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**Initiating transitions towards
1.5-degree lifestyles:
*An action research study
on a design game***

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Abstract

Ilmastonmuutoksen ja siihen liittyvien ympäristökriisien hillitseminen vaatii kokonaisvaltaisia muutoksia nykyisissä elämäntavoissa sekä yhteiskuntajärjestelmissä. Tämän opinnäytetyön perustana on tarve edistää kestävyys siirtymiä (engl. *sustainability transition*) kohti kestävämpiä elämäntapoja.

Tutkielman tavoitteena oli kehittää, testata ja arvioida 1,5 asteen elämäntapoja koskevan tutkimuksen pohjalta käytännön sovellusmuoto kotitalouksien ja muiden sidosryhmien kannustamiseksi kohti vähähiilisempiä elämäntapoja. Tutkimus jaettiin kahteen peräkkäiseen vaiheeseen: suunnitteluvaiheeseen ja kenttätutkimukseen. Suunnitteluvaiheessa kehitettiin yhteiskehittämisen menetelmällä muotoilupeli, ja kenttätutkimuksen aikana muotoilupeliä testattiin, parannettiin ja arvioitiin toimintatutkimusmenetelmän avulla Suomessa ja Japanissa. Tulosten vahvistamiseksi ja täydentämiseksi järjestettiin lisäksi seitsemän puolistrukturoitua haastattelua.

Kehittämistyön tuloksena syntyi työpajamuotoinen muotoilupeli, *1,5°C asteen palapeli*, jonka avulla kotitalouksia ja sidosryhmiä voidaan ohjata siirtymään kohti 1,5 asteen mahdollistavia elämäntapoja. Kenttätutkimuksen tulokset osoittivat, että muotoilupeli auttoi osallistujia (a) muuttamaan elämäntapoja ilmastotavoitteiden mukaisiksi, (b) tunnistamaan ilmastotekojen vaikutus oman hiilijalanjalan pienentämisessä (c) kehittämään suunnitelmia kohti vähähiilisempää elämäntapaa, ja (d) tunnistamaan sellaisia käytännöllisiä toimia, joita he voivat hyödyntää omassa elämässään. Lisäksi muotoilupeli loi vuorovaikutteisen oppimisympäristön sidosryhmien yhteistyön ja vuoropuhelun tehostamiseksi. Muotoilupeli tuki vähähiilisiä elämäntapoja edistämällä osallistujien oppimista, tiedon jakamista ja oman toiminnan merkityksellisyys ymmärtämistä. Muotoilupeliä voidaan todennetusti käyttää kunta- ja kaupunkiorganisaatioissa osallistavan päätöksenteon edistäjänä ja koululaitoksessa tietouden lisääjänä.

Tutkielma yhdistää kolme tutkimusaluetta: siirtymien hallinnan tutkimuksen (engl. *transition management*), käytänteorian ja muotoilun tutkimuksen. Tutkielma osoittaa, että muotoilun menetelmät – ja erityisesti muotoilupelit – voivat tukea siirtymien hallinnan menetelmää luomalla innostavan oppimisympäristön, joka mahdollistaa keskustelun ja vertaisoppimisen. Muotoilupeli on herättänyt laajaa kiinnostusta ja toiminut useamman sovellusmuodon pohjana. Koska työpajamuotoisen muotoilupelin järjestäminen vaatii aikaa ja resursseja, peliä jatkokehitetään saavutettavuuden parantamiseksi.

Keywords kestävyys siirtymä, muotoilupelit, toimintatutkimus, ilmastonmuutos, 1,5 asteen elämäntavat

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Abstract

The current climate crisis and the interrelated socio-ecological problems underscore the need for systems transitions towards low-carbon societies. These transitions require exhaustive changes in contemporary lifestyles and the system that shapes these lifestyles. Hence, this study emerges from the urgent need for developing systemic tools to initiate transitions towards lifestyles within the confines of the 1.5-degree aspiratory target.

The overall objective of this research is to develop, test, and evaluate a practical application of the emerging 1.5-degree lifestyle research to encourage households and other stakeholders to transition towards low-carbon lifestyles. To achieve this objective, a design game was developed, and its impact and characteristics were evaluated following an action research methodology.

The research design was divided into two consecutive phases: design inquiry and fieldwork. In the design inquiry phase, a design game was developed through a co-design process. In the field study phase, the game was tested, improved and evaluated in a real-life context following an action research methodology. Furthermore, seven semi-structured interviews were conducted to validate and complement the findings. The cultural context of this study was Finland and Japan.

The study resulted in developing a design game, *the 1.5 °C Puzzle*, which can support households and stakeholders to move towards 1.5-degree lifestyles. Furthermore, the results imply that the design game was successful in enabling the participants to (a) understand the societal sustainability target in relation to their own lives, (b) perceive the content and scale of multiple actions for reducing their carbon footprint, (c) develop pathways towards low-carbon lifestyles, as well as to (d) identify actions that they can implement directly. Moreover, the design game was partially successful in creating a learning space for enhancing stakeholder collaboration and dialogue. The evaluation of the design game revealed its potential to contribute to low-carbon lifestyles through learning, knowledge sharing, and empowerment.

This study combines design games with transitions management approach and practice theory to initiate low-carbon transitions. The development process and results indicate that design methods – and in particular design games – can enhance transition management processes by creating engaging experiences that allow participation and creativity. The design game has evoked wide interest and inspired numerous applications, indicating its distinctive advantages in facilitating discussion and engaging in action. However, running the workshop requires a considerable amount of time and resources. Consequently, the next steps for developing the design game include scaling up the process to increase its accessibility.

Keywords sustainability transitions, design games, action research, climate change, design for sustainability

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Abbreviations

ARC: Action Research Cycle

DfS: Design for Sustainability

DfST: Design for Sustainability Transitions

IGES: Institute for Global Environmental Strategies

IPCC: Intergovernmental Panel on Climate Change

LCF: Lifestyle Carbon Footprint

MLP: Multi-level Perspective of System Innovation

PT: Practice Theory

SLA: Sustainable Lifestyles Accelerator

TM: Transition Management

Definitions of key terms

Action research – a practical research methodology that arises from a problem and should lead to an improvement in a real-world situation through an iterative process of reflection and action (adapted from Muratovski, 2016).

Co-design – the creative collaboration of multiple participants in contributing to a design process (adapted from Sanders & Stappers, 2008).

Co-creation workshops – a term used in this thesis for describing the co-design gatherings for developing and improving the design game with the core team.

Core team – the research team for developing the product of this study, including Sonja Nielsen, Michael Lettenmeier, and Viivi Toivio.

Criteria 1, 2, 3 – criteria sets for evaluating different aspects of the design game (characteristics, performance, impacts, and outputs).

Design games – design activities with gamified elements, as delineated by Vaajakallio (2012).

Design tool – a term used in this thesis for describing the design game before it was identified as such. This term is used in the research questions and when explaining the design process in Chapter 3.

Sustainable lifestyles – decisions and actions of purchasing including the use and disposal of products, as well as other activities, such as values, knowledge, and relationships (Akenji, 2019).

Sustainable living – a definition incorporating both sustainable lifestyles and consumption, aiming to contribute to wellbeing within the ecological limits (adapted from Akenji, 2019).

1.5-degree lifestyles – lifestyles within the sustainable level of the carbon footprint of average households in relation to the 1.5-degree aspiratory target set by the Paris Agreement (IGES et al., 2019).

1o5 study – an abbreviated name of the technical report *1.5-Degree Lifestyles: Targets and Options for Reducing Lifestyle Carbon Footprints* (IGES et al., 2019).

1o5 team – the research team for conducting the 1.5-degree lifestyles report (IGES et al., 2019).

1. Introduction

1. Introduction

1.2. Background

Humanity is facing tremendous challenges to tackle the complex and intertwined socio-ecological problems, such as climate change (Rockström et al., 2009). The Intergovernmental Panel on Climate Change (IPCC) *Special Report on Global Warming of 1.5°C* has stressed the necessity to reduce global greenhouse-gas emissions drastically to reach the ambitious but indispensable 1.5°C target (IPCC, 2018). The purpose of this objective is to protect societies from unforeseen political and ecological consequences, such as desertification, sea-level rise, and political conflicts caused by extreme weather conditions (IPCC, 2018).

Despite awareness, actions to mitigate climate change have been marginal, and greenhouse gas emissions contributing to climate change have steadily increased over the past decades (e.g., Figueres et al., 2018). The public discussion around plausible solutions has long focused on advancing technological solutions, while ignoring the importance of behavioral and systemic changes for steering transitions (Akenji & Chen, 2016). According to the 1.5-degree lifestyles report (IGES et al., 2019), changes in dominant lifestyles can contribute to the package of solutions for addressing climate change, because lifestyles can change relatively quickly compared to infrastructure. However, to release the potential contribution of household consumption in mitigating climate change, not only action by private households is required but governments and companies have to enable households to develop towards 1.5-degree lifestyles (IGES et al., 2019). The transition towards a low-carbon and just society requires exhaustive changes in our lifestyles, economic-political system, and value systems.

1.3. Research scope

Several multidisciplinary strands of research have engaged in analyzing and steering societal sustainability transitions since the late 1990s (Markard, Raven, & Truffer, 2012). Out of these approaches, transition studies and practice theory provide partly complementary approaches to conceptualize the dynamics of low-carbon transitions (Röpke, 2015). Transition theories aim to explain the dynamics of socio-technical system transitions over time, through exploring the role of niche innovations in initiating societal change (Geels, 2002). However, as the focus of the TM approach is primarily on technological and policy tools, it scarcely conceptualizes the agency of individuals in transitions (Rauschmayer, Bauler, & Schöpke, 2013). Practice theories aim to extend the debate on transitions by providing a way of conceptualizing the dynamics of demand (Shove & Walker, 2010). It takes social practices and the everyday as the focus of attention and aims to promote a more systemic approach to steering transitions through intervening the elements that reconfigure practices (Röpke, 2015). Consequently, practice theory and transitions theory can partly complement each other for conceptualizing the dynamics of lifestyles transitions (Rauschmayer et al., 2013).

Transitions theory has been the starting point for several governance approaches, such as transitions management (Wittmayer & Roorda, 2014; Loorbach, 2007). TM strives for interactive and participatory processes striving to enhance learning and experimenting for steering transitions

(Grin, Rotmans, & Schot, 2010). The approaches are widely applied on a policy level (transitions arenas) and community level (community arenas) (Wittmayer & Roorda, 2014). However, as the focus of the TM approach is primarily on policy making, it scarcely conceptualizes the agency of individuals in transitions (Rauschmayer et al., 2013). Thus, there is a need for developing novel approaches, which consider the dynamics of transitions, recognize the systemic nature of lifestyles and agency of individuals, and aim at encouraging lifestyle changes through participatory engagement (Rauschmayer et al., 2013).

The design discipline can provide a useful framework for developing such approaches for enhancing learning and empowerment for steering transitions. According to Erdoğan Öztekin and Gaziulusoy (2019), design can have a crucial role to play in contributing to “transitions for the alternative experiences, practices, and configurations it delivers, and the learning processes it triggers” (p. 149). Furthermore, Swann (2002) argues that design is a solutions-oriented discipline capable of addressing real-life challenges through a collaborative process. According to Buchanan (1998), design operates in a learning phase combining problems and solutions, where knowledge is created through experiments and creativity. Hence, design approach contributes to transitions projects through integrative, explorative, and collaborative approaches that can tackle real-life challenges (Erdoğan Öztekin & Gaziulusoy, 2019).

Particularly the recent developments in design research towards system-level innovation (design for sustainability transitions) and towards more collaborative work practices (co-design) would make the design approach especially suitable in the context of this study. The emerging field of design for sustainability transitions (DfST) diverges from the necessity for societal transformations towards sustainability and states that design could have an important role to play in facilitating these transitions (Irwin, 2015). The approach integrates the theories of sustainability science, design research, and transitions management (Gaziulusoy, 2018). Likewise transitions research, DfST examines social practices and innovations in niches for developing participatory visions of alternative futures for catalyzing transitions (Gaziulusoy, 2018). Furthermore, design research has recently engaged in more collaborative practices, where various stakeholders are invited to take part in and contribute to the design process (Sanders & Stappers, 2008). These co-design processes emphasize the importance of co-constructing and exploring ideas in dialogue to address the imminent design task (Vaajakallio, 2012). Design games is one method for engaging participants in co-creation processes, as they can work as tangible tools for enabling creative collaboration. Consequently, DfST gives a direction and scope for practical design projects to contribute to collaborative sustainability transitions projects and co-design provides methods for exploring and enhancing such collaboration.

To conclude, this research emerges from the urgent need for developing systemic tools to enhance transitions towards sustainable lifestyles. The study departs from the notion that design research and practice can contribute to creating engaging and collaborative learning environments for steering sustainable lifestyle transitions. In the course of this study, an empirical case study is developed and evaluated by applying design games as a tool for engaging collaboration in transitions projects.

1.3. Context

This thesis relates to the research project *1.5-Degree lifestyles: Targets and options for reducing lifestyle carbon footprints* (IGES et al., 2019), which explores the sustainable level of lifestyle carbon footprint in Finland and Japan. This thesis sought to apply the research results in practice. Hence, the thesis aims to make the implications of the project more understandable and approachable to households and other stakeholders to, ultimately, initiating low-carbon lifestyle transitions.

1.4. Research objective and questions

The overall aim of the thesis is to develop, test, and evaluate a practical application the 1.5-degree lifestyle research (IGES et al., 2019) through action research methodology to encourage households and other stakeholders to transition towards low-carbon lifestyles.

To achieve this objective, this research is divided into complementary research questions. These research questions support achieving the primary objective:

1. What kind of a design tool could encourage households to transition towards 1.5-degree lifestyles? What are the characteristics of it?
2. What indicates that the developed tool is a valuable method for promoting 1.5-degree lifestyles? What possible effects can it have?

*At the beginning of the study, the form of the end result was not clear. Thus, I use the term *design tool* to describe the design intervention before its form was identified.

1.5. Research structure

This thesis study followed an action research methodology. This implies that the research process was iterative, cyclical, collaborative, and real-life oriented (see Chapter 4). To make this iterative process more comprehensible in a written form, I have divided it into two consecutive phases, developing the design game and evaluating the design game. However, it is important to note that the design process and the action research process were not separate from each other but intertwined; The design process continued throughout the action research cycles when new prototypes were prepared and released. The following paragraphs and Figure 1 summarise the research process to achieve the research objective. Figure 2 illustrates the research timeline to help the reader understand the time used for each phase.

Developing the design game

Aim. In this phase, a design game was developed through a co-design process to address the research objective. This phase included iterative rounds of problem analysis, synthesis, ideation, and prototyping, and was conducted in close collaboration with the 1o5 team. The form of the design tool was not clear from the beginning and, thus, the final outcome was strongly influenced by the expertise and objectives of the team and the researcher. The outcome of the process was a workshop process with playful elements, which could be identified as a design game. This first prototype is called P1 in Figure 1. At this point, three sets of criteria were prepared for analyzing different aspects of the game. The first criteria set was designed to specify the characteristics of the

game in line with the first research questions (Criteria 1). The latter two were intended to guide the evaluation of the game in terms of what it can achieve (Criteria 2) and what kind of impacts and outputs it might create (Criteria 2), in line with the second research question. The color codes in Figure 1 (light orange and purple) indicate which research question each criteria relates to.

Methods. Data for developing the design game was collected through gathering field notes in reflection meetings, and generated through co-creation and prototyping.

Output. The first version of the design game, and three criteria sets for evaluating different aspects of it (characteristics, performance, impact and output).

Evaluating the design game

Aim. In the field study phase, the developed design game was improved and evaluated in a real-life context through an action research methodology. This phase included five action research cycles (ARC) of testing, evaluating, and improving the developed design game. These cycles included five workshops, nine reflection meetings, and four co-creation workshops. For validating and complementing the findings, seven semi-structured interviews were conducted. As Figure 1 shows, four prototypes were tested and iterated during the field study (P2, P3 and P4), and the fifth one was the final revised version of the design game. The collected data was analyzed through thematic analysis using the developed criteria as a basis for answering the research questions. In order to answer the first research question, the collected data was reflected against the characteristics of design games (Criteria 1). In order to answer the second question, the performance of the design game was evaluated (Criteria 2) and its potential outputs and impacts analyzed (Criteria 3).

