly deductive, and qualitative content analysis is mainly inductive. Deductive reasoning aims to test hypotheses or address questions generated from theories or previous empirical research. Inductive reasoning aims to ground the examination of topics and themes, as well as the inferences drawn from them, in the data. However, the two analysis methods are not mutually exclusive and can be used in combination. (Zhang & Wildemuth 2009, 1-2) Therefore, a combination of quantitative content analysis and qualitative content analysis were used since both questionnaires included close-ended and open-ended questions. Quantitative content analysis included descriptive statistical analysis and inferential statistical analysis.

Descriptive statistical analysis is used to describe the basic features of the data in a study; hence it simply describes what is in the data or what the data shows. Regarding inferential statistical analysis, conclusions reach above the immediate data alone, and it is used, for example, to infer from the sample data what the population thinks. Therefore, inferential statistical analysis is used to make inferences from the data to more general conditions, and descriptive statistical analysis is used to simply describe what is going on in the data. (Trochim 2007)

In qualitative content analysis, data is condensed into categories or themes based on valid inference. This process uses inductive reasoning, whereby categories or themes develop from the data due to thorough examination and comparison by the researcher. (Zhang & Wildemuth 2009, 2)

In addition, site visits were conducted in Ruka and Pyhä Ski Resorts in December 2024. During the visits, waste collection points were inspected and general observations made. The data was gathered and processed with Microsoft Excel software by taking notes and making tables of what could be recycled at which waste collection points.

Furthermore, three semi-structured interviews were conducted by phone in January 2025. Focus of the interviews was on waste management processes in general and in lift/slope operations. Thus, the real estate specialist of the commissioner, customer service manager of Ruka and Pyhä lift/slope operations manager were interviewed to get more in-depth knowledge regarding the processes. The data was gathered by taking notes and processed with Microsoft Word software. The interview questions were following:

- How are waste management and recycling realized in practice?
- What is recycled at the lift/slope operations?
- Where is the waste taken at the lift/slope operations?

This thesis focuses on reducing the commissioner's waste generated in operations (scope 3, category 5) emissions, which can be achieved, for example, by reducing amount of waste generated in operations, implementing recycling systems that lead to emission reduction, and implementing low emission waste treatment methods. Treatment of waste generated in operations is categorized as an upstream scope 3 category since waste management services are purchased from a third party by the commissioner. (GHG Protocol 2011, 74-110) In addition, even though the commissioner's commercial tenants waste generated in operations are not included in the commissioner's scope 3 emissions, since they are included in the tenant's own scope 3 emissions, but

because they use the same waste rooms and points, it is challenging to separate the waste streams. Furthermore, they offer valuable information regarding waste management, hence they are included in the study.

4 RESULTS

In this section the results of the study are presented using descriptive statistical analysis, inferential statistical analysis, and qualitative content analysis. The questionnaires were conducted and the software that was used for data processing and analysis was in Finnish. Therefore, the figures presented are in Finnish as well. To understand the figures, the terms 'keskimääräinen arvio' means mean value and 'taso' means level.

4.1 Employee questionnaire

The employee survey was shared with the commissioner's entire staff, which was approximately 250 employees, and it got 52 answers in total. Response rate was approximately 21%, which was low. Therefore, the statistics measures may be affected by nonresponse bias.

Level of recycling, problem areas, and improvements

Recycling at the Ski-Inn apartments got a mean value of 3.11 on a scale from 1 to 5 (5 being the highest score). This suggest that the level of recycling at the Ski-Inn apartments was at a good level, but improvements could be made. In addition, the answers were distributed the following way: 2 answers for level 4, 6 answers for level 3, and 1 answer for level 2 (9 answers in total). The deviation of answers was small, which suggests consistency. The distribution of answers is further illustrated in Figure 4.

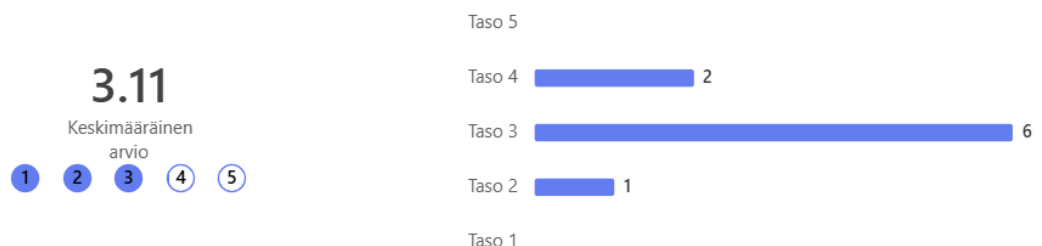


Figure 4. Recycling at the Ski-Inn apartments

The suggested problem areas regarding recycling at the Ski-Inn apartments were divided into two main categories, which were informing and sorting in locations. Concerning informing, the problem areas identified were that the waste collection points were challenging for the customers to find, the instructions in the waste collection points were inadequate, and the customers general lack of interest in recycling during the holidays. Regarding sorting in locations, the problem areas were that the rooms and apartments did not have enough waste containers for different waste types. In addition, in some of the room and apartment types, the cupboards in which waste containers were located were so small that it made it challenging to add more containers. The customers general lack of interest in recycling during the holidays was most likely caused due to the lack of different waste containers in the rooms and apartments, which makes it tricky to recycle different waste types. Therefore, the suggested improvements were adding more waste containers in the rooms and apartments. However, in some room and apartment types this would require either the cupboards to be enlarged or containers small enough to fit inside the cupboards.