Methods. Data for improving and evaluating the results were collected through participant observation in five workshops, field notes in nine reflection meetings, as well as through seven semi-structured interviews. Furthermore, data was generated through prototyping in order to improve the design game.

Output. The revised version of the design game and findings to answer the research questions.

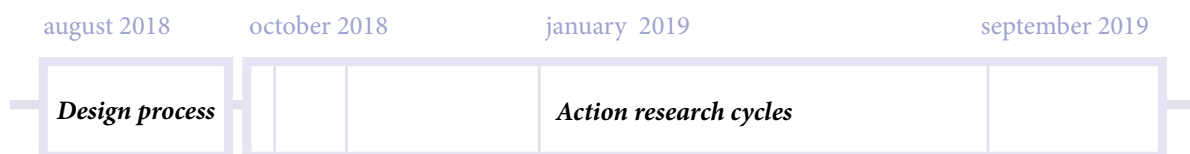
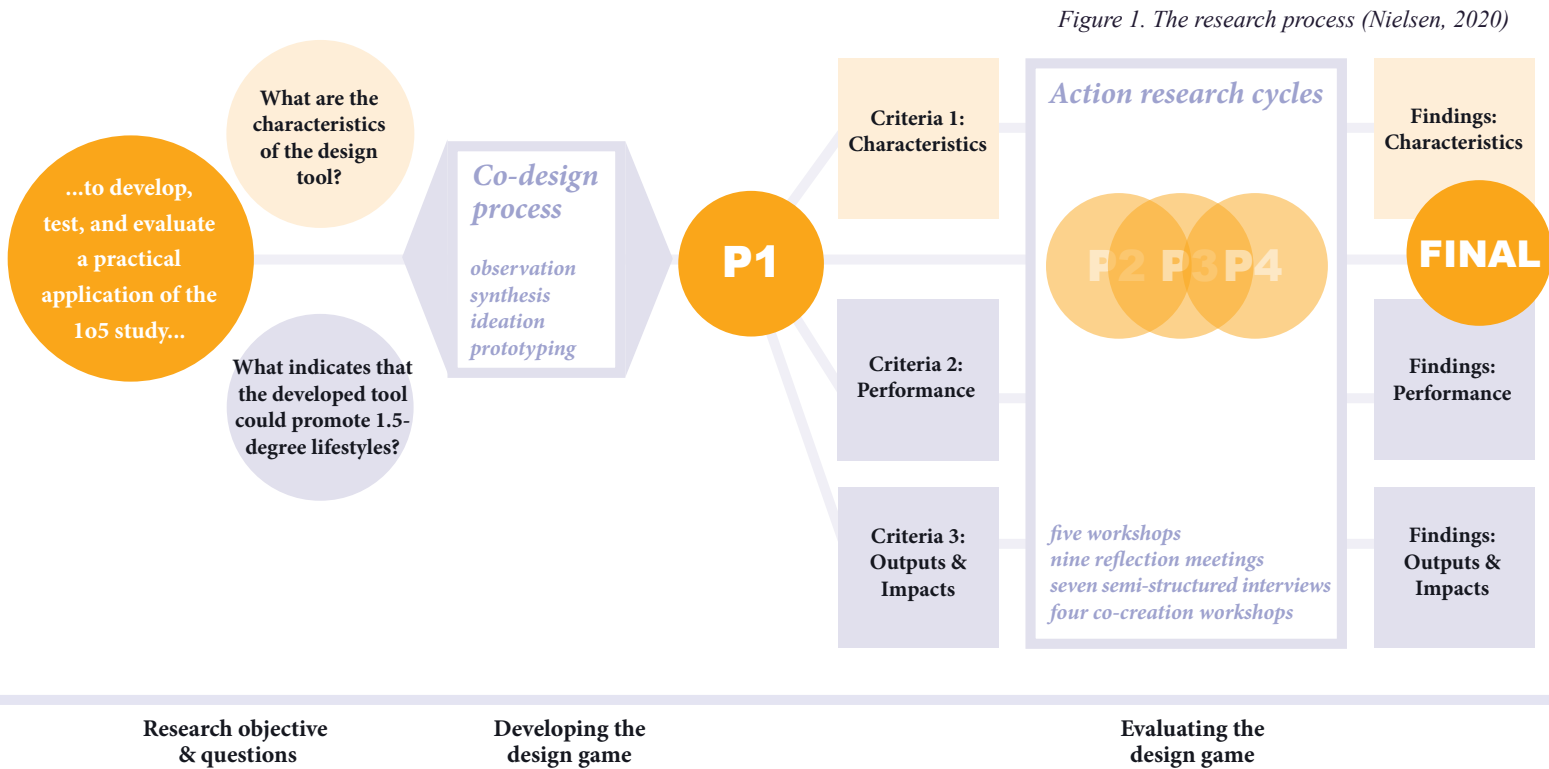


Figure 2. The research timeline (Nielsen, 2020)

1.6. Structure of the thesis

Chapter 2 provides an overview of the theoretical background on the topic and delimits the theoretical framework within which this study is situated. The purpose of this chapter is to summarize relevant academic discussions and key assumptions in relation to the research questions.

Chapter 3 provides an overview of the first phase of the empirical research, the design phase. Firstly, I introduce the socio-cultural context and background for the study. Secondly, I describe the four-stage design process for developing the design game with the core team. Thirdly, I introduce the result of the design process, namely a design game that combines the long-term global emission targets with the daily lifestyles of households to enhance low-carbon transitions. Furthermore, I present three criteria sets that were developed for evaluating different aspects of the game to answer the research questions.

Chapter 4 presents the field study phase, where the developed design game was tested, improved, and evaluated in a real-life context in Finland and in Japan. This chapter introduces the general research approach, methodology, and methods for conducting the field study, and how these methods were used in practice. Furthermore, it discusses the ethical considerations related to the study.

Chapter 5 introduces the findings from the fieldwork. The first section of this chapter provides an overview of the improvements made during each action research cycle, and describes the final refined version of the game. Thereafter it presents findings related to each of the developed criteria.

Chapter 6 discusses the findings in relation to the research objective and the subsequent research questions. The aim of this chapter is to evaluate the extent to which the research objectives were answered. Furthermore, practical and theoretical contributions, applications, and limitations of this study are discussed.

2. Literature review

2. Literature review

This chapter summarizes relevant academic discussions and critical assumptions concerning the research questions. The purpose of this chapter is to articulate the theoretical framework within which this research is situated. The chapter begins by introducing the problem area and the need for sustainability transitions (Section 2.1). After that, it discusses the role of lifestyle change in societal sustainability transitions (Section 2.2) and outlines different theories for analyzing the dynamics of transitions, especially regarding sustainable lifestyles (Section 2.3). Furthermore, it introduces the emerging field of design for sustainability transitions (DfST) and delineates current attempts to integrate this theory with practice theory and transitions studies (2.4). The last section (2.5) introduces contemporary directions within design research and practice towards collaborative design processes and presents design games as a method within co-design. Finally, it summarizes the key insights derived from this literature review.

2.1. The urge to act

Humanity is facing tremendous challenges to tackle the complex and intertwined socio-ecological problems that we have created during the last few centuries (Rockström et al., 2009). According to Steffen and colleagues (2015), four out of nine planetary boundaries, which define the precautionary limits for pivotal processes of environmental change, have already been severely or partly been breached. One of these interlinked boundaries refers to human-caused climate change, which has already been overstepped, and approaches several thresholds causing high risk for unpredictable and irreversible changes in Earth systems (Steffen et al., 2015). The Intergovernmental Panel on Climate Change (IPCC) *Special Report on Global Warming of 1.5 °C* has stressed the necessity to drastically reduce global greenhouse gas emissions to reach the ambitious but indispensable 1.5 °C target (IPCC 2018). The purpose of this objective is to protect societies from unforeseen political and ecological consequences, such as desertification, sea-level rise, and political conflicts (IPCC, 2018). Despite awareness, actions to mitigate climate change have been insufficient: According to researchers, greenhouse gas emissions that contribute to warming have been steadily rising over the past decades (Figueres et al., 2018).

The technical causes of human-caused climate change have been clear to the scientific community for decades (White, Rudy, & Gareau, 2015): The greenhouse effect of burning fossil fuels. However, it has become clear that the root cause of the sustainability problem lies in the preconditions of our modern life. In their book *Energy and Experience* (2015), Salminen and Vadén describe how the use of seemingly endless and cheap fossil fuels have enabled humans to disconnect from the energy sources that construct our everyday lives. According to the authors (Salminen & Vadén, 2015), the easy availability and low cost of oil, natural gas, and coal enabled rapid energy production for industrial needs and, thus, the construction of modern welfare states and the economic system for the past 150 years. Furthermore, the development of unsustainable lifestyles has also been influenced by the availability of cheap labor and low resource prices (Röpke, 2015). These factors have played a key role in the formation of the contemporary provision systems and are not prepared to operate with low environmental impact (Röpke, 2015). However, volatile resource prices and severe socio-environmental consequences indicate that large systemic

transitions are soon becoming a necessity (Røpke, 2015). As a result, it has become clear that the economic system and the associated lifestyles based on invisible energy, undervalued labor, and resource extraction must change.

In the light of the reasoning above, it is fair to say that every person and actor within the financial system recreates the economic system through their daily activities: The Western family's breakfast table items, lamps, radios, and magazines and other objects are all primarily related to the economic system and thus to fossil fuels. Hence, unsustainability is deeply embedded in our culture and daily chores (Salminen & Vadén, 2015). Therefore, the need for profound socio-ecological transitions becomes evident: The current way of living needs to be restructured, and the challenges needs to be addressed at the level of socio-technical systems. This transition requires not only technical solutions, but changes in our institutions, economies, behavior patterns, and more profoundly in our values and belief systems (Steffen et al., 2018). Consequently, the transition towards a post-fossil society must take place through economic, social, cultural, and value-based change to reform our everyday.

2.2. Lifestyles' need and potential to change

As discussed in the previous section, transitions towards more sustainable societies require radical changes in dominant lifestyles and the system within which they occur. This section intends to explore the role of lifestyle change in societal sustainability transitions. Research on sustainable lifestyles is about studying how to achieve wellbeing within planetary limits (Akenji & Chen, 2016), which includes investigating the drivers, impacts, and patterns of people's behavior and how the system that shapes lifestyles (IGES et al., 2019). Akenji and Chen (2016) provide the following definition:

A "sustainable lifestyle" is a cluster of habits and patterns of behavior embedded in society and facilitated by institutions, norms, and infrastructures that frame individual choice, to minimize the use of natural resources and generation of wastes, while supporting fairness and prosperity for all. (p. 3)

Thus, this definition integrates the planetary limits with wellbeing from a holistic perspective and highlights the need for equal prosperity for achieving sustainability.

As sustainable lifestyles are concerned with achieving wellbeing within the planetary boundaries, measuring ecological and social limits to lifestyles is essential for setting actionable targets (Gilby et al., 2019). In recent years, these measurements have mainly focused on studying macro-level greenhouse gas emissions (e.g., IPCC, 2018) or the planetary boundaries (Rockström et al., 2019) at a national or global level, thus putting less emphasis on the micro-level, such as that of households (Gilby et al., 2019). Some examples for micro-level measurements exist, for instance the ecological footprint (Moore, Kissinger, & Rees, 2013), the lifestyle material footprint (Lettenmeier, 2018), and the lifestyle carbon footprint (IGES et al., 2019). The lifestyle carbon footprint (LCF) is an initial effort to demonstrate the carbon footprint of average households in relation to the 1.5-degree target set by the Paris Agreement (IGES et al., 2019). The results of this project indicate that considerable reductions in lifestyle carbon footprint are required, especially in industrialized countries, but increasingly also in developing countries to reach a sustainable lifestyle within the prescribed ecological limits (IGES et al., 2019). Although carbon

footprint calculations provide valuable information in terms of targets, they do not consider the implementation of sustainability transitions (Gilby et al., 2019). Hence, such calculations can be seen as a budget for humanity, which needs to be complemented with considerations of equity and wellbeing (Gilby et al., 2019).

Several publications have aimed to combine the notions of wellbeing with ecological limits, such as *the Doughnut Economics* by Raworth (2012). This publication attempts to define "the sweet spot" for humanity to prosper within the nine planetary boundaries and twelve dimensions of social sustainability derived from the UN Sustainable Development Goals (Raworth, 2012; UN, n.d.). According to Hickel (2019), it is theoretically achievable to reach wellbeing within the ecological limits in both poor and rich nations, but this requires halving (40–50% reduction) the biophysical footprints of the rich nations. According to the study (Hickel, 2019), this reduction target is unlikely to be attained through contemporary attempts to decouple economic growth from environmental impact.

According to Gilby and colleagues (2019), several challenges exist for conceptualizing and promoting sustainable lifestyles in practice. Although progressive policies and projects exist, they often lack a holistic perspective and either promote individual, technological, or policy change (Gilby et al., 2019). This argument aligns with Røpke (2015), who states that the mainstream discussion on promoting lifestyles is largely focused on influencing individuals while ignoring that sustainable lifestyles are largely dependent on changes in the system and its values. Furthermore, as stated by Jackson (2012), changes in infrastructure and policies are not valid without behavioral change and vice versa, since political, technical, and behavioral changes are intertwined. Hence, as concluded by Akenji and colleagues (IGES et al., 2019), achieving low-carbon lifestyles requires extensive changes in behavior and the system that shape lifestyles, which the policies and projects should reflect.

Moreover, a profound understanding of diverse cultural contexts and lifestyle segments is currently lacking in many sustainability projects (Gilby et al., 2019). Considerably many projects target the urban middle class in high-income countries while putting less emphasis on changing lifestyles in the Global South (Gilby et al., 2019). This research focus is reasonable due to the enormous historical and current emission production in the Global North (Akenji & Chen, 2016). However, the urban middle class and their subsequent consumption patterns are proliferating in the Global South (Akenji & Chen, 2016). With signs that urbanization will affect the remaining carbon budget significantly, it is crucial to find novel ways to increase wellbeing while appreciating the appreciating planetary boundaries in these contexts (Akenji & Chen, 2016). Hence, as stressed by Gilby and colleagues (2019), sustainable lifestyles researchers and practitioners have to shift their focus from high-income nations towards supporting lifestyle transformations in the Global South. Furthermore, these attempts should be drafted locally using context-specific methods, as each lifestyle segment manifests their specific values, attitudes, ideals, and practices (Gilby et al., 2019). Consequently, to make sustainability projects effective, each segment needs to be invited to reconsider and co-create together their pathways towards sustainable living (Gilby et al., 2019).

2.3. Practice theory and transition studies

In the previous sections, I have emphasized the need for transitions towards sustainable living and how sustainable lifestyles can be conceptualized. This section discusses different theories for analyzing the dynamics of transitions, especially regarding sustainable lifestyles. To achieve this, I introduce two different perspectives, practice theory and transition theory, which provide sociological and system-oriented approaches to understanding these dynamics (Røpke, 2015). In addition, I discuss how these perspectives could complement each other when applied in practice.

Transitions theory

Several multidisciplinary strands of research have engaged in analyzing societal transitions since the late 1990s (Markard et al., 2012). Among the longest lines of research is the field of system innovations and transitions (referred to as transitions theories in this study) (Hyysalo et al., 2019), which strives to explain the dynamics of socio-technical system transitions over time (Geels, 2002). In the scope of this work, I mainly discuss the multi-level perspective model proposed by Geels and collaborators (Geels, 2002; Geels 2005; Geels & Schot, 2007), and the transitions management approach proposed by Loorbach and colleagues (e.g. Loorbach, 2010), as both these concepts are widely used in transition studies (Røpke, 2015).

Transition theories explain how socio-technical systems change through different states over time, i.e. the dynamics of socio-technological transitions (Geels, 2002). Socio-technical systems refer to complex and large-scale provision systems that provide societal functions, such as energy, mobility, and food (Geels, 2002). The stable state of these systems is called the socio-technical regime, and it transforms through stabilizing and dynamic processes: Stabilizing processes, such as dominant infrastructure and routines, keep the regime in the current state; Dynamic processes, such as technological development, change the regimes (Røpke, 2015). Geels and collaborators (e.g., Geels 2002; Geels 2005; Geels & Schot, 2007) have introduced the multi-level perspective model to further elaborate on the dynamics of these processes through the concept of three hierarchical levels: niche, regime, and landscape. The lowest level refers to innovations in niches, the middle level describes the socio-technical regime including mainstream infrastructure and provision systems, and the highest level, the landscape, consists of macroeconomics, cultural patterns, and other macro developments (Geels & Schot, 2007). The basic idea is that changes on the landscape level destabilize the regime, which creates opportunities for niche innovations to challenge the regime, thus leading to changes in the socio-technical system (Geels & Schot, 2007).

Although the multi-level perspective model has gained wide popularity in recent years, it has received cautionary criticisms (as reviewed by e.g., Smith, Voß, & Grin, 2010; Geels, 2011; Papachristos, 2018). This criticism considers, for instance, the lack of methodological consistency, epistemological status, and agency (e.g., Genus & Coles, 2008), and bias towards bottom-up change models (Berkhout, Smith, & Stirling, 2004). Furthermore, it has been criticized for being mainly concerned with the dynamics of supply, hence, leaving the activities of individuals partially under-theorized (Røpke, 2015). This point of criticism is elaborated by Elizabeth Shove and Gordon Walker (2010), who argue that these theories are mainly focused on initiating change through innovation while ignoring how the demand side will react to these innovations. This technological

focus is understandable, considering the original intention of transitions theories for analyzing technological change and innovations (e.g., Geels, 2002). However, when applied to examine societal level change, it may benefit from being complemented with the theories that conceptualize the dynamics of demand.

Practice theory

Practice theories aim to extend the debate on transitions by providing a way of conceptualizing the dynamics of demand (see e.g., Shove & Walker, 2010). Practice theory takes social practices – rather than individuals or societies – as the focus of attention for analyzing transitions (Røpke, 2015). Hence, it helps to conceptualize how societal changes occur through everyday actions as culturally and historically evolved patterns of practices (Järvensivu, 2017). Although there are several traditions of practice theory, as reviewed by Nicolini (2012), I focus primarily on the works by Shove, Røpke, and collaborators (e.g. Shove, 2003; Shove & Walker, 2010; Shove, Pantzar, & Watson, 2012; Røpke, 2015), as these contributions conceptualize the dynamics of the everyday life in relation to environmental sustainability, which is the focus of this study.

Practices are socially learned and involve routinized ways of acting and thinking, consisting of activities, which people perceive as entities (Schatzki, Knorr-Cetina, & Von Savigny, 2001), and that are identifiable over time and space (Røpke, 2015). According to the practice-theoretical view, social life is formed by historically learned practices that describe the accustomed ways of interacting with other people and material artifacts (Järvensivu, 2017). Consequently, practices exist when they are enacted by groups of people (Røpke, 2015), and change when "practitioners" start to perform them in a new way. According to Shove and colleagues (2012), practices consist of three types of elements: competences (knowledge, skills), materials (objects, technologies), and meanings (emotions, values, aspirations). These elements, the ingredients of the practice, are continuously integrated in the process of performing the practice (Shove et al., 2012). When the practitioner repeats the same connections between the elements that form the practice, it stabilizes the practice (Røpke, 2015). The practices change, when the practitioner starts to perform them in new ways, triggered by changes in the elements that constitute them (Røpke, 2015; Shove et al., 2012). Consequently, although practices are relatively stable and performed in a relatively routinized manner, they are also in a flow of evolvment as the configurations of elements shift over time (Røpke, 2015).

Practice theory can be used for conceptualizing sustainable consumption at an individual level (Røpke, 2015). According to practice theory, people's behavior is driven by a will to engage in meaningful activities rather than a self-built will to consume. Based on this reasoning, one key concern with achieving sustainable consumption is that other motivations might easily conflict and override environmental concerns, as they are distant from everyday life (Røpke, 2015), thus leading to unsustainable behaviors. Furthermore, as practices are socially and historically learned and rooted in unsustainable provision systems, it can be difficult for individuals to independently initiate social change (Jalas et al. 2017).

Combining transitions theory and practice theory

In recent years, several contributions have explored developing an integrative approach between transitions theory (and particularly MLP) and practice theory in conceptualizing transitions (e.g., Shove, 2003; Smith et al., 2010; Hargreaves, Longhurst, & Seyfang, 2013; Røpke, 2015; Cass, Schwanen, & Shove, 2018). This approach is understandable due to their similarities: The theories share the same research interest, develop frameworks for analyzing the dynamics of systemic sustainability transitions, and both agree that technological efficiency and narrow product focus are not sufficient methods for achieving sustainability (Røpke, 2015). In terms of differences, they have different focus areas: As transition theories focus on the role of technological innovations in initiating sustainability transitions, practice theory departs from the everyday practices in explaining change processes.

A relatively early contribution exploring the intersections between PT and MLP is written by Shove (2003), who used MLP as a basis to argue and elaborate on the role of practices in transitions. According to the author (2003), practice theory could complement transitions theory by showcasing the horizontal circulation of elements between the vertical levels of the multi-level perspective model. Hargreaves and colleagues (2013) elaborate on the model proposed by Shove (2003) and adapt it for two case studies for understanding innovation in regimes. The authors stress that adopting only one of these lenses might risk in producing a rather narrow view of transition dynamics, and the integrative approach could benefit both the theories. Røpke (2015) offers a different approach, suggesting that practices are, in fact, somewhat similar to socio-technical systems. According to her, the activity of reconfiguring practices subsequently changes broader systems, and “merges transition theory into practice theory” (Røpke, 2015, p. 353). This view has also been challenged by, for instance, Smith and colleagues (2010), who discuss challenges regarding the integration of practices with niches and regimes. A more recent contribution by Cass and colleagues (2018) explores the intersections between the theories for understanding the role that infrastructures can play in transitions addressing climate change.

Besides exploring the theoretical intersections, integrating these theories for studying transitions governance has evoked academic interest. During the last decades, transitions theories have inspired practical implementation projects for steering sustainability transitions, one of these being transitions management (TM) (Schäpke, Omann, Wittmayer, Van Steenberg, & Mock, 2017). The TM approach was introduced by Loorbach (2007, 2010), and it proposes a complexity-based and prescriptive model of governance for steering transitions. When applied in practice, the TM approach strives for strategic, iterative, and participatory searching processes aimed at enhancing learning and empowerment amongst the participants (Schäpke et al., 2017). Recently, this approach has been increasingly applied by researchers and policy practitioners for advising policymaking in steering and mainstreaming niche practices and innovations (Wittmayer & Roorda, 2014). Despite its popularity, there are also limitations to the TM approach, especially in terms of addressing sustainable lifestyles. The approach does not conceptualize why and how individuals engage with niche experiments psychologically, and what intrinsic changes occur within individuals (Rauschmayer et al., 2013). Thus, according to Rauschmayer and colleagues (2013), finding workable methods to implement such participatory and iterative transition projects that still acknowledge the agency of lifestyles is essential to complement TM research.

Practice theory can provide one approach for complementing the TM approach (e.g., Rauschmayer et al., 2013; Shove & Walker, 2010). In their paper *Governing transitions in the sustainable everyday* (2010), Shove and Walker explain how practice theory can be applied for steering societal transitions, especially from the governance perspective. The authors (2010) strive to challenge and complement the TM approach by suggesting a more systemic approach to policymaking that considers and intervenes in the elements that reconfigure social practices. Furthermore, according to a practice-theorist view, policy-makers act within and according to practices, not outside of them, and should hence be attuned to the everyday practices for drafting relevant policies to achieve sustainable every day (Shove & Walker, 2010). During the recent years, the practice-theoretical research has gained more considerable attention in, for example, directing energy research and policy as it enables to conceptualize a range of interconnected practices that form contemporary living conditions (Jensen et al., 2018). Thus, this perspective allows practitioners to take into account the agency of individuals in transitions and could hence complement the TM approach in policymaking regarding sustainable lifestyles.

2.4. Design for sustainability transitions

This section discusses the evolution of sustainable design from products towards systems, and introduces the emerging field, design for sustainability transitions (DfST). Furthermore, contemporary attempts to combine DfST practice theory and transitions studies are discussed.

The evolution of design for sustainability

Ceschin and Gaziulusoy (2020) provide a framework for investigating the evolution of sustainable design. The framework is based on three elements, the scope of design (the horizontal axis), the problem space (the vertical axis) and the focus of design activity (five innovation levels) (Ceschin & Gaziulusoy, 2020). Based on this division, the authors (2020) introduce three aspects that characterize the evolution of design for sustainability: the expanding design scope from products towards systems; a shift of problem space from technology-orientation towards human-centeredness; and, the change of sustainability focus from product-level innovations towards socio-technical transitions. Consequently, the framework helps to position the distinct DfST approaches in relation to one another and showcases how the different DfST approaches might contribute to sustainability.

The five innovation levels in the framework indicate the primary focus of design activity in terms of design scope and problem space. The first innovation level, product design, refers to technical and product-centric solutions, striving to improve existing products and services or develop new more sustainable ones. The second innovation level refers to product-service system innovation, where the objective is to develop combinations of products and services, such as new business models. The third level, the spatio-social innovation level, focuses on innovation in communities with the aim to improve social and environmental conditions within them. The fourth approach, socio-technical system innovation level level, focuses on promoting sustainability transitions at the level of socio-technical systems. Thus, the framework describes the evolution of sustainable design from single product, towards product life cycles and product-service systems and, furthermore, towards socio-technical system innovations (Ceschin & Gaziulusoy, 2020). Importantly, as stated

by the authors (2020), the different DfST approaches are interlinked and complementary, and all of them are needed for achieving systems transitions towards sustainability.

The emerging field of research and practice, design for sustainability transitions (DfST), aims to explore the role and agency of design in contributing to socio-technical systems transitions through the creation of long-term visions and pathways (Gaziulusoy & Erdoğan Öztekin, 2018). This field strives to connect the theories of sustainability transitions with design research and practice (Gaziulusoy & Erdoğan Öztekin, 2018). Gaziulusoy (2018) presents three main developments that have affected the evolution of the field: the maturing of the sustainability science field, the development of system innovations and transitions theories, as well as the urgent need for sustainability transitions at the level of socio-technical systems. These theories supported the development of the field by providing conceptualizations on the dynamics of transitions and the complexity of sustainability challenges, helping to link sustainability transitions and design research (Gaziulusoy 2018).

As the field is emerging, the theoretical foundations, framing of sustainability, agency of design and methodological approaches are still being developed and debated, as reviewed by Gaziulusoy and Erdoğan Öztekin (2018). According to the authors (2018), despite their differences the early contributions to the field (Gaziulusoy, 2010; Joore, 2010; Ceschin, 2012; Irwin, 2015) highlight the urgency for radical reconfigurations of socio-technical systems to move towards more sustainable societies and “that these change processes can be formulated and approached as design projects” (p. 80). Irwin, Kossoff and Tonkinwise (2015) state that transition design is “an attempt to name an ambition for an expert craft of designing that acknowledges the extent of our social crises by advancing the practices of social and sustainable designing through the incorporation of multi-stage practice-oriented transformation” (p. 61). Likewise, Scupelli (2015) elaborates that transition design differs from traditional design in that it defines a clear societal intention for the design work and proposes a process to pursue that intention while acknowledging the systemic and complex nature of sustainability problems. Thus, it gives a specific direction and purpose to traditional design practice (Scupelli, 2015). By contrast, Manzini (2015) states that transitions design should not be formed as another kind of designing as “[l]ong horizons of time and visions of a sustainable future should become the ‘normal’ cultural background of future mainstream design” (p. 59). To conclude, as the field is emerging, there are opposing views on the definition of the field amongst design scholars.

The characteristics of the field can be explored in relation to the roles, skills, and agency that design can bring to transitions processes. According to Erdoğan Öztekin and Gaziulusoy (2019), design can have a vital role to play in contributing to “transitions for the alternative experiences, practices, and configurations it delivers, and the learning processes it triggers” (p. 149). According to the authors (Erdoğan Öztekin & Gaziulusoy, 2019), design is capable of working with real-life challenges and coming up with situated solutions by using unconventional integrating approaches. This point is further elaborated by Gaziulusoy and Ryan (2017), who emphasize that the roles of design in transitions projects include “very tangible, technical, skills-based roles, to very intangible roles, relating to how information is received, processed and synthesised” (p. 1297). According to their case study (Gaziulusoy & Ryan, 2017), design could play a role in strategic, tactical, and operational activities, which Loorbach (2010) defines as necessary for achieving transitions.

However, as stated by Gaziulusoy and Erdoğan Öztekin (2018), further empirical case studies of DfST could provide valuable insights for specifying the theoretical foundations of the field, as well as exploring the roles and agency of design in transitions processes.

Combining MLP, PT and design research

As stated in the previous section, the design field can contribute to sustainability transitions through various ways. However, as stated by Erdoğan Öztekin and Gaziulusoy (2019), it needs to be complemented with theories that conceptualize the dynamics of change in transitions for attaining a comprehensive understanding of societal change processes. As discussed earlier in this chapter (Section 2.3), practice theory and transitions theory provide partly complementary approaches for analyzing the dynamics of transitions. Hence, this section discusses some contemporary attempts to integrate design research with the respective theories.

When it comes to connecting transitions theory and design research, this approach has been explored in three early contributions of DfST (Gaziulusoy, 2010; Joore, 2010; Ceschin, 2012). In line with transition theories, these contributions focus on the dynamics of supply and the role of design in contributing to socio-technical systems transitions (Gaziulusoy & Erdoğan Öztekin, 2018). Several design scholars have investigated the role of design in contributing to sustainable consumption through coupling social practice theory with design research, subsequently building the foundations for *practice-oriented design* (Pettersen, 2016). According to Jalas and colleagues (2017) this approach highlights the role of the (design) researcher in engaging in identifying and affecting the elements of practices for transforming the everyday life towards sustainability. Furthermore, the contributions of Kossoff, Irwin, and collaborators (Kossoff, 2011; Irwin, 2015; Irwin, Tonkinwise & Kossoff, 2015) draw partially from social practice theory and identify lifestyles as a platform for socio-technical transitions. Thus, during the last decade, several attempts have emerged for combining design research with transitions studies and practice theory respectively.

Furthermore, some contributions have explored the interrelations between design research, transition studies, and practice theory (Kossoff, Tonkinwise, & Irwin, 2015; Pettersen, 2016; Erdoğan Öztekin & Gaziulusoy, 2019). In their article *Designing Transitions Bottom-up: The agency of design in formation and proliferation of niche practices*, Erdoğan Öztekin and Gaziulusoy (2019) develop an analytic-theoretical framework for exploring "the learning spaces interrelated to design and sustainability transitions"(p. 2) by combining these respective fields. The reason for focusing on these theories is that both practice theory and the multi-level perspective (MLP) of system innovations take learning as an essential part of transitions and acknowledge the agency of design in contributing to systems transitions (Erdoğan Öztekin & Gaziulusoy, 2019). Based on theoretical insights from these fields, the writers identify that learning in transitions may occur through connecting between practical and intellectual experiences, and through engaging in processes of meaning-making and purpose-seeking (Erdoğan Öztekin & Gaziulusoy, 2019). The results from the study indicate that transition design could help to create *learning spaces* where such learning could occur, and that MLP, PT and DT could effectively complement each other in building a more comprehensive view of the dynamics of transitions, especially in terms of learning (Erdoğan Öztekin and Gaziulusoy, 2019).

2.5. Co-design and design games

This section introduces new design research approaches to collaborative design and introduces design games as a tool for involving stakeholders in these design processes. As discussed in previous sections, the transition management approach requires interaction between multiple stakeholders to guide transitions (Loorbach, 2010), and according to Ryan and Gaziulusoy (2017), design could have the potential to facilitate and frame the production of these collaboration processes. Similarly, Scupelli (2015) suggests that design could play a central role in integrating and harmonizing cooperation in transition projects. Thus, research in co-design may support the contribution of design for sustainability transitions.