Recycling at the departments got a mean value of 3.15 on a scale from 1 to 5 (5 being the highest score). This suggest that the level of recycling at the departments was at good level, but there was room for improvement. In addition, the answers were distributed the following way: 2 answers for level 5, 19 answers for level 4, 18 answers for level 3, 11 answers for level 2, and 2 answers for level 1 (52 answers in total). There was some deviation in the answers, which suggest inconsistency. This was caused by the variation in the experience of how well recycling is carried out depending on the department of the respondents. The distribution of answers is further illustrated in Figure 5.



Figure 5. Recycling at the departments

The suggested problem areas regarding recycling at the different departments were divided in three main categories, which were informing, sorting in locations, and waste collection points. Concerning informing, the problem points were lack of general plan for waste management and lack of staff's interest and knowledge in recycling. Hence, a lot of the waste that could have been recycled, went into mixed waste. Additionally, there was, for example, ambiguity in recycling keycards, what counts as hazardous waste and how it should be handled. In addition, there was ambiguity in who empties the waste containers and if the different waste types are sorted by the collector. Furthermore, the customers had difficulties in finding the waste rooms.

Regarding sorting in locations, there were some differences in recycling at the departments, and in some departments, there was not clear sorting, for example, the containers were not clearly marked, and some of the offices only had one container (which was for mixed waste). In addition, in the lift/slope operations only mixed waste, bottles, and cans were collected. Additionally, there was not paper recycling close to the sales counters, which produced a lot of receipts. Therefore, receipts often ended up into mixed waste containers. Furthermore, in some departments the containers were not emptied often enough, for example, in some cases the collection of biowaste was stopped due to the bad smell.

Concerning waste collection points, some of them were missing crucial waste types to be recycled, such as plastics and biowaste. In addition, the waste collection points were too small, and the waste was not collected often enough, since the containers at the waste collection points were frequently full. Additionally, the waste rooms were located far away from the job posts, and they were disorganized, for example, there were scrap on top of the containers and cardboard was left in the trolleys even though there was room left in the container. Furthermore, the waste containers at the waste collection points were not clearly marked, and in some cases the containers were broken.

Level of communication, problem areas, and improvements

Communication to the staff concerning recycling got a mean value of 2.96 on a scale from 1 to 5 (5 being the highest score). This suggests that the communication level was at a satisfactory level, but improvements could be made. The answers were distributed the following way: 2 answers for level 5, 18 answers for level 4, 14 answers for level 3, 12 answers for level 2, and 6 answers for level 1 (52 answers in total). There was quite a lot of deviation in the answers, which was mainly caused due to the variance in the departments of the respondents. The distribution of answers is further illustrated in Figure 6.



Figure 6. Communication to the staff regarding recycling

The suggested improvements concerning communication of recycling to the staff were divided into two categories. First category was informing, and the suggested improvements were reminding the staff about the importance of recycling in the weekly and monthly meetings, going through the recycling process in the introduction for new employees, adding clear recycling instructions in the departments, and adding sustainability (including recycling) course compulsory to Vuolearning (an online learning platform, which the commissioner uses for staff training). In addition, sustainability values could be made more visible in the staff info sessions, meetings, and the commissioner's objectives and key results (OKR) framework. However, there were some statements that the communication is on adequate level, and therefore emphasis should be on improving the recycling possibilities. Hence, the second category identified was sorting in locations, and the suggested improvements were adding clear recycling containers with instructions to the departments and adding more clear information where the waste collection points are located.

Communication to the customers regarding recycling got a mean value of 3.27 on a scale from 1 to 5 (5 being the highest score). This suggests that the communication level was at a good level, but there was room for improvement. The answers were distributed the following way: 1 answer for level 5, 16 answers for level 4, 22 answers for level 3, 4 answers for level 2, and 1 answer for level 1 (44 answers in total). There was some deviation in the answers, which was due to the variance in the departments of the respondents. The distribution of answers is further illustrated in Figure 7.