Design research has recently engaged in more collaborative design processes, where various people are invited to take part in and contribute to design processes, also known as participatory design (e.g., Sanders & Stappers, 2008). During the past decades, research in this field has evolved from user participation towards co-creation and co-design (Sanders & Stappers, 2008). According to Sanders and Stappers (2008) “co-creation refers to any act of collective creativity, i.e. creativity that is shared by two or more people” (p. 6). Co-creation is an umbrella term for co-design, which refers to the creative collaboration of various participants in a design process (Sanders & Stappers, 2008). This aligns with the definition provided by Ezio Manzini (2016), who describes co-design as “the overall design process resulting from the interaction of a variety of disciplines and stakeholders – final users and design experts included” (p. 53). Hence, in co-design, ideas are initiated through interaction between the designers and other stakeholders with the purpose to co-construct and explore ideas in a dialogue (Vaajakallio, 2012).

According to Vaajakallio (2012), the development towards co-design has at least two major implications to the design practice and research: the change of designer’s work, and the change of design scope. Firstly, this development affects designers work, as the emphasis has moved from designing products towards designing opportunities for collaboration (Vaajakallio, 2012). Secondly, the problem area and scope of design changes from single product development tasks towards larger developing projects demanding creative methods to address old assumptions with novel solutions (Vaajakallio, 2012). Along similar lines, Sanders and Stappers (2008) state that also the focus and purpose of the design disciplines changes: When the traditional design disciplines were focused on a single product or a methodology, the emerging design practices focus on designing for purposes, such as societal needs. Consequently, managing these design processes require the acknowledgement of longer time spans and a diverse set of new skills for enabling collaboration (Staples and Sanders, 2008).

These recent developments in design research and practice emphasize the importance of developing novel approaches for creating spaces and activities for co-design “to direct exploration of design possibilities rising from people’s daily experiences, needs and dreams” (Vaajakallio, 2012, p. 13). Organizing such collaboration between people with various backgrounds and interests is demanding, and thus highlights the need for developing novel methods to assist this task (Brandt, 2006).

In this sphere, methods combining game-elements with design processes have gained increased attention, as playing can create a foundation for enhancing mutual learning in design processes (Brandt, 2006). These activities can be described as design games and can offer one

effective method for inviting stakeholders to participate in the design process, thus, enabling creative collaboration (Vaajakallio, 2012). There is no generic definition for the term, as design games change according to the context and purpose of the game (Vaajakallio, 2012). According to Vaajakallio (2012) “design games are tools for co-design that purposefully emphasise play-qualities such as playful mindset and structure, which are supported by tangible game materials and rules” (p. 229). Likewise, Brandt (2006) states that design games include rules and game materials that direct the design process and enhance participation, but seldom involve competition.

Kirsikka Vaajakallio (2012) introduces the Play Framework for understanding the characteristics of design games in the context of co-design. Grounding for this framework integrates insights from co-design, with research on games and performance. Based on these foundations, the Play Framework outlines “the main play-qualities that design games provide for co-design in open-ended design contexts, such as service design” (Vaajakallio, 2012, p. 228). In this framework, the *design* part defines the context of use for the game and the *play* part illustrates its play qualities (see Figure 3). Design games are presented from three different perspectives – as a tool, a mindset, and a structure – depending on the roles people have in experiencing them: In terms of seeing design games as tool, the focus is on the purpose of the game; Perceiving design games as a mindset refers to reaching “a play spirit” amongst the participants; Seeing design games as a structure relates to the specific play-qualities of the design game. Vaajakallio (2012) highlights that it is not sensible to propose one recipe or framework for designing design games due to their context-specific nature. Thus, the framework serves as a tool for specifying the elements of design games and for exploring the connections between co-design and play-elements.



Figure 3. The Play Framework (adapted from Vaajakallio, 2012)

Based on the reasoning above, design research and practice in co-design can contribute to creating collaborative learning environments for supporting transitions projects. In the course of this study, an empirical case study is developed and evaluated by applying design games as a method for engaging collaboration in transitions projects.

2.6. Summary of the main findings

This section presents the main insights from the literature review that guided the research process. These insights can be divided into theoretical (purple) and practical (orange) ones (see Figure 4). As Figure 4 illustrates, the theoretical insights draw from studies in sustainable lifestyles, practice theory, transitions studies and design for sustainability transitions. The practical insights that guided the design work are derived from research in co-design and, in particular, design games.

- To address the climate crisis, the current way of living needs to be restructured, and the challenge needs to be addressed at the level of socio-technical systems. Consequently, the transition towards a post-fossil society must take place through economic, social, cultural, and value-based change to reform our everyday.
- Lifestyles play an important role in the package of solutions for mitigating climate change. Considerable reductions in lifestyle carbon footprint are required, especially in industrialized countries, but increasingly also in developing countries to reach a sustainable lifestyle within the ecological limits. Achieving low-carbon lifestyles requires extensive changes in behaviour and system that shape lifestyles and the policies and projects should reflect this intention. Moreover, a profound understanding of diverse cultural contexts and lifestyle segments is needed for promoting sustainable lifestyles.
- Practice theory and transition theory provide sociological and system-oriented approaches to understanding dynamics of transitions, especially regarding lifestyles. Transition theories explain how socio-technical systems change through different states over time. Practice theories aim to extend the debate on transitions by providing a way of conceptualizing the dynamics of demand, by taking social practices as the focus of attention. During the recent years, several contributions have explored developing an integrative approach between transitions theory and practice theory in conceptualizing in transitions. When applied in practice, this integrative approach could allow practitioners to take into account the agency of individuals in steering transitions governance regarding sustainable lifestyles.
- The emerging field of research and practice, design for sustainability transitions (DfST), aims to explore the role and agency of design in contributing to socio-technical systems transitions through the creation of long-term visions and pathways. This field strives to connect the theories of sustainability transitions with design research and practice. Several contributions have explored the interrelations between design research, with either transition studies or practice theory, or integrating both.
- Design research and practice in co-design can contribute to creating collaborative learning environments for supporting transitions projects. In co-design, ideas are initiated through interaction between designers and other stakeholders with the purpose to co-construct and explore ideas in a dialogue. Organizing such collaboration between people with various backgrounds and interests is demanding, and there is a need for developing novel methods to assist this task. In this sphere, methods combining game-elements with design processes have gained increased attention, as playing can create a foundation for enhancing mutual learning.

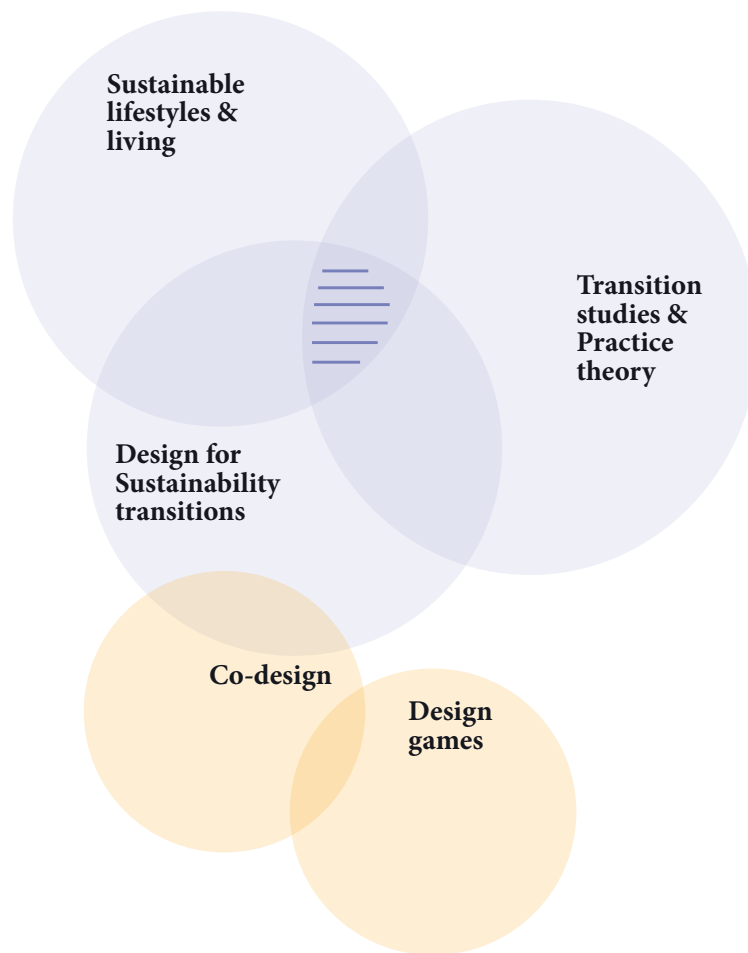


Figure 4. The theoretical framework (Nielsen, 2020)

2. Developing the design game

3. Developing the design game

The research structure was divided into two phases, developing the game and evaluating the game, to address the research objective. This chapter presents the first mentioned phase. Firstly, I briefly outline the socio-cultural and research context for this study. Secondly, I introduce the iterative design process of developing a design game through a collaboration with the 1.5-degree research team (1o5 team). Thereafter, I present three criteria sets that were prepared for analyzing different aspects of the game to help to answer the research questions (see Figure 5). The first set of criteria was designed to specify the characteristics of the game in line with the first research question. The second one to guide the evaluation of the game in terms of what it achieves. And the third one to examine the kinds of impacts and outputs it might create. The latter two criteria sets are in line with the second research question. Figure 5 illustrates the iterative design process and its outcome.

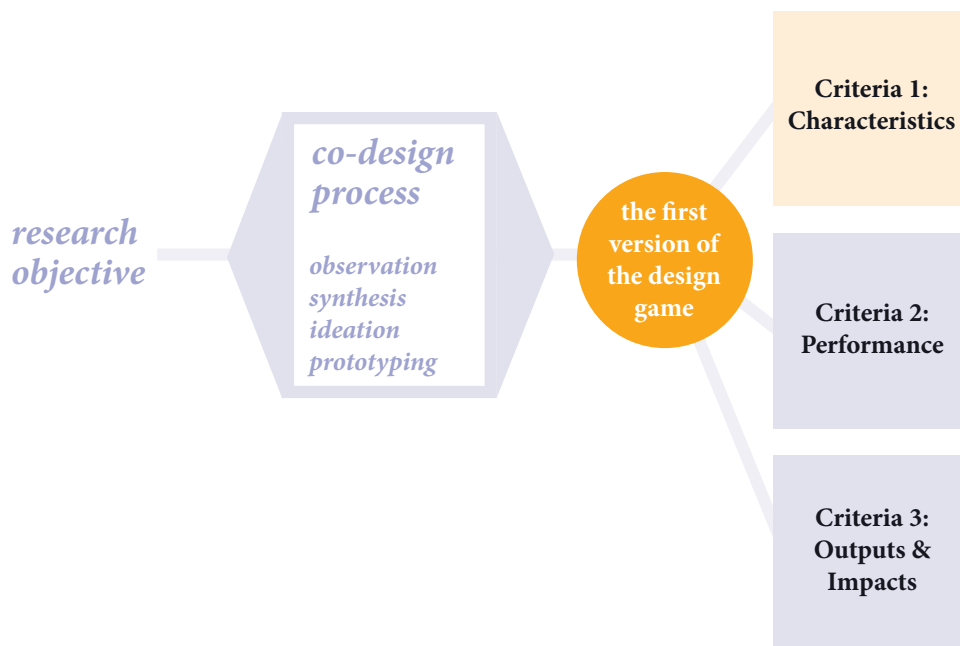


Figure 5. The design process and its outcome (Nielsen, 2020)

3.1. Research context

Socio-cultural context

This thesis project started in the early fall of 2018, which, in many ways, witnessed the new wave of climate awakening in Finnish society. The essential initiator for this was the *IPCC Special Report on Global Warming of 1.5°C* (IPCC, 2018), which stressed the need for significant reductions in greenhouse gas emissions to limit global warming to 1.5 degrees Celsius. Although the topic of climate change had aroused wide and nuanced discussions in media and politics for a decade, and an unusually hot summer had evoked concern, the report made the urgency and amplitude

of the problem more evident. The subsequent discussions brought the topic to coffee our tables and made people realize change is required in one's own life as well as at the systemic level. At the same time, the voices of opponents and climate skeptics also increased, political confrontation and polarization deepened, and public debates were characterized by disbelief and concern (Onali, 2018).

Households play a significant role in combating climate change as their activities account for two-thirds of Finland's consumption-based greenhouse gas emissions (Nissinen & Savolainen, 2019). Since 2016, the Finnish Innovations Fund Sitra has prominently raised the importance of sustainable lifestyle transitions in their resource wise citizen program. According to Sitra's 2017 survey (Rajantie, Mänty, & Poussa, 2017), most respondents attached importance in acting in an environmentally friendly way, but only under a half of respondents mentioned that they have reduced their environmental consumption and strive for responsible choices in everyday life. Their carbon footprint calculator ("lifestyle test") has received nearly a million users in Finland (Finnish Innovation Fund Sitra, n.d.-b). This project started with these preconditions.

Research context of this thesis

This thesis project started when post-doctoral researcher Michael Lettenmeier contacted me regarding the study on 1.5-degree lifestyles (IGES et al., 2019). The initiative stemmed from the need to explore practical ways to share the research results to a wider public. What is noteworthy to mention is that at the beginning of our co-operation, the form of my contribution was not clear. Hence, the research process in this thesis has been exploratory, integrative, and iterative by nature.

Consequently, this thesis work was carried out in relation to the *1.5-degree lifestyles: Options and targets to reduce lifestyle carbon footprints* (IGES et al., 2019) with the intention to apply its results. This research (IGES et al., 2019) provided a comprehensive view of the relation of the 1.5-degree target of the Paris Agreement as it relates to the consumption pattern and footprint of private households. More specifically, the research set the targets for Lifestyle Carbon Footprints (LCF) which would stay within 1.5 or 2 degrees; estimated the average Lifestyle Carbon Footprints in Finland, Japan, China, Brazil and India and compared them to the targets; and identified alternative options that would notably reduce current LCFs (IGES et al., 2019). The research project was conducted by The Institute for Global Environmental Strategies (IGES), Aalto University, and D-mat, and funded by the Finnish Innovation Fund Sitra, and the KR Foundation. From now on, I use the abbreviated name, 1o5 study, to refer to this research. In addition, this thesis relates to The Sustainable Lifestyles Accelerator project, which strives to engage 70 000 households in seven countries to plan and implement strategies for footprint reductions (SLA, n.d.). The three-year-project was launched in 2018 and is co-organized by research partners in the seven respective countries and funded by the KR Foundation.

It is noteworthy to mention that both the design process and the field study in this thesis were shaped by a collaboration between multiple actors, combining the expertise of Sitra, the 1o5 team, and external experts. My main collaborators in this thesis project were Viivi Toivio and Michael Lettenmeier from Aalto University and D-mat ltd., who contributed with their expertise in developing and testing the design game. In addition, Anu Mänty, Markus Terho, and Emma Hietaniemi from Sitra, as well as Ryu Koide and Lewis Akenji from IGES provided valuable help throughout the thesis process.

3.2. Design process

This section presents the design process for developing the design game. The development process was conducted through an iterative design process. Several academics and practitioners have proposed models for describing design processes, as reviewed by, for instance, Howard, Culley, and Dekoninck (2008) and Bobbe, Krzywinski, and Woelfel (2016). One widely used model for describing a design process is the double diamond model (Design Council, 2007; Lindberg, Meinel, & Wagner, 2011), which can be used for communicating the different stages and elements of a design process on a general level (Figure 6). According to the model, a typical design process explores the problem space and the solution space through diverging and converging thinking to come up with viable solutions (Lindberg, 2011). Thereafter, the process is reflected through iterative alignment (Lindberg, 2011). Despite its popularity, the model has been criticized for providing a generic, simplified, and linear picture of a design process (e.g., Green, Southee, & Boulton, 2014), and is therefore not suitable for describing a non-linear and context-specific design process. The same critique aligns with design process models in general: although following a specific process can be seen as seemingly beneficial for giving a structure to the design task, it can also lead the process in the wrong direction, as the models are perceived contrarily by different individuals (Eckert et al., 2010).