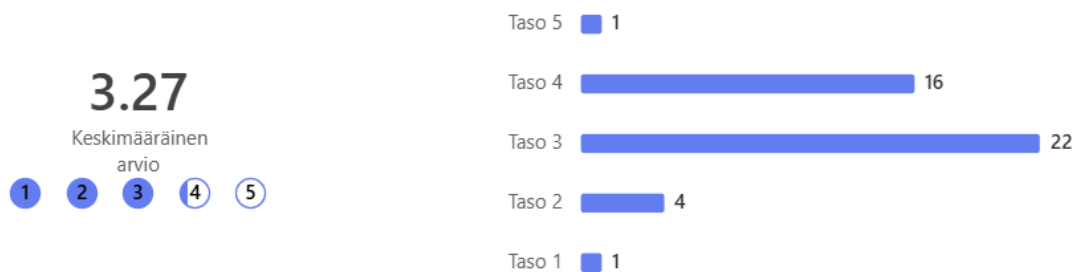


Figure 7. Communication to the customers regarding recycling

The suggestions for improving communication of recycling to the customers were divided into three categories, which were informing, sorting in locations, and waste collection points. Concerning informing, the suggestions were adding information about recycling (such as what to recycle and where) to the booking confirmations, common areas, and to the waste cabinet doors in the Ski-Inn rooms and apartments. Regarding sorting in locations, the suggestions were to add clear general instructions with pictures to the waste containers, which would also acknowledge foreigners and having the same system in all locations. Concerning waste collection points, the suggestions were to add clear signs and instructions to the waste collection points.

Waste reduction

According to a small majority of 20 respondents (38%) it was possible to reduce the amount of waste at the departments. However, 13 respondents (25%) didn't think it was possible, and 19 respondents (37%) couldn't say. The answers were

quite evenly distributed, and there was some variation depending on the departments of the respondents, which suggests that waste can be reduced in some departments more than others.

The suggestions for reducing the amount of waste at the departments were divided into 4 categories, which were planning, informing, sorting in locations, and technological solutions. Regarding planning, waste could be reduced by reducing packaging material through using durable boxes for loads and by using suppliers, which minimize the amount of packaging material used. Concerning informing, waste could be reduced by informing the staff and customers. Regarding sorting in locations, waste could be reduced through proper recycling containers and emptying them accordingly. Concerning technological solutions, waste could be reduced through using digital services, printing less, and having a completely paperless office. Additionally, waste could be reduced by reducing receipts and orders, by reducing the amount of print material, such as flyers and magazines. In addition, waste could be reduced through not buying readymade meals but instead preferring home-made meals or dining at the staff lunch restaurants and not using disposable cups for beverages but instead more sustainable options such as travel cups.

4.2 Commercial tenant's questionnaire

The commercial tenants survey was sent to 26 contact persons via email, and it got 9 answers in total, which included all commercial tenants in Ruka and Pyhäski resorts. Response rate was 35%, which was quite low. Therefore, the statistics measures may be affected by nonresponse bias.

Level of recycling, problem areas, and improvements

Recycling at the tenants got a mean value of 3.78 from 1 to 5 (5 being the highest value). This suggest that the recycling at the tenants was at higher level than at the commissioner's departments. However, improvements could still be made. The answers were distributed the following way: 1 answer for level 5, 6 answers for level 4, 1 answer for level 3, and 1 answer for level 2 (9 answers in total).

There was some deviation in the answers, which was caused due to variation in the locations of the tenants and since the companies were in different industries with different recycling needs. The distribution of answers is further illustrated in Figure 8.



Figure 8. Recycling at the tenants

The problem areas and suggested improvements regarding recycling at the tenants were divided into two categories, which were sorting in locations and waste collection points. Concerning sorting in locations, the problems were that the containers were too small and often full. In addition, they often caused unpleasant smell. Considering waste collection points, the problems were that plastic and biowaste collection were missing. Furthermore, there was lack of space in the tenant's own warehouse.

Level of communication, problem areas, and improvements

Communication concerning recycling to the tenant by the commissioner got a mean value of 3.44 from 1 to 5 (5 being the highest value). This suggests that recycling was at good level, but there was room of improvement. The answers were distributed the following way: 7 answers for level 4, 1 answer for level 2, and 1 answer for level 1 (9 answers in total). There was some deviation in the answers, which suggest that there were some inconsistencies in the communication. The distribution of answers is further illustrated in Figure 9. In addition, the suggestion for improving communication was to provide clear instructions for the waste collection points.



Figure 9. Communication regarding recycling by the commissioner

Communication concerning recycling to the staff got a mean value of 4.22. This suggests that the communication is at a good level, and there were no suggestions to improve internal communication of the tenants. The answers were distributed the following way: 3 answers for level 5, 5 answers for level 4, and 1 answer for level 3 (9 answers in total). The deviation was quite small, which suggests consistency. The distribution of answers is further illustrated in Figure 10.



Figure 10. Communication regarding recycling to the staff

Communication concerning recycling to the customers got a mean value of 3.50 from 1 to 5 (5 being the highest value). This suggests that the communication was at a good level, but improvements could be made. The answers were distributed the following way: 2 answers for level 5, 1 answer for level 4, 1 answer for level 3, and 2 answers for level 2 (6 answers in total). There was some deviation in the answers, which suggests that there was some variation in the level of communication depending on the tenant. The distribution of answers is further illustrated in Figure 11. In addition, the suggested improvements for customer communication were to bring out more clearly where food scraps can

be left, and the sorting instructions could be displayed better in the biowaste containers.



Figure 11. Communication regarding recycling to the customers

Waste reduction and monitoring

According to three of the respondents (33%) it was possible to reduce the amount of waste, and 6 respondents (67%) did not think that it was possible. The suggestion for reducing the amount of waste was that amount of biowaste could be reduced by paying more attention to the occurrence of food waste. In addition, two of the respondents (22%) did monitor the amount of waste and recycling rate, and 7 respondents (78%) did not. Furthermore, one respondent (11%) had set goals for reducing the amount of waste generated in operations and increasing their recycling rate, and 8 respondents (89%) had not.

4.3 Site visits and interviews

Site visits were conducted in Ruka and Pyhä Ski Resorts in December 2024. During the visit, waste collection points were inspected, and general observations made regarding waste management. The data was gathered and processed with Microsoft Excel software. In addition, three semi-structured interviews were conducted by phone in January 2025. Focus on the interviews was on waste management processes in general, and especially in the lift/slope operations, since this process was a bit unclear and more in-depth information was needed. Data was processed with Microsoft Word software.

The waste collection points and the types of waste that were collected in Ruka based on the site visit:

	Ruka Valley	Vuosselin portti	Maintenance hall	Piste	RukaVillage A	RukaVillage B	Kumpare
Packaging plastic	x		x		x	x	x
Cardboard	x		x	x	x	x	x
Biowaste	x	x		x	x	x	x
Glass	x	x		x	x	x	x
Small metal	x	x		x	x	x	x
Paper	x	x		x	x	x	x
Confidential paper							
Mixed waste	x	x	x	x	x	x	x
Electronic waste			x				x
Hazardous waste			x				
Construction waste			x				
Scrap metal			x				
Rubber			x				
Accumulators			x				
Batteries			x			x	
Cooking oil	x			x	x		

The different departments use different waste collection points the following way: RukaValley waste collection point was used by Ski-Inn RukaValley and Valley

Rental shop. Vuosselinportti waste collection point was used by Vuosselinportti rental shop. Maintenance hall waste collection point was used by lift and slope operations. In addition, rental shops take hazardous waste to the maintenance hall waste collection point. Piste waste collection point was used by Piste rental shop and ski school. RukaVillage A waste collection point was used by Ski-Inn RukaVillage. RukaVillage B waste collection point was used by RukaStore and Ruka Brand Village. Kumpare waste collection point was used by the office at Kumpare. Additionally, the same waste collection points were used by commercial tenants except for the maintenance hall, which was only used by the staff. Furthermore, RukaValley, RukaVillage A, RukaVillage B and Kumpare waste collection points were used by the customers as well. In addition, the Ski-Inn apartments and caravan area in Ruka have their own waste collection points in which the following can be sorted: mixed waste, plastics, small metal, paper, biowaste, cardboard and glass (Ruka Ski Resort 2025).

The waste collection points and the types of waste that were collected in Pyhä based on the site visit:

	Lower rental shop	Kultakero	Hotel Pyhätunturi	Maintenance hall
Packaging plastic				
Cardboard	x	x		x
Biowaste		x		
Glass	x	x		
Small metal	x	x		
Paper	x	x	x	
Confidential paper				
Mixed waste	x	x	x	x
Electronic waste				x
Hazardous waste				

Construction waste				
Scrap metal				x
Rubber				x
Accumulators				
Batteries				
Cooking oil			x	

The different departments use different waste collection points the following way: Lower rental shop waste collection point was used by lower rental shop and caravan area. Kultakero waste collection point was used by Kultakero rental shop, PyhäStore and conference center/office. Hotel Pyhätunturi waste collection point was used by Hotel Pyhätunturi. Maintenance hall waste collection point was used by lift/slope operations. Additionally, Kultakero and Hotel Pyhätunturi waste collection points were used by commercial tenants. Furthermore, Kultakero waste collection point was used by customers as well. In addition, the Ski-Inn apartments in Pyhä have their own waste collection points in which the following can be sorted: mixed waste, small metal, paper, biowaste, cardboard, and glass (Pyhä Ski Resort 2025).

The site visits supported the survey results that some of the waste collection points were lacking recycling instructions, they were somewhat disorganized and partly located far away. However, there were some inconsistencies when comparing the survey results and site visit regarding what can be recycled and what is recycled, for example, in one of the departments that is in Kumpare/office only mixed waste was collected even though mixed waste, plastics, cardboard, biowaste, glass, small metal, and paper are sorted at the Kumpare waste collection point. This was only one example and there were multiple other similar inconsistencies, which suggests that even though there is sufficient sorting at the waste collection points, there is not necessarily sufficient sorting at the different departments offices or job posts, and that it varies a lot depending on the location.