Consequently, I use the double diamond model for communicating the stages of the design process on a general level. However, this particular design process was based on my expertise and that of my colleagues for addressing the particular task at hand. The process was roughly divided into exploring the problem space by observing the situation and synthesizing insights, and exploring the solution space by producing alternative ideas and elaborating these into a tangible form (see Figure 7). However, as Figure 7 illustrates, the four phases were deeply intertwined, and the design process was actually more complex than the process model describes.

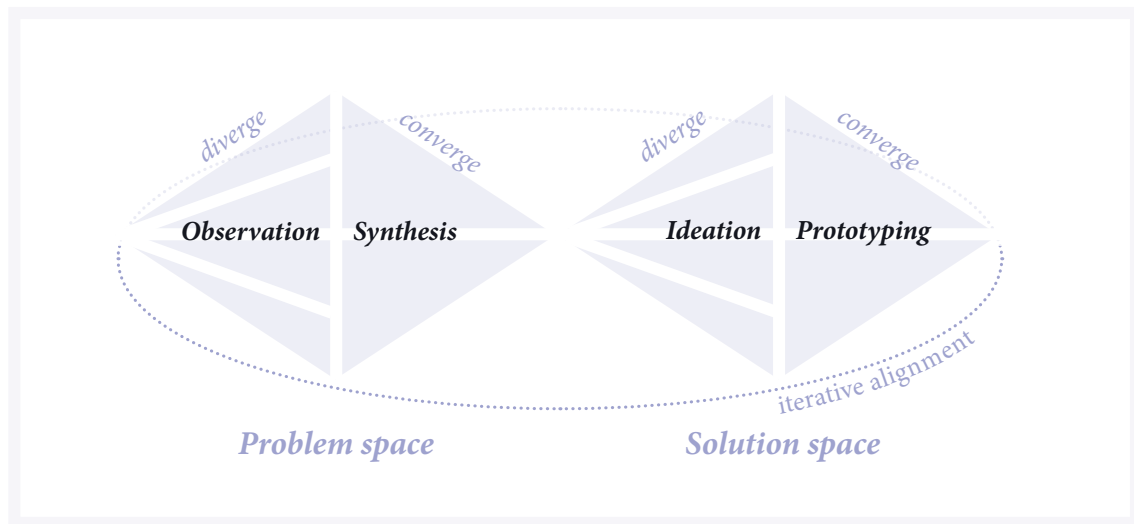


Figure 6. Problem and solution space in design thinking (adapted from Lindberg et al., 2011)

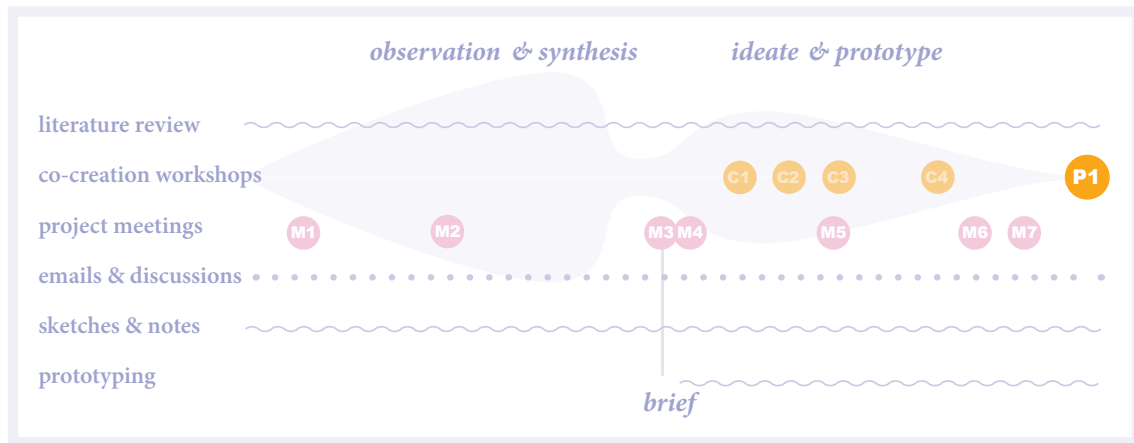


Figure 7. The design process for developing the design game (Nielsen, 2020)

Most suitable methods were chosen in an exploratory manner based on the objectives of each stage of research. These methods included taking field notes in meetings and prototyping. Data was collected and generated through field notes, sketches, pictures, and prototypes, in project meetings (MX), co-creation workshops (CX) and through informal discussions (see Figure 7). The collected data was used for developing the design tool (P1), as well as the subsequent criteria. The design process is explained in detail to enable the reader to estimate the validity of the arguments and the design decisions, as advised by Muratovski, (2015).

Problem space: Observation & Synthesis

Observation. The initial framing of my task was to make the results of the 1o5 report understandable to households and other stakeholders, such as municipalities and businesses (freely translated from an e-mail). Hence, the framing was relatively open for interpretation and, hence, required more in-depth research on its context. To enable this framing, the research process proceeded with desktop research and project meetings.

Desktop research. I started the design process with an initial literature review to broaden my understanding of the topic, most of which is covered in the literature review part of this thesis (Chapter 2). The initial desktop research was based on recommendations from the 1o5 team and my own research interests. Insight from this literature guided the development of the design tool and is partially elaborated on in Chapter 2, which describes the theoretical framework of this study.

Project meetings. To further define the problem, I was invited to internal project meetings with the 1o5 team. These meetings provided an opportunity to gather insight and ask questions regarding the needs and requirements for developing the design tool. The participants included the 1o5 team (Ryu Koide, Lewis Akenji, Viivi Toivio, and Michael Lettenmeier) and experts from Sitra. These meetings were arranged online or in person at the Sitra Headquarters in Helsinki. The research data was collected by taking field notes, which I documented in a project log. During the discussions, it became evident that the project members had different needs regarding the design tool, but all the stakeholders seemed to agree on the importance of applying the research results in practice in a real-life context. Furthermore, the cultural context for applying the tool was also

discussed. Below is a list of design criteria from the project meetings.

Synthesis. The problem framing stage was followed by a synthesis stage. In this stage, the design criteria from project meetings were synthesized to identify a design brief. The synthesis phase was conducted in close collaboration with the 1o5 team through informal discussions, emails, and expert meetings. The following data evidence including chronological sketches describe how the synthesis process proceeded (Figure 8).

Based on the synthesis phase, the brief for the design process was stated as: *How might we design a tool that would engage different stakeholders in action to enhance low-carbon lifestyles? How might we apply the results of the 1.5-degree lifestyle research in an engaging and participatory manner?*

Table 1. A summary of the design criteria from the research team (Nielsen, 2020)

A summary of the design criteria from the research team:	
1A.	The tool should engage different stakeholders in action.
1B.	The tool should make the research results understandable and actionable.
1C.	The tool should be interactive.
2A.	The tool should apply the results from the research project.
2B.	The tool should preferably be targeted towards policymakers.
2C.	The tool should not simplify the results too much.
3A.	The tool should enhance experimentation amongst households.
3B.	The tool should allow for the planning of sustainable lifestyles.
3C.	The tool should be applicable for real households.
3D.	The tool should provide insight to scale up sustainable lifestyles to a wider public.
4A.	The tool should enhance systemic transitions towards low-carbon living.
4B.	The tool should engage different stakeholders to collaborate.
4C.	The tool could function as a case example for DfST.
5A.	The tool should apply the results of the 1o5 study including <ul style="list-style-type: none"> a. The targets for sustainable household footprints b. The actions and domains that have the biggest impact potential c. The systemic nature of lifestyles
6A.	The tool should be primarily designed for the Finnish context.
6B.	The tool should take into account the possibility to adapt it to other cultural contexts, such as Japan.

Solution space: Ideation & prototyping

Ideation. The synthesis phase was partly intertwined with the ideation phase, where the aim was to ideate concepts to respond to the design brief through co-design. Transdisciplinary co-operation was especially relevant in the context of this study to ensure the relevance of the solution, as the topic is inherently complex by nature (Muratovski, 2015). Co-design allows this kind of co-operation by enabling different stakeholders to participate in the design process (Muratovski, 2016). According to Crouch and Pearce (2012), "this way of working also ensures that the research is relevant, democratic and is there to meet people's needs" (p. 151).

The co-design process occurred via three face-to-face co-creation workshops accompanied by informal discussions in person, online, and via phone. I use the term co-creation workshop to describe these events, as it captures the explorative and collaborative nature of these events. The co-creation workshops included primarily the core team (Sonja Nielsen, Michael Lettenmeier, and Viivi Toivio), complemented with the infrequent participation of external actors. Ideas were generated through notetaking, sketching, and prototyping, and the collected data consisted of notes, sketches, and pictures from the co-design sessions. The exact duration of the co-creation workshops is partly indefinable due to the creative nature of the process.

During ideation, we came to the conclusion that the tool should take the form of a workshop for two reasons. First, the workshop form disconnects the activity from everyday life, hence allowing more abstract thinking about one's own life, which is important for allowing migration of competences towards more sustainable practices (Shove, Pantzar & Watson, 2012). Secondly, the workshop form enhances a dialogue amongst the participants and hence, may encourage common commitment (White & Habib, 2017) and transmission of learning (Schäpke et al., 2017).

Prototyping. After the co-creation workshops, the ideas had to be made visible to test their feasibility in a real-life context. Prototyping is a common method to design research and practice for making ideas tangible to explore people's perception, interaction, and experience of an idea (Wensveen & Matthews, 2014). In design research, prototypes can serve as a hypothesis, an exploration tool, a research archetype, or a means of inquiry (Wensveen & Matthews, 2014). In this study, prototyping functioned as a hypothesis that can be tested to answer the research questions.

The prototyping process was conducted by the core team, complemented by external consultation from other professionals. Transparency of the process was assured through systematic documentation of the prototypes, production stages, and co-creation workshops. The process consisted of several interlinked stages of data analysis, text formatting, color and font experimentation, lay-outing, workshop design, and mockup building. The early mockups were continuously tested and discussed to receive feedback in order to improve and build more advanced prototypes. This cyclic process of testing and improving continued until the core team agreed that the prototype met the design brief closely enough. The outcome of the process is the first version of a design game, which is introduced in the next chapter.

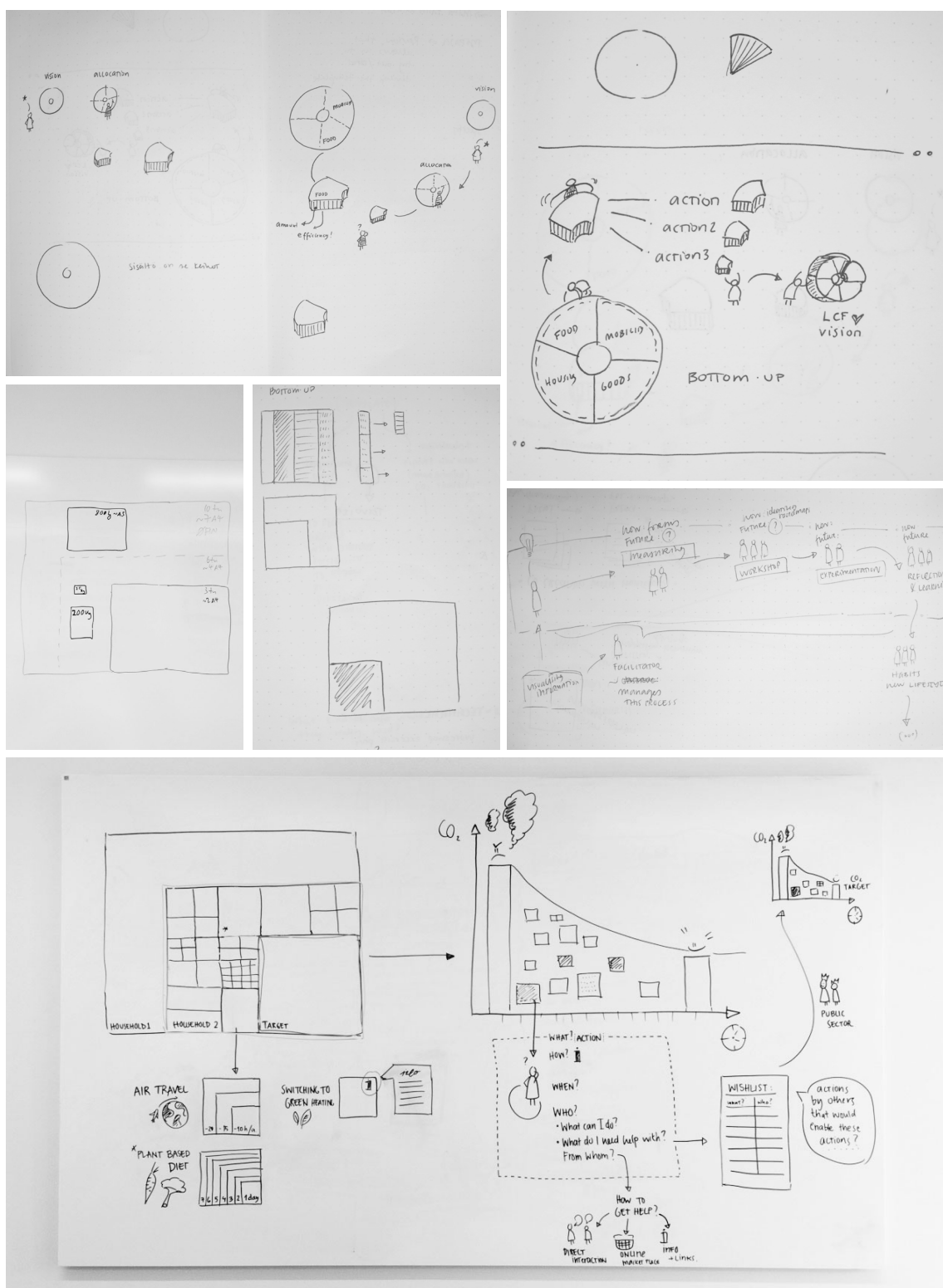


Figure 8. Personal notes and early sketches from co-creation sessions, September 2018 (Nielsen, 2018)

3.3. The first version of the design game

This Section introduces the first prototype of a *design game* that was developed during the design process to address the research objective. As explained earlier in this chapter, the form of the outcome was not clear from the beginning. Thus, the outcome of the design process was influenced by the expertise and objectives of the 1o5 team and the researcher, as well as the relevant literature.

The design process resulted in a workshop process with playful elements such as action cards and play boards. At this point, it was clear to me that it resembled a design game and, from this point on, it was studied as such. Thereafter, three criteria sets were created to specify the characteristics of the developed design game (Criteria 1), help evaluate the performance of the game (Criteria 2), and to explore the potential impacts of the game (Criteria 3). These criteria also helped to answer my research questions. I will first introduce the prototype, as it helps the reader to understand the criteria, which are present in the next sections of this chapter.

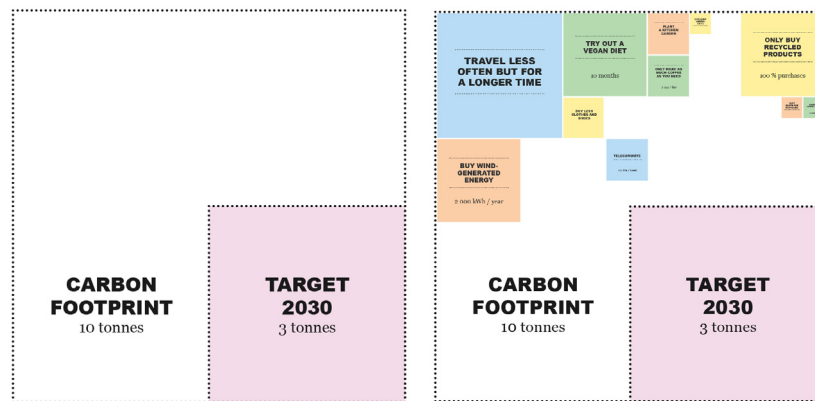
Workshop outline

The objective of the developed design game was to apply the results of the 1o5 study to inspire households and other relevant stakeholders to move towards low-carbon lifestyles. The first version of the design game included three stages. Table 2 introduces the workshop outline including the activities in the workshop and its participants. Figure 9 introduces the three phases of the workshop in detail.