The interviews confirmed that waste disposal and treatment was purchased from a third party in both ski resorts (Kujala 2025). In addition, they confirmed that

there were waste containers at lift stations in both ski resorts but most of them only had mixed waste and bottles/cans. In Ruka ski resort, there were a few separate recycling points for customers in the ski area, but the challenge was emptying them, since waste trucks did not have access to them. Thus, they needed to be emptied by lift/slope operation staff, which brought the waste to maintenance hall waste collection point. This made sorting in the ski area impractical and therefore adding more recycling points challenging. (Heikkilä 2025; Rantanen 2025) In Pyhä ski resort, the lift/slope operations also brought waste to maintenance hall waste collection point. Even though there were containers only for mixed waste, cardboard, and a shared container for scrap metal, electronics, and rubber at the waste collection point, hazardous waste and wood was collected separately and collected by a third party when necessary. (Rantanen 2025)

5 DISCUSSION

5.1 Conclusions

CE principles can advance the transition towards carbon neutrality at ski resorts by using renewable energy, reducing waste generated in operations, and increasing recycling rate. Thus, reducing ski resorts GHG emissions generated in operations. In addition, ski resorts can obtain sustainable growth by using the CE business models including circular inputs, sharing platforms, product as a service, product life extension, and resource recovery.

Considering the commissioner, it is currently using the five CE business models in some way. Regarding circular inputs, the commissioner uses renewable energy in its operations and the slope machines use biodiesel as fuel. Concerning sharing platforms, the commissioner has online rental shops for ski equipment and bike equipment. In addition, the Ski-Inn accommodation ownership model is based on renting apartments owned by private persons throughout the year, which makes it a more ecologically viable option because there is no need for building additional holiday apartments for renting. Regarding product as a service, the main product of the commissioner is a lift ticket, which is essentially a service provided to the customers including, for example, running the ski lifts and maintaining the slopes. Additionally, other services are also offered to the customers including, for example, ski rentals, ski school, and accommodation. Overall, the commissioner is selling an experience instead of a physical product. Concerning product use extension, the commissioner offers ski/snowboard and bike service for the customers to keep their gear in shape and in use for a longer time. Regarding resource recovery, snow preservation is key for snow certainty in Ruka ski resort because the season is started with snow from last winter, which is preserved over summer under thick insulated tarps. Furthermore, as part of resource recovery, the commissioner wants to improve its waste management and recycling processes. (Ruka Ski Resort 2024a)

The commissioner's status of waste management is on a decent level, but several improvement areas are identified. There are differences in the level of recycling

between the departments, hence unification of processes is needed and making sure that waste management meets the requirements of the renewed Waste Act. The identified problem areas of waste management are lack of planning, lack of knowledge, lack of waste containers in the departments and Ski-Inn apartments, lack of instructions to and in the waste collection points, and lack of space in the waste collection points. To improve waste management, which includes means to reduce waste generated in operations and to increase recycling rate, five categories identified are planning, informing, sorting in locations, waste collection points and technological solutions.

5.2 Development and further research proposals

Planning

First and foremost, a proper waste management and recycling plan or programme, which includes monitoring the amount of waste generated, setting targets for reducing waste, and increasing recycling rate would be beneficial. This could be done with digital services offered by third parties, for example, one of the third parties, which handles waste disposal in both Ruka and Pyhä ski resorts offers this kind of data-based management tool that also helps with reporting (Lassila & Tikanoja 2025b). Additionally, waste management could be integrated into the commissioner's OKR framework. Thus, different departments could plan how to repurpose materials or possibly sell them at the material market instead of wasting them. The material market promotes the utilization of waste, side streams, and surplus materials as well as reusable parts by providing a meeting place where users and providers of materials can find each other (Materiaalitori 2025). In addition, the departments could plan, for example, how to minimize packaging waste and if eco-friendly suppliers could be used.

Commercial tenants use the same waste collection points, which makes it challenging to separate waste streams, hence it would be beneficial to engage with them as well regarding the waste monitoring and goal setting. Some of the tenants do this already, but only a few of them. Additionally, one challenge concerning the tenants was minimizing food waste at restaurants, perhaps

collaboration could be done considering this, for example, by selling discounted leftover food to the staff. If reducing the amount of food waste is not possible, a collaborative composting incentive could be a possible solution for minimizing emissions caused by food waste. Furthermore, it seems like the responsibility of waste management has been left to the departments rather than looking at the big picture, therefore as part of the plan could be naming people responsible for waste management, and since unification of processes along the different departments and locations is needed, it would be beneficial to name someone responsible for the whole organization of the commissioner.

Informing

Regarding informing, staff, tenants, and customers could be informed about the waste management processes itself, the importance of waste reduction and recycling. Staff could be informed through training, for example, in the orientation phase, Vuolearning (an online learning platform, which the commissioner uses) could be a great tool for this and not just about waste management, but as a wider aspect about sustainability as well. It could be a compulsory part of the orientation to go through the sustainability course, which covers waste management and recycling as well. In addition, in the staff info sessions that are held at the beginning of the seasons (in which all staff attend), sustainability could have its own section in which these issues could be brought to attention. Furthermore, staff could be reminded in the weekly and monthly meetings (in which all the departments attend) about these issues and perhaps here as well sustainability could have its own section. Commercial tenants could be informed when the contracts are made and in the newsletters that are sent to them via email. Customers could be informed about recycling on the website (now only recycling at the Ski-Inn apartments is mentioned), on the booking confirmations, and newsletters. Furthermore, staff, tenants, and customers could be informed through clear recycling instructions and signage in the departments such as rental shops.