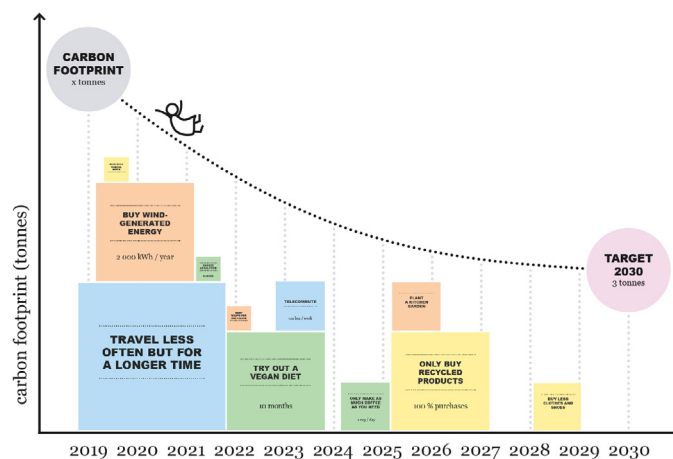
Table 2. The outline of the design game (Nielsen, 2020)

Time	Phase	Activity
15–30 min	Welcome	The participants check-in. One team member expert gives a presentation on relevant concepts related to climate change and lifestyle carbon footprints, and introduces the workshop agenda and the team.
10 min	Intro	The main facilitator gives a short presentation on the background, purpose, and content of the workshop.
30 min	Phase 1	The main facilitator introduces the first task, clarifying the available time and other considerations. Other facilitators help and support the participants with their concerns. The participants choose actions to fill in the gap between the current carbon footprint of an average person and the target for 2030.
15–20 min	Phase 2	The participants place the chosen actions on a timeline from the present until 2030.
10–15 min	Phase 3	The participants are asked to think which options should be promoted by the private sector and the public sector, and distribute separate tags accordingly.
5–10 min	Wrap-up	The participants may ask questions. Thereafter, the facilitators will wrap up the event.

Phase 1. The play board of 1.5-degree lifestyles puzzle presents the carbon footprint of the Average Finn as a square. Inside that square, there is a smaller square indicating the sustainable level of LFC in 2030. The participants choose actions to fill the gap between the current carbon footprint and the target for 2030.



Phase 2. When the gap between the present footprint and the target for 2030 is filled, the participants are asked to place the chosen options on a timeline from the present until 2030



Phase 3. The participants are asked to think which options should be specially promoted by other actors in society, like municipalities or private companies. To indicate their decisions, the participants distribute three tags of a different color to any of their actions.

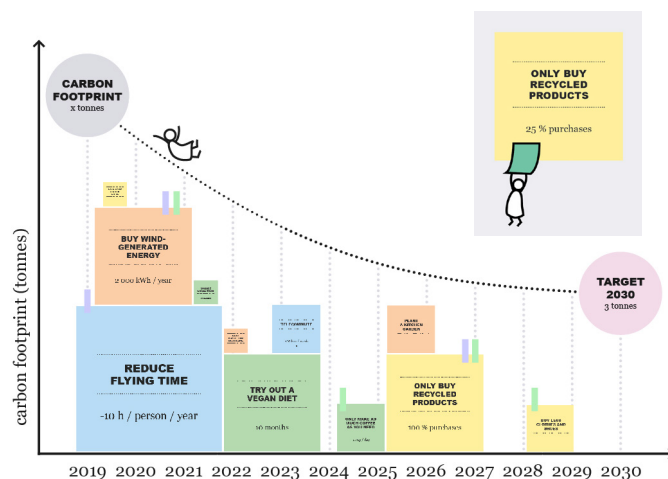


Figure 9. The phases in the first prototype (Nielsen, 2020)

3.4. Criteria 1: Characteristics as a design game

This chapter presents the criteria used for specifying and evaluating the characteristics of the developed design game. These criteria were created to help answer the first research question: *What kind of a design tool could encourage households to transition towards 1.5-degree lifestyles? What are the characteristics of it?* As presented above, the first prototype could be identified as a design game, as it was a workshop process with playful elements. When it was clear to me that the characteristics of the game overlapped with design games, I started looking for literature to help understand design games more profoundly. In this regard, I found the Play Framework by Vaajakallio (2012, discussed in Section 2.5), useful for identifying, specifying, and communicating design games. This framework defines design games as a tool, mindset, and structure (see Figure 10). I use the same breakdown below to specify the features of the developed design game.

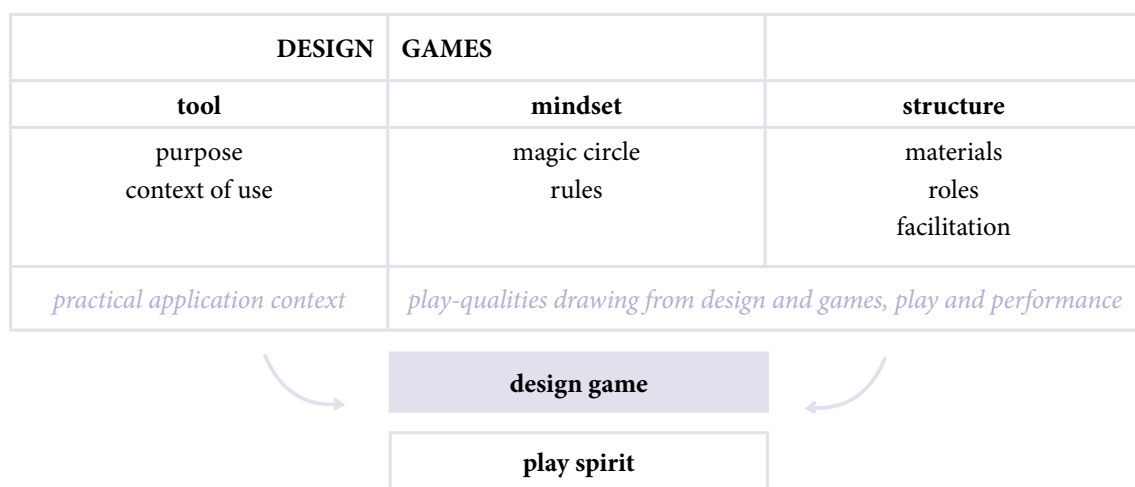


Figure 10. Positioning the game in the Play Framework (adapted from Vaajakallio, 2012)

Design game as a tool

Purpose. Perceiving design games as a tool refers to the purpose of the activity. According to Vaajakallio (2012), design games are tools for addressing context-specific design needs for “organizing dialogue, supporting empathic understanding and gaining several contributions in order to identify, frame and solve design problems” (p. 219). The purpose of design games can be considered as an agenda when the goal is to empower users; an instrument, when the emphasis is on the outcomes; or a competence, when the aim is to explore and improve the design process as elaborated by Vaajakallio (2012) from Keinonen (2009). In line with this description, the initial objectives of this tool can be perceived as to:

1. empower the participants to plan their pathways towards low-carbon lifestyles (agenda)
2. facilitate a collaborative dialogue in constructing new collective and subjective understandings on the topic of 1.5-degree lifestyles (instrument)
3. learn from the process to support in developing the tool and other similar applications (competence).

These aims were tested during the design process.

Context of use. Design games should be flexible in adapting to different contexts (Vaajakallio, 2012), and should not be seen as "toolkits" or replicable methods, because they are always influenced by the participants and the context (Mattelmäki, 2006). Thus, the context of use for the developed design game was planned to be tested with different users.

Design game as a mindset

Magic circle. Perceiving a design game as a mindset refers to attempts at creating "a magic circle" to reach a playful attitude to support creativity, and to help bear feelings of uncertainty (Vaajakallio, 2012). According to Vaajakallio (2012), the magic circle refers to the mental and physical state that is often associated with games and can be created through tangible objects, such as materials, or intangible elements, such as word choices or new perspectives, which create *creative tension*. In this prototype, the overall aim of "the magic circle" is to create an encouraging space to discuss and reflect the participants' life experiences in the past and mirror them towards the future. This is done through activities, which balance between serious and play and reality and fiction. The developed design game was serious in the sense that the players are tackling real-life challenges, but at the same time, it was play, as the activity did not require immediate actions or consequences, hence allowing imagination and creativity to emerge. In addition, the tool also allowed the participants to move between reality and fiction by allowing them to create narratives of their lives in the long-term. These characteristics will be explored further during the field study.

Rules. According to Vaajakallio (2012), game rules are essential for creating a playful atmosphere and giving the structure to the workshop process. In the initial prototype, the rules consisted of the general workshop outline, presentation slides, and the facilitator's manuscript, combined with context-specific requirements for each workshop situation. The rules were continuously adapted and iterated throughout the development process.



Figure 11. The first version of the prototype in use, September 2018 (Nielsen, 2020)

Design game as a structure

Perceiving design games as a structure concerns the play qualities that it possesses, such as workshop materials, facilitation processes, and role division (Vaajakallio, 2012).

Materials. According to Vaajakallio (2012), design game materials can stimulate thinking and dialogue, and support ideation and collaboration. The materials consisted of two playboards, action cards in different sizes, post-its of varied sizes, and pens.

Playboards. The first playboard represented the carbon footprint of an average Finn in relation to the sustainable level of carbon footprint in 2030. The reason for the square-shaped form was to make the action cards fit on the game board to create a puzzle-like experience. The second playboard depicted a timeline from the present until 2030 to allow the participant to design their transition pathways. A downward-looking graph accompanied by a downward-sliding character encouraged to choose actions earlier rather than later. The playboards were printed on art canvas to make them durable and easier to carry around.

Action tiles. The action tiles represented nearly 100 actions for reducing lifestyle carbon footprints based on the household size of an average Finn. The action tiles came in five sizes according to the impact of each action: 35 mm x 35 mm, 70mm x 70 mm, 140mm x 140 mm, 210 mm x 210 mm, 280 mm x 280 mm. As the sizes were multiples of each other, the tiles allowed a puzzle-like experience. The frontside introduced the name and scale of the action, and the backside showcased a description and estimated impact of the action. The different colors of the action tiles represented the different lifestyle domains: food, housing, mobility, and others.

Facilitation. According to Vaajakallio (2012), the facilitator and the design game designer play a major role in the design game process by continuously adapting the process to new contexts. These roles are often overlapping, as facilitating co-design demands skills in reinterpreting the rules, as well as improvising and designing (Vaajakallio, 2012). Thus, in this particular workshop, the design researcher worked initially as the main facilitator but aimed to make others capable of running the workshop towards the end of the process.

Roles. According to Vaajakallio (2012), the different roles given to participants may support the facilitation of creative collaboration, and the role division can be done through role-play or personal immersion. In this particular workshop, the roles were divided according to the three intentions of the design game: agenda, instrument, and competence. The participants were given the roles of designers in drafting their own lifestyles, where the game aims to empower them (agenda). The role of the service providers (e.g. municipalities) and researchers was to gain insight regarding sustainable lifestyles, where the game aimed to enable dialogue (instrument). The role of the design game designer was to gather insight for developing the tool further, where the game aims to provide insight on e.g. user interaction and strategies to play the game (competence)

3.5. Criteria 2 & 3: A design game for promoting 1.5-degree lifestyles

This section introduces two criteria sets, which were prepared for evaluating the design game's potential to promote low-carbon lifestyles. As such, they were intended to help answer the second research question: *What indicates that the developed tool is a valuable method for promoting 1.5-degree lifestyles? What possible effects can it have?* These criteria were prepared after the first prototype of the design game was ready, in order to evaluate the performance and potential impacts and outputs of the design game. These two criteria had slightly different functions. I first introduce the Criteria 2 for evaluating the design game's performance based on insights derived from literature. I prepared this set of criteria myself, based on the objectives and theoretical assumptions that the game was built upon. After that, I introduce the Criteria 3, which helps determine the potential outputs and impacts of the design game to promote 1.5-degree lifestyles. For this purpose, I adopted a framework for evaluating the effects of transdisciplinary transition management processes by Schöpke and colleagues (2017).

Criteria 2: Evaluating of the performance of the design game

This section introduces the criteria for evaluating the performance of the design game, derived from the literature review. These criteria showcase the theoretical assumptions and objectives that the design game was built upon. I prepared these criteria after the first prototype of the design game was created by integrating insights from the 1o5 report, transitions management, practice theory, and design for sustainability transitions (see Chapter 2). In addition, the criteria draw from the SHIFT report (White & Habib, 2018), which outlines the drivers for encouraging ecologically sustainable behavior. Table 3 presents the criteria and the related workshop phases. I use the term *requirement* in this context to avoid confusion with the criteria sets.

Table 3. The requirements related to each workshop phase (Nielsen, 2020)

Code	Phase	Requirement
R1	Phase 1	The design game helps the participants to understand the implications of a normative sustainability target (the target 2030 (and 2050)) in relation to their own individual lifestyles, hence, enabling them to link their present situation on a personal level to the normative vision on a societal level.
R2	Phase 1	The design game helps the participants to perceive the content and scale of multiple actions for reducing their carbon footprint, hence, making the abstract actions and their impacts approachable and actionable.
R3	Phase 2	The design game enables the participants to develop pathways towards low-carbon lifestyles informed by a long-term target, hence, enabling them to think and plan in the long-term.
R4	Phase 3	The design game enables multi-stakeholder collaboration and allows the participants to identify actions the implementation of which requires special efforts from the public and private sector.

R1: The design game helps the participants understand the implications of a normative sustainability target (the targets for 2030 and 2050) in relation to their own individual lifestyles, hence, enabling them to link their present situation on a personal level to the normative vision on a societal level.

This criterion related to the first phase of the workshop, which presented the current lifestyle carbon footprint in relation to a sustainability target. This normative target is adapted from the 1o5 study, which defines the sustainable level of the carbon footprint for the year 2030 and 2050 for reaching the 1.5-degree target of the Paris Agreement. This target sets the ecological limits within which lifestyles can occur, and thus defines the preconditions for reaching other aspects of sustainable living, such as wellbeing and equality (IGES et al., 2019).

The concept of sustainability might seem distant or abstract for individuals to comprehend, which might limit action (Weber, 2010). One way to make these concepts more approachable, relevant, and concrete is through clear communication that connects abstract societal problems with everyday life (Akerlof et al., 2013). In the design game, this is achieved by making the environmental targets, impacts, and actions tangible through visual representations.

R2: The design game helps the participants perceive the content and scale of multiple actions for reducing their carbon footprint, hence, making abstract actions and their impacts approachable and actionable.

This criterion related to the first phase of the workshop, where the participants chose actions for reducing their carbon footprint. The design game aimed to convey accurate information about desired behavior to overcome the challenges regarding information overload, lack of knowledge, and confusion that may restrict the adoption of sustainable behaviors (see White & Habib, 2017). In the design game, pure information provision is combined with visualizations and personal consultation to make the solutions and problems seem more concrete and personal, as advised by White and Habib (2017). The main motivation for providing a multitude of actions is to let the households themselves discover which actions they want to adopt, each aligning with their values, beliefs and personal lifestyles (White & Habib, 2017). This approach can also activate feelings of hope and self-efficacy, which might help overcome the fear that might be caused by the distressing topic (White & Habib, 2017). Furthermore, the action tiles cover all lifestyle domains instead of focusing on one, which might reduce the risk for rebound effects (see Gilby et al., 2019). The action tiles are based on *100 actions to live more sustainably* (Finnish Innovation Fund Sitra, n.d.-a), which were initially developed, tested, updated, and elaborated by Sitra with collaborators.

R3: The design game enables the participants to develop pathways towards low-carbon lifestyles informed by a long-term target, hence, enabling them to think and plan in the long-term

This criterion related to the second phase of the workshop, where the participants created pathways towards low-carbon living. Both DfST and TM approaches emphasize the need to create visions of sustainable futures in the long-term to influence action in the present (Gaziulusoy, 2018; Loorbach, 2010). Loorbach (2010) introduced the TM framework, which included three activities to steer system transitions: strategic activities to create visions, tactical activities to implement actions towards the vision, and operational activities to experiment with new actions. In this design game, all the activities are present: the 1.5-degree aspirational target sets the normative target, and the participants create visions and plan pathways and experiments towards this target.

One can argue that a household is too small an entity for contributing to societal transition processes. However, this design game departs from the practice-theorist perspective, according to which individuals play a key role in reconfiguring and reproducing social practices which leads to changes in socio-technological systems (Shove & Walker, 2010). On an individual level, building pathways involves creating personal commitments, which might trigger sustainable behavior, especially when making them in public (White & Habib, 2017), and tying them to implementation plans (Bamberg, 2002).

R4: The design game enables multi-stakeholder collaboration and allows the participants to identify actions, the implementation of which requires special efforts from the public and private sector.

This criterion referred to the third phase of the workshop as well as to the overall objective of the workshop to create a learning space for stakeholders to envision sustainable lifestyle transitions. The TM approach aims to bring together a wide range of stakeholders to enable empowerment, social learning and social capital development amongst them (Schäpke et al., 2017) for steering transitions. This approach aligns with the results from the research on 1.5-degree lifestyles (IGES et al., 2019), according to which reaching the 1.5-degree aspirational target necessitates radical changes in behavior and in the provision systems that enable lifestyles.

Criteria 3: Evaluating the effects of the design game

This section introduces the second set of criteria for evaluating the design game's potential to promote 1.5-degree lifestyles. After the first prototype was prepared, I found it important to be able to specify what kind of outputs or impacts the design game could produce. It was not reasonable to try to find quantitative indicators for measuring these outputs, as the results of the workshop could only be produced and measured during the workshop situation. Thus, I found *the framework for evaluating the effects of transdisciplinary sustainability projects* by Schöpke and colleagues (2017) helpful. This framework is designed for evaluating the outputs, impacts, and outcomes of transdisciplinary TM processes (see Figure 12). I found it suitable for evaluating the design game for two reasons: first, the developed game draws from sustainability research and transitions management, which the framework aims to integrate. Secondly, the framework has been applied for evaluating similar projects, such as community arenas (e.g., Schöpke et al., 2017).

In this framework, the effects of transitions management projects are differentiated in terms of how immediately they occur (Schöpke et al., 2017): Outputs are direct achievements from a project, impacts are changes from participants' involvement in producing the outputs, and outcomes are societal effects generated from outputs and impacts in the long-term in terms of structural changes. In this thesis, I focus on outputs and impacts as these tend to have tangible results that can be assessed in the timeframe of this study and might indicate the potential outcomes of the project. These effects include *outputs* in terms of tangible and intangible experiences, and *impacts* in terms of social learning, empowerment, and social capital building. Thus, this framework was used for specifying and evaluating the potential outputs and impacts of the design game for promoting 1.5-degree lifestyles.

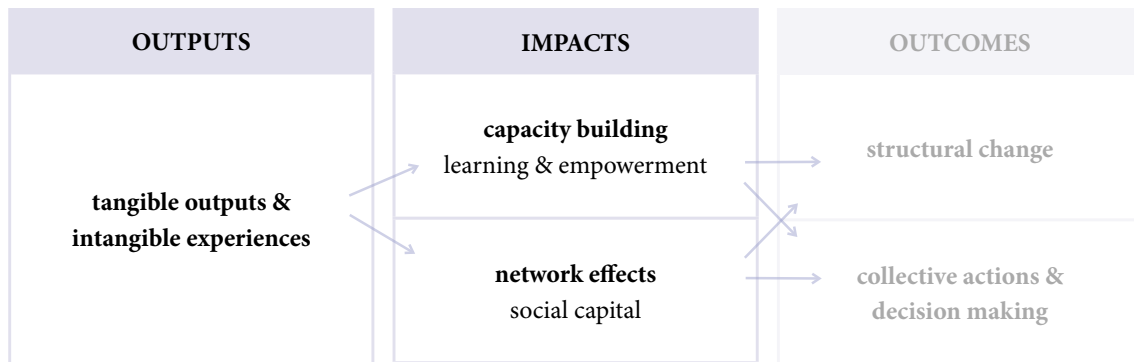


Figure 12. Framework for evaluating the effects of transdisciplinary sustainability projects (adapted from Schöpke et al., 2017)

Summary

This chapter introduced the design process for initiating and creating a design game, as well as three criteria sets for analyzing and evaluating it. These criteria sets are different, but share the same purpose; They help to analyze certain aspects of the design game. Thus, I decided to use the word Criteria to refer to all of them, even though they might not resemble traditional criteria. In the next chapter, the design game is tested and evaluated through using these three criteria as lenses for analysis.

4. Evaluating the design game

4. Evaluating the design game

This chapter presents the field study for testing, improving and evaluating the developed design game. The chapter begins by presenting the general research approach and methodology. Thereafter, I introduce the fieldwork design for conducting the study and specific methods for collecting and analyzing the data. Furthermore, ethical considerations related to the field study are discussed.

4.1. Overview

This section provides an overview of the field study phase, where two aspects were explored: improvement and evaluation. First, the intention of the field study was to improve the design game with several rounds of prototyping and testing. Secondly, the aim was to evaluate its performance in terms of promoting 1.5-degree lifestyles. Thus, the objective was to improve the developed design game in a real-life context and to gather findings to answer the research questions. To achieve both of these goals, the fieldwork was conducted through an action research methodology. This phase included four action research cycles (ARC) of testing, evaluating and iterating. The data was comprised of participant observations from five workshops, and field notes from nine reflection meetings and four co-creation workshops, as well as seven semi-structured interviews. The developed criteria (introduced in Chapter 3) were used as a basis for data collection and analysis. The output from the fieldwork was the final version of the design game, as well as the answers to the research questions. The Figure 13 summarizes the objectives of the field study: To improve the prototype (P1) by releasing new versions, and at the same time evaluate it through three lenses. See Figure 15 for a more detailed picture of the fieldwork design.

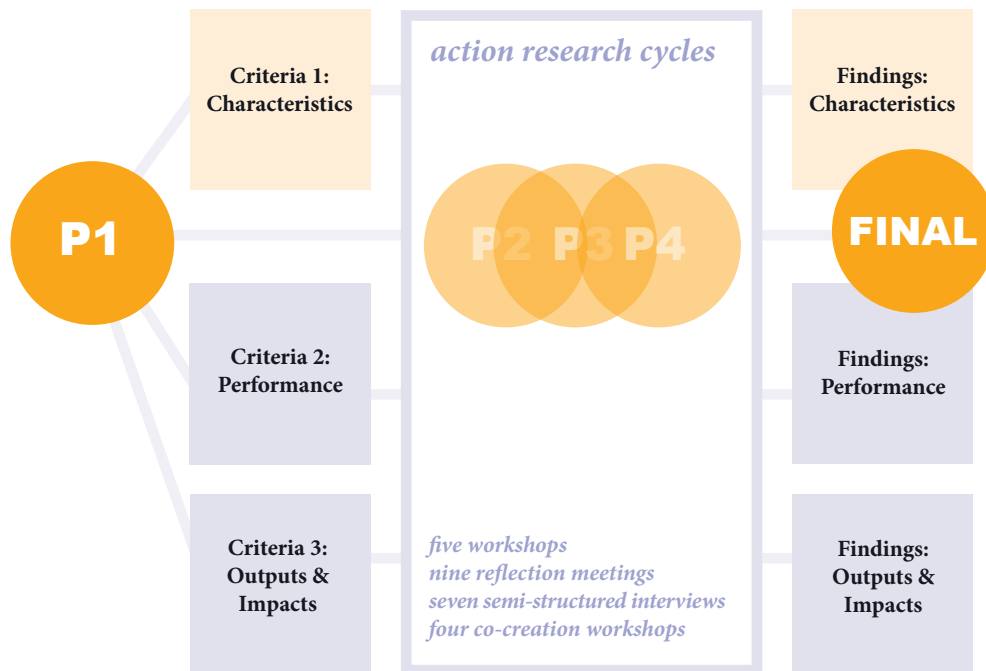


Figure 13. The objectives of the field study (Nielsen, 2020)

4.2. Research approach & methodology

John Creswell (2009) describes the research approach as the plan to conduct research, which involves the philosophical worldview of the researcher, strategies of inquiry (i.e. methodology), and research methods of data collection and analysis. The final choice of research approach is based on these aspects as well as the research problem, researchers' experiences, and their audiences (Creswell, 2009). I followed this approach to articulate the overall research design of the study (see Figure 14).

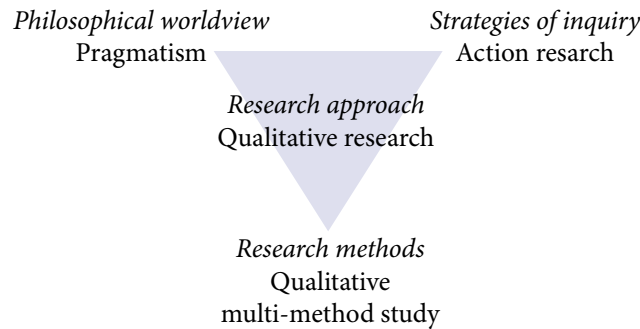


Figure 14. A framework for research design (adapted for this study from Creswell, 2009)

Qualitative research approach

As stated above, the aim of this fieldwork was to improve and evaluate the design game in a real-life situation. Hence, a qualitative research approach was applied in the study, as it can be used for investigating people's "thoughts, feelings, or interpretations of various meanings and processes' that occur in an everyday real-life setting," (Leedy & Ormrod, 2010, p. 135). Furthermore, the qualitative research approach often includes open-ended questions, data collection in a real-life setting, and inductive data analysis (Creswell, 2014), all of which are suitable approaches for collecting and analyzing evidence to improve and evaluate the design game.

Philosophical worldview: Pragmatism

Philosophical worldview refers to the beliefs and attitudes that the researchers hold, which are influenced by, for instance, their academic discipline, values, politics, and past experiences (Creswell, 2009). I discovered that pragmatism best explains my standpoints as a (design) researcher, as it represents a "pluralistic, problem-oriented and real-world practice oriented," (p. 5) worldview, concerned with the effects of actions (Creswell, 2009). According to pragmatism, knowledge-making is a social process of problem-solving, "based on experimentation, learning and context specificity," (Popa, Guillermin, & Dedeurwaerdere, 2015). In pragmatism, methodological choices should be based on evolving values and assumptions, which are constantly reframed through collaborative processes of learning and experimentation (Popa et al., 2015). Consequently, it challenges divisions between theory and practice and knowledge-making and doing (Popa et al., 2015), which aligns with my views on the purpose of design research and transdisciplinary sustainability research, something my academic background builds upon. At a practical level, it stresses the importance of organizing stakeholder collaboration that transforms values and practices (Popa et al., 2015), which aligns with my intentions for this thesis project.

Methodology: Action research

As suggested by Creswell (2009) the choice of methodology should align with the research objectives and conditions, as well as with the research approach and worldview. The aim of this research was to improve and evaluate a method in a real-life context to provide comprehensive answers to the research objective and questions. Hence, the chosen methodology had to fulfill three conditions. First, the methodology should enable the testing and development of the method in a real-life context. Secondly, the methodology should allow participatory processes for shaping the final solution, as the research was conducted in collaboration with the core team. Thirdly, the methodology should enable critical reflection and transparency throughout the research process, to ensure the credibility of the research.

These conditions aligned with the characteristics of action research for the following reasons. In line with the research objective, action research arises from a problem and should lead to an improvement in a real-world situation through an iterative process of reflection and action (Muratovski, 2016). According to Meyer (2000), action research should be participatory, democratic, and result in social contribution, which aligned with the characteristics of this study. Furthermore, Swann (2002) states that in action research, the research subject is situated in a social context, researchers work in collaboration, and the study proceeds through iterative action research cycles, which aligned with the practical requirements of this study. Action research is also compatible with the qualitative research approach (Muratovski, 2016), and is a suitable methodology for conducting design research (Swann, 2016). For the aforementioned reasons, the action research methodology was chosen to be suitable for conducting the study.

According to Creswell (2014), action research typically follows two types of research designs: *practical* and *participatory* action research. Practical action research focuses on addressing a specific immediate problem by an individual practitioner or an internal team. Participatory action research "has a social and community orientation and an emphasis on research that contributes to emancipation or change in our society," (Creswell, 2014, p. 614). Out of these alternatives, participatory action research was selected suitable for this study, as the aim of the study was to improve upon the developed method to empower individuals and organizations.

4.3. Fieldwork design

The fieldwork consisted of five action research cycles, which included five workshops, nine reflection meetings, four co-creation workshops, and seven semi-structured interviews, all of which included their own data collection strategies. Figure 15 showcases all the events for data collection, and these events are explained in the following paragraphs.

The action research process followed the model introduced by Kemmis and McTaggart (2005), which involves iterative action research cycles (ARC) of *planning* a change, *acting* and *observing* the process of change, and *reflecting* on the consequences. The process started with designing the design game to address a societal problem (plan). Thereafter, the design game was tested in a workshop (act), where insights were collected through observation and feedback to evaluate the action (observe). These experiences were reflected in project meetings to evaluate and interpret

emerging issues (reflect), and based on these insights, new prototypes were planned and prepared (plan). Thereafter the process started again with a new prototype. Although the process follows a certain structure, it is not rigid, but cyclic and responsive, as highlighted by Kemmis and McTaggart (2005).

The design process and action research process were not separate from each other; the design process continued throughout the action research cycles when new prototypes were prepared and released in co-creation workshops. Consequently, in this study, the design process described in Chapter 3 formed the first phase of *planning* a change and identifying the research problem in the action research model.

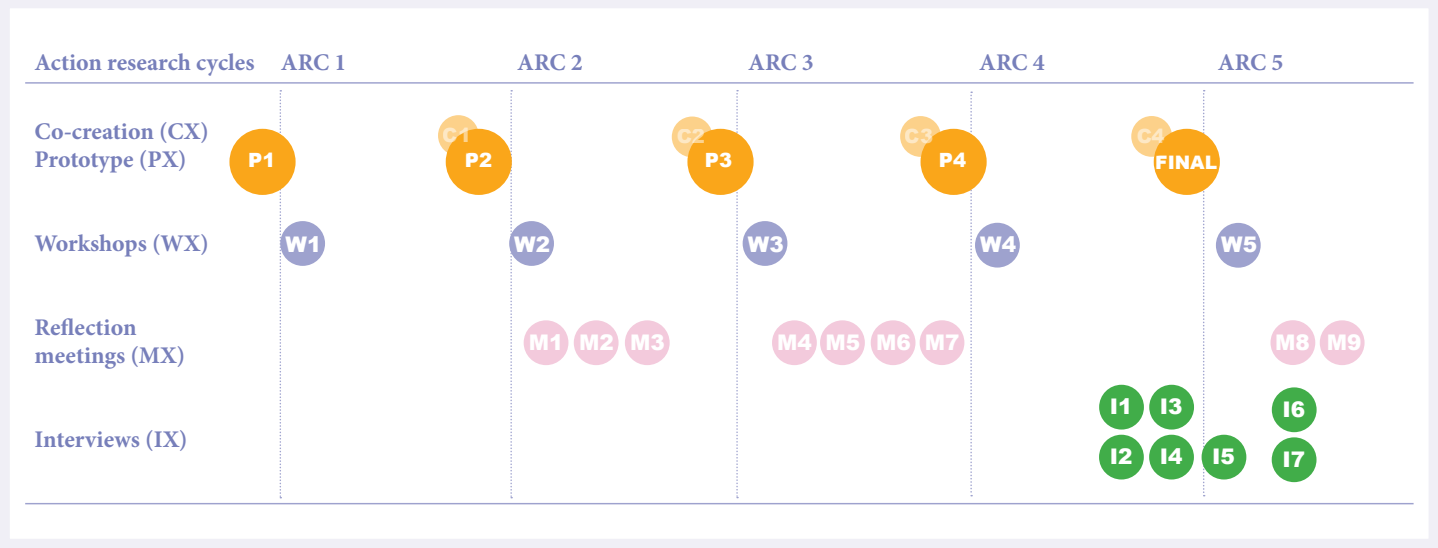


Figure 15. Fieldwork design including ARC and interviews (Nielsen, 2020)

Workshops

The purpose of organizing the workshops was to *test* and *observe* the feasibility of using the design game in different contexts. The workshops were intentionally organized with several user groups in various settings to include a variety of perspectives to develop and evaluate the design game. The expert workshop (W1) and the household workshop (W2) were pre-planned and the participants were recruited in advance by the core team. After receiving positive feedback from these two workshops, a third workshop (W3) was organized to try out the design game in the Japanese context. The participants were recruited by our colleague at IGES, who also helped organize the workshop in practice. The two following workshops (W4 and W5) were organized iteratively to respond to occurring opportunities. All the workshops were prepared separately according to the context-specific needs of the core team and the co-organizers. The researcher was the main facilitator in each of the workshops, accompanied by other facilitators, experts, and co-organizers, who provided further advice and support for the participants. Table 4 showcases the participants and the intention of each workshop.