Sorting in locations

Concerning sorting in locations, there could be added more waste or recycling containers in the departments, since many were missing these (only mixed waste was collected in some). In addition, waste containers could be added to the Ski-Inn apartments. Additionally, these containers would need clear sorting instructions and directions to the closest waste collection point. Furthermore, in locations such as Kumpare/office in which, for example, there was not much biowaste generated, there could be shared recycling containers for the whole office space. Also in the ski area, there could be more recycling points for the customers and the employees to use, and this could mean adding more sorting possibilities to all the lift stations.

Waste collection points

Regarding waste collection points, containers for all waste types needed could be added, such as packaging plastics to Piste, Vuosselinportti and all the waste collection points in Pyhä. Cardboard containers to Vuosselinportti and Hotel Pyhätunturi. Biowaste containers to maintenance halls, lower rental shop and Hotel Pyhätunturi. Glass containers to maintenance halls and Hotel Pyhätunturi. These need to align with the requirements of the renewed Waste Act in which packaging plastics, paper and cardboard, biowaste, glass, and metal should be recycled if it is generated a certain amount. These amounts are quite small as shown in the literature review and thus they affect also smaller companies. Therefore, it could be necessary to monitor and maybe in some cases calculate the amounts generated. This is especially a challenge in Pyhä ski resort, where collection of plastics is not done at all now since the third party, which handles waste disposal does not collect plastics in that area (Lassila ja Tikanoja 2025a). However, the municipality collects plastics in Pyhä, which is organized by Lapeco (Pelkosenniemi 2025). Therefore, there are other service providers, which could be used instead, perhaps Lapeco could also collect from the Pyhä ski resort or maybe some collaboration could be done with the municipality concerning the collection of packaging plastics. In addition, the waste collection points could use some maintenance more often, since they were disorganized, and the containers

were full during the peak season, which means that they need to be emptied more often (here some kind of monitoring system could be of help). Furthermore, clear instructions in the waste collection points would be beneficial.

Technological solutions

Considering technological solutions, there are smart waste sensors, which enable to measure, analyse, and manage waste. These are often quite expensive and implementing them requires stakeholder engagement. However, an interesting study was found and presented in the literature review in which these kinds of sensors were done by do-it-yourself manner and successfully tested. Essentially, only these inexpensive microcontrollers and a tech-savvy person is needed since all the instructions and software are found online and everything is an open source. In addition, other digital services could be implemented, such as the data-based management system mentioned before, Ruka and Pyhä applications, which could have, for example, digital ski passes, maps, and receipts, this could also replace all the printed brochures and flyers. Furthermore, paperless office policy could be implemented due to all the digital services already implemented, and printing is mostly unnecessary. Additionally, since a lot of receipts go into the mixed waste containers, especially at the ticket sales counters, the system could ask if the customer wants the receipt or not.

Further research proposals

Waste generated in operations is only one category of the 15 scope 3 value chain categories. Therefore, it would be beneficial to investigate reducing the other emission sources as well. In addition, the scope of this thesis excluded the calculation of scope 3 emissions, which would also be beneficial, since it is impossible to reduce the emissions completely. Thus, to reach carbon neutrality, the emissions that cannot be reduced must be compensated in some way. Furthermore, CE has gotten some criticism regarding its lack of clear implementation. Therefore, it would be beneficial to further inspect concrete ways to implement CE principles to achieve carbon neutrality on organizational level. Additionally, it would be interesting to replicate the study later after the

development proposals have been implemented to see how it would affect the results.

5.3 Validity and reliability

Validity is dependent on how well the research measures the concept it is meant to measure (Barribeau et al. 2005). Reliability is related to the possibility of replication of the study (Quintão, Andrade & Almeida 2020, 270). In the conventional positivist research paradigm, both criteria are used to evaluate the quality of research (Zhang & Wildemuth 2009, 6). In addition, the validity and reliability of the process and the results achieved must also be analysed in case studies (Quintão, Andrade & Almeida 2020, 272).

Case studies are often criticized by their validity and reliability (Quintão, Andrade & Almeida 2020, 264). Therefore, triangulation as in using multiple sources of data was used, which increases the validity and reliability of the data and results (Fusch, Fusch & Ness 2018, 21). In addition, data gathering and analysis processes are clearly documented to improve reliability of the research. Furthermore, the low response rate of the surveys may create bias because the results can reflect an excessive amount of a specific group. However, nonresponse bias cannot generally be avoided, hence it affects majority of surveys through creating errors in statistics. (Barribeau et al. 2005)

5.4 Ethical considerations

The first thing to consider in research ethics is to 'do no harm'. It is crucial to identify any negative effects the research could possibly have on any of the respondents. Related to this comes privacy & confidentiality. (Dooly, Moore & Vallejo 2017, 351) Therefore, the staff survey was conducted completely anonymously and concerning the tenant's survey, the results are presented anonymously.