Table 4. List of workshops during the fieldwork (Nielsen, 2020)

	Aim and participants	Place and time
W1	<p>The workshop was organized with international experts, who were in Helsinki for evaluating the 1o5 report. The objective was to test the feasibility of the game and to gather feedback for improving it.</p> <p><i>Participants:</i> Ten international sustainability experts, eight experts from Sitra, one expert from Aalto University, and five project members participated in the workshop. The experts represented eight countries, and their knowledge of sustainable lifestyles was extensive.</p>	<p>September 27, 2018 at 15:00–16:30 Sitra Headquarters, Helsinki, Finland</p>
W2	<p>The workshop was co-organized with the City of Porvoo as a part of the SLA program. The objective was to test the game in a real-life context. The city wished to gather insights for supporting sustainable lifestyles.</p> <p><i>Participants:</i> Seven households (15 individuals), two city employees, and three project members attended the workshop.</p>	<p>October 8, 2018 at 10:00–12:00 Porvoon Paahtimo, Porvoo, Finland</p>
W3	<p>Two workshops were organized to test the feasibility of the game in the Japanese context. Japan has been one country studied in the 1o5 report.</p> <p><i>Participants:</i> The two workshops consisted of 16 participants from Japan and the UK, and two project members. The participants had double roles as sustainability researchers and households.</p>	<p>November 1, 2018 at 14:00–17:00 IGES Headquarters, Hayama, Japan</p>
W4	<p>The workshop was co-organized with the City of Helsinki and Sitra. The main objective for the organizers was to gather citizens together to discuss low-carbon lifestyles. To enable this dialogue, the workshop tool was complemented with the NextEra dialogue method.</p> <p><i>Participants:</i> In total, 62 individuals attended the workshop, and five experts, seven table facilitators, and the core team provided the participants with further advice.</p>	<p>January 10, 2019 at 17:15–20:00 Oodi Library, Helsinki, Finland</p>
W5	<p>The workshop was co-organized with the city of Valkeakoski as a part of the SLA project. The city wished to support sustainable lifestyles amongst the citizens. We intended to validate the improvements to the prototype.</p> <p><i>Participants:</i> Six households (10 individuals), one city employee, the researcher, and another facilitator attended the workshop.</p>	<p>September 17, 2019 at 17:00–19:00 Voipaala Art Centre, Valkeakoski, Finland</p>

Reflection meetings

The intention of organizing reflection meetings was to *reflect* on the experiences and ideas related to the design game. These meetings were different in character but shared the same function in the research process, and thus, are grouped together in this thesis. Three types of meetings were organized: meetings with the 1o5 team and Sitra (M1, M2, M3, M4, and M8), meetings with external professionals (M6 and M7), and feedback workshops with the participants (M5 and M9). The first mentioned meetings were organized in connection with discussing the 1o5 report, where the aim was to interpret emerging issues and to identify the next steps for action. Meetings M4 and M6 were set to discuss possibilities for using the design game, and meetings M7 and M9 were intended to elaborate on the workshop experience with workshop participants. The data was collected through field notes (see Section 4.4) and analyzed qualitatively (see Section 4.5). I was a participant in all these meetings, and sometimes facilitated the discussions and at other times took on the role of an observer. Table 5 showcases the intention and the participants of each meeting.

Co-creation workshops

The action research cycles (ARC) included a phase for "planning a change", which was conducted through co-design and prototyping with the core team. The aim of these workshops was to synthesize the results from the reflection phase and to collaboratively improve the prototype. The reason for choosing this method was based on the notion that co-design allows different stakeholders to participate in the design processes to address complex societal problems (see Muratovski, 2016). Moreover, it enables a participatory and democratic research process, which is in line with the characteristics of action research methodology (Meyer, 2000).

In these co-creation workshops, new prototypes were prepared. As discussed in Chapter 3, prototypes work as research tools in this research process. This process included several activities, such as updating the background data for informing the impact of each action, summarizing and translating texts for each action and designing and ordering new sets of action cards and play boards. Furthermore, the distinctive phases of the workshop were updated and presentation slides, introductions, and speeches updated accordingly. The co-creation workshops included primarily the core team complemented by external actors. The co-design sessions were organized according to context-specific needs for improving the design game or for applying it to new situations. In these meetings, data was collected through field notes and generated by producing new prototypes. The main outcome of the sessions was the refined prototypes, including workshop materials and outlines.

Table 5. List of reflection meetings during the fieldwork (Nielsen, 2020)

	Content and participants	Date
M1	The project meeting with the 1.5 degree-lifestyle team consisted of the 1o5 team accompanied by the design researcher. The aim was to discuss how to adapt the design game in the Japanese context.	October 1, 2018, Aalto University, Espoo
M2	The 1.5-degree lifestyles project meeting consisted of the research team and three representatives of Sitra and evoked discussions on what researchers and stakeholders can learn from the developed game.	October 12, 2018, Sitra HQ, Helsinki
M3	The expert meeting consisted of the 1o5 team, the researcher, and one outside expert, who had been involved in the expert workshop in Helsinki. In this meeting, we focused deliberately on discussing the benefits and challenges if the design game.	October 26, 2018, Tokyo, Japan
M4	The 1.5-degrees project meeting consisted of the 1o5 team, the researcher, and three representatives from Sitra. The aim was to reflect experiences from Japan and discuss the context of use for the game.	November 14, 2018, Sitra HQ
M5	The workshop was organized for sharing results and gathering feedback on the experience of participating in the workshop (W2) and subsequent experimentation period. The workshop involved 12 individuals, three company representatives, one city employee, and the core team.	November 21, 2018, Porvoo Art Factory, Porvoo, Finland
M6	The SYKLI meeting consisted of three experts in the field of environmental education. This meeting provided valuable insights regarding the play-qualities and context of use for the game.	December 11, 2018, Sykli, Helsinki
M7	The planning meeting with the city of Helsinki and Sitra was initiated by Sitra to plan a co-organized workshop. The meeting consisted of two experts from Sitra, four representatives from the city, and the core team.	December 17, 2018, City of Helsinki
M8	The Sitra meeting was organized with two representatives of Sitra and two representatives of the core team, with the aim to reflect workshop experiences and to discuss how the game could be turned into a web-based tool.	October 2, 2019, Sitra HQ, Helsinki
M9	The workshop was organized for sharing results and gathering feedback on the experience for participating in the workshop (W5) and the following experimentation period. The workshop consisted of eight individuals and one municipality representative, and the researcher and one project member facilitated it.	November 6, 2019, Voipaala Art Centre, Valkeakoski, Finland

4.4. Methods for data collection

The methods for data collection involved participant observation at workshops, field notes in reflection meetings and seven semi-structured interviews. The aim of this method was to gather insight into both improving and evaluating the performance (criteria) and characteristics (design criteria) of the design game. Consequently, a qualitative multimethod approach was adopted in this study, as it enables greater flexibility in investigating new ways of understanding people, artifacts, and events, allowing for both the generation and confirmation of research findings (see Muratovski, 2016), in line with the research objective. Furthermore, the data collection methods were chosen to align with the action research methodology to enable improving and evaluating the design game to a real-life context (see Muratovski, 2016).

Participant observation

Participant observation was chosen as suitable for gathering data during the workshops, as it allows for the observation of how people interact with certain spaces or artifacts in a real-life situation (see Muratovski, 2016). Observation is a data collection technique for systematically following and documenting a certain situation, which according to Crouch and Pearce (2012) can be used for improving a particular design (Muratovski, 2016). The main benefit of observation is that unexpected aspects can be observed (Creswell, 2009).

According to Muratovski, observation techniques can be divided into *direct observations* and *participant observations* (Muratovski, 2016). Out of these alternatives, *participant observation* was selected suitable for this study, as it allows the researcher to work as a facilitator while simultaneously collecting data (see Muratovski, 2016). Furthermore, it allows for discussions with the participants on their experiences while observing. In participatory observation, the researcher engages in the research situation, while striving to maintain objectivity (Muratovski, 2016).

Conducting the observations. Qualitative observations included taking field notes and photographs on the behavior and activities in workshops and reflection meetings, as advised by Creswell (2009). The observation in workshops was conducted concerning two domains, "behavior and interaction" and "structures and settings", as advised by Muratovski (p. 64). The *structures and settings* involved observing physical circumstances, such as interiors and lighting, of the workshop space, as well as the social and emotional atmosphere in the workshop situation. The behavior and interaction refer to observing participants' interaction with the gamewW materials, as well as the interaction between the participants and other stakeholders in the space. Furthermore, reactions to the workshop phases and facilitation were written down. Additionally, direct feedback and comments were documented.

I collected the field notes in a semi-structured way following pre-planned questions (see Appendix A). Directly after a workshop situation, I wrote down first impressions and insights in a project log. This log contained practical information regarding each workshop, including the duration of the workshop and the number of participants. The participants and duration of each workshop and reflection meeting are introduced in section 5.2.

Fieldnotes

Field notes were used as a data collection method in reflection meetings and during co-creation workshops. Writing field notes is a data collection method for recording behaviors, discussions and other aspects during a specific research situation (Schwandt, 2015). The objective of the field notes is to provide evidence that the researcher can use to create a broader understanding related to the topic at hand (Schwandt, 2015). Furthermore, this method may supplement other data collection methods, such as interviews and observations (Schwandt, 2015), which aligned with the intention of this study.

The researcher plays an important role in deciding what to document in the research situation, which should, therefore, be determined in advance (Wolfinger, 2002). Emerson and colleagues (1995) suggest two strategies for taking field notes “the *salience hierarchy* or *comprehensive strategies*” (Wolfinger, 2002, p. 93). The first one refers to recording the most interesting and perceptive insights, and the latter one to systematically documenting everything that occurred in the research situation.

Writing fieldnotes. More specifically, I focused on collecting insights regarding the characteristics and performance of the game, in line with the research questions. Furthermore, I also wrote down new ideas and thoughts that emerged, sometimes accompanied by sketches. I participated in these meetings myself, which enabled me to ask clarifying questions related to some observations. The field notes consisted of both descriptive and reflective information. The former refers to facts related to the research situation, such as the intention, time, location, and participants of the reflection meeting. The latter refers to documenting my thoughts, impressions, and other observations during the research situation.

Prototyping

As explained earlier in this section, the design process continued throughout the action research cycles in co-design workshops. In these sessions, prototyping was used as a method for continuously improving the developed design game. In prototyping, knowledge is both generated and collected through producing novel and improved versions of a specific concept. Thus, prototypes work as experimental research tools that enable the engagement of the participants (Miettinen et al., 2014). This method is not in the portfolio of traditional research methods but is a common method of design research and practice for making ideas tangible, to explore people's perception, interaction, and experience of an idea (Wensveen & Matthews, 2014). The practical use of the method was described in Chapter 3.

Semi-structured interview

Seven semi-structured interviews were conducted to validate the insights from observations and field notes to gain an in-depth understanding of participants' experiences. The purpose of the interviews was to gather the views and experiences of many stakeholders regarding the design game. In particular, I was interested in gaining more insight regarding the potential competencies, capabilities or actions that stemmed from the workshop experience as well as hearing the participants' overall experience with participating in the workshop. The reason for choosing

this method was that it allows for examining people's views, feelings, and attitudes profoundly (Muratovski, 2016). Furthermore, it allows the researcher to focus on the most essential aspects of the research (Creswell, 2009), and can be used for complementing other data collection methods (Muratovski, 2016). The main advantage of conducting interviews is that the participants can freely express their personal and professional knowledge and experiences regarding the topic (Creswell, 2009).

The interview types differ in their structure, formality, and number of participants (Muratovski, 2016). In this study, the most suitable type was the semi-structured interview, as it allows the researcher to gain a deeper understanding of the respondents' experiences regarding the studied phenomena without guiding the respondent (see Brinkmann & Kvale, 2018). This is a flexible form of interviewing, which has pre-planned themes and some suggested questions but can be adapted along with the study (Brinkmann & Kvale, 2018).

Conducting the interviews. Planning and conducting the interviews followed the seven stages proposed by Brinkmann and Kvale (2018) including “thematizing, designing, interviewing, transcribing, analyzing, verifying and reporting” (p. 55). All the stages were planned prior to the interview process to obtain the intended knowledge and to ensure credibility in the study. As advised by Brinkmann and Kvale (2018) the process began by *thematizing*, which included clarifying the purpose of the study and preparing the interview themes based on the research questions (see Appendix A).

In the second phase, *designing*, I identified the potential participants and recruitment procedures, ethical considerations, as well as practicalities for the interviews. To build a more comprehensive picture of workshop experiences, it was beneficial to interview a variety of stakeholders. Thus, seven interviews were conducted with eight respondents, who represented different stakeholder groups (see Table 6). The respondents K1 and K2 attended the same interview. I contacted the potential interviewees via email and briefly explained the purpose and content of the interviews and outlined ethical considerations. After reviewing the answers of the participants, we agreed on the time and place for the interviews according to the participants' wishes, to make them feel comfortable in the interview situation. The ethical considerations involved preparing informed consent for the participants to secure the confidentiality of the subjects (see Appendix B). Furthermore, I drafted interview questions and guides for different stakeholder groups. In the participant interviews, the interviews concerned the overall workshop experience, the potential new competencies or capabilities it resulted in, as well as the challenges related to sustainable lifestyles. In interviews with the city employees and the research team members, their experiences related to the development process were also discussed.

Table 6. The interview participants (Nielsen, 2020)

Code	H1	H2	K1	K2	K3	K4	I1	I2
Respondent	City employee	City employee	Participant household	Participant household	Participant household	Participant household	Research team	Research team

The *interviewing* began by introducing the purpose of the interview, the obtainment of informed consent, and the conditions for the study. The interviews were recorded with both a voice recorder and a mobile phone to secure the quality of the recording, and to allow the researcher to play the recording again several times to ensure the reliability of the results (Brinkmann & Kvale, 2018). Furthermore, the first reactions of the interviews were documented immediately after the interview to provide a richer picture of the subject's experiences than the transcribed text would allow (Brinkmann and Kvale, 2018). The duration of the interviews varied between 30 and 40 minutes. The language for the interviews was Finnish for six interviewees, and English for one interviewee. After the interviews, I *transcribed* the interviews in their entirety to written form, resulting in approximately 50 pages of transcripts. Thereafter, I created separate sets of data for each participant including the transcripts, the first impressions, and practicalities. The phases of *analyzing*, *verifying*, and *reporting* are discussed in detail in the following section.

4.5. Qualitative data analysis

This section introduces the method for data analysis, the data content, and the analysis process. The aim of the analysis was to gather findings from the collected data to evaluate the game's characteristics as a design game (Criteria 1), its potential contribution to sustainability (Criteria 2 and 3). The qualitative raw data consisted of seven interview transcripts, observation documents, and pictures from five workshops and nine reflection meetings. The data analysis is explained in detail to enable the reader to judge the credibility of the generated results.

Thematic analysis

Thematic analysis was found suitable for conducting the analysis, as the data amount was large and came from multiple sources and participants. According to Braun and Clarke (2006), "[t]hematic analysis is a method for identifying, analyzing, and reporting patterns (themes) within data" (p. 6), with the aim to categorize and describe the collected data in a comprehensive manner to better understand the studied phenomena (Braun & Clarke, 2006). According to King (2004), thematic analysis is a relevant method for summarizing findings from a large data set through systematic inquiry. Furthermore, it allows for the comparison of the diverse perspectives of several research participants for producing unanticipated findings