In addition, respondents in the research have the right to know enough about the research to decide if they want to participate in the research or not. (Dooly, Moore

& Vallejo 2017, 352) Thus, it was clearly stated who did the study and for what intentions. It was completely voluntary to take part in the research, and considering the interviews, informed consent was obtained to use the information gained with name and title. Furthermore, when interpreting the research results, it was done as ethically as possible in order not to over-interpret or misinterpret the data.

5.5 Reflection of the thesis process

This thesis was a lengthy process since the planning started already at the first week of the studies in September 2023. The selected commissioner was an obvious choice since it was the employer of the author at the time, and the thesis agreement was signed in March 2024. The initial topic changed quite swiftly, and the final topic was chosen due to the author's interest in carbon neutrality, CE and the commissioner's interest and need for improving their waste management processes. Building the theoretical background was laborious and finding reliable sources was time consuming, but it developed the author's information retrieval skills. In addition, choosing the appropriate research methods was time consuming, but it was interesting to learn about different research and development methods. Although, the first survey was managed to be conducted in April 2024, the second survey was not finished until December 2024. This was delayed due to the seasonality of the industry. In addition, the site visits were conducted in December 2024 and the interviews in January 2025. The greatest challenges of the process were managing time and other resources considering balancing studies, work, and family life. During the process it was noticed how important scheduling and setting deadlines was for the progress of the thesis. Therefore, project management and time management skills of the author developed during the process. Overall, the thesis process included a lot of ups and downs, but in the end, it was a rewarding learning experience.

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APPENDICES

- Appendix 1. Employee questionnaire (in Finnish)
- Appendix 2. Commercial tenant's questionnaire (in Finnish)

Appendix 1 1(4);

Jätehuolto ja kierrätys Rukalla sekä Pyhällä

Kyselyn tarkoituksena on selvittää, miten jätehuolto ja kierrätys toteutuu tuntuureissa toimipisteittäin. Kysely toteutetaan osana Lapin ammattikorkeakoulun ylemmän ammattikorkeakoulututkinnon opinnäytetyötä ja vastaukset käsitellään anonyymisti. Kyselyn tuloksia tullaan hyödyntämään Rukan, Pyhän ja Ski-Innin jätehuollon sekä kierrätyksen kehittämisessä.

* Pakollinen

1. Työnantaja *

Mikäli työskentelet vuokrayrityksen kautta, valitse yritys, jonka toimipisteessä työskentelet.

- Rukakeskus Oy
- Pyhätunturi Oy
- Ski-Inn Hotels & Apartments Oy

2. Toimipiste *

Valitse toimipiste, jossa työskentelet pääsääntöisesti.

- Piste vuokraamo/Hiihtokoulu
- Valleyn vuokraamo
- Vuosselinportin vuokraamo
- Kumpare/Toimisto
- Huoltohalli
- Hissit/Rinteet
- RukaStore
- Ruka Brand Village
- Muu

3. Toimipiste *

Valitse toimipiste, jossa työskentelet pääsääntöisesti.

Appendix 1 2(4);

- Alavuokraamo
- Kultakero vuokraamo
- PyhäStore
- Hotelli Pyhätunturi
- Kokouskeskus/Toimisto
- Huoltohalli
- Hissit/Rinteet
- Muu

4. Toimipiste *

Valitse toimipiste, jossa työskentelet pääsääntöisesti. Mikäli työskentelet Hotelli Pyhätunturissa, valitse työnantajaksi "Pyhätunturi Oy".

- RukaVillage
- RukaValley
- Muu

5. Miten koet, että kierrätys toteutuu Ski-Inn huoneistoissa? (1=ei lainkaan, 5=erinomaisesti)

1	2	3	4	5
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6. Mitkä ovat ongelmakohdat ja miten parantaisit kierrätystä Ski-Inn huoneistoissa, esim. puuttuuko jonkin jätelajikkeen lajittelu tai onko muita ongelmakohtia?

7. Mitä on mahdollista kierrättää toimipisteessä, jossa työskentelet pääsääntöisesti? * Valitse vaihtoehdoista ne, joiden tiedät toimipisteessä varmasti kierrätettävän.

Appendix 1 3(4);

- Pakkausmuovi
- Pahvi
- Biojäte
- Lasi
- Pienmetalli
- Paperi
- Tietosuojapaperi
- Sekajäte
- Sähkö- ja elektroniikkalaiteromu
- Vaarallinen jäte (ongelmajätteet esim. maalit, liimat, öljyt, öljysuodattimet, liuottimet, loisteputket ja ledit)
- Rakennusjäte
- Rauta/metalli
- Kumi
- Akut
- Paristot
- En osaa sanoa
- Muu

8. Miten kierrätys toteutuu toimipisteessä, jossa työskentelet pääsääntöisesti? (1=ei lainkaan, 5=erinomaisesti)

1	2	3	4	5
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9. Mitkä ovat ongelmakohdat ja kuinka kierrätystä voisi parantaa toimipisteessä, esim. puuttuuko jonkin jätelajikkeen lajittelu tai onko muita ongelmakohtia?

10. Kuinka hyvin kierrätyksestä on viestitty henkilökunnalle? (1=ei lainkaan, 5=erinomaisesti)

1	2	3	4	5
---	---	---	---	---

Appendix 1 4(4);

11. Kuinka sisäistä viestintää voisi parantaa?

12. Kuinka hyvin kierrätyksestä on viestitty asiakkaille? (1=ei lainkaan, 5=erinomaisesti) Mikäli toimipisteessä ei käy asiakkaita, tämän kysymyksen voi jättää välistä.

1	2	3	4	5
---	---	---	---	---

13. Kuinka asiakasviestintää voisi parantaa?

14. Onko mielestäsi mahdollista vähentää jätemäärää toimipisteessä?

- Kyllä
- Ei
- En osaa sanoa

15. Miten jätemäärää voisi vähentää toimipisteessä?

Appendix 2 1(4);

Jätehuolto ja kierrätys Rukalla sekä Pyhällä (vuokralaiset)

Kyselyn tarkoituksena on selvittää, miten jätehuolto ja kierrätys toteutuvat tunturessa toimipaikkakohtaisesti. Kyselyn toteuttaa Ski-Inn Hotels & Apartments Oy:n työntekijä Tuomas Lipasti osana Lapin ammattikorkeakoulun ylemmän ammattikorkeakoulututkinnon opinnäytetyötä. Vastaukset käsitellään anonyymisti, eikä yrityksen nimeä tuoda ilmi tuloksia raportoidessa. Kyselyn tuloksia tullaan hyödyntämään Rukan, Pyhän ja Ski-Innin jätehuollon sekä kierrätyksen kehittämisessä. Tavoite on, että Rukakeskus ja Pyhätunturi Oy:n vuokralaisista jokaisesta toimipaikasta yksi henkilö vastaisi kyselyyn, joten välittäthän tarvittaessa kyselyn oikealle henkilölle.

* Pakollinen

1. Yritys *

2. Toimipaikka *

Jos yrityksellä on useampia toimipaikkoja, vastaattehan jokaisen toimipaikan osalta erikseen.

Appendix 2 2(4);

3. Mitä seuraavista lajitellaan toimipaikassa? *

- Pakkausmuovi
- Pahvi
- Biojäte
- Lasi
- Pienmetalli
- Paperi
- Tietosuojapaperi
- Sähkö- ja elektroniikkalaiteromu
- Vaarallinen jäte (ongelmajätteet esim. maalit, liimat, öljyt, öljysuodattimet, liuottimet, loisteputket ja ledit)
- Rakennusjäte
- Rauta/metalli
- Kumi
- Akut
- Paristot
- Rasvanerotuskaivoliete
- En osaa sanoa
- Muu

4. Miten kierrätys toteutuu toimipaikassa? (1=ei lainkaan, 5=erinomaisesti)

1	2	3	4	5
---	---	---	---	---

5. Mitkä ovat ongelmakohtat ja kuinka kierrätystä voisi parantaa toimipaikassa, esim. puuttuuko jonkin jätelajikkeen lajittelu tai onko muita ongelmakohtia?

6. Kuinka hyvin kierrätyksestä on viestitty yritykselle vuokranantajan toimesta? (1=ei lainkaan, 5=erinomaisesti)

1	2	3	4	5
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Appendix 2 3(4);

7. Miten viestintää voisi kehittää?

8. Kuinka hyvin kierrätyksestä on viestitty henkilökunnalle? (1=ei lainkaan, 5=erinomaisesti)

1	2	3	4	5
---	---	---	---	---

9. Kuinka sisäistä viestintää voisi kehittää?

10. Kuinka hyvin kierrätyksestä on viestitty asiakkaille? (1=ei lainkaan, 5=erinomaisesti)

Mikäli toimipaikassa ei käy asiakkaita, tämän ja seuraavan kysymyksen voi jättää välistä.

1	2	3	4	5
---	---	---	---	---

11. Kuinka asiakasviestintää voisi kehittää?

12. Onko mielestäsi mahdollista vähentää jätemäärää toimipaikassa? *

- Kyllä
- Ei
- En osaa sanoa

13. Miten jätemäärää voisi vähentää toimipaikassa?

14. Tehdäänkö toimipaikassa jätemäärän ja kierrätysasteen seuranta? *

- Kyllä
- Ei
- En osaa sanoa

Appendix 2 4(4);

15. Onko jätemäärän vähentämiseen ja kierrätysasteen nostamiseen asetettu tavoitteita? *

- Kyllä
- Ei
- En osaa sanoa

16. Onko yrityksellä vastuullisuusohjelmaa tai -sertifikaattia? *

- Kyllä
- Ei
- En osaa sanoa

17. Mikäli yrityksellä on vastuullisuussertifikaatti, niin mikä sertifikaatti on kyseessä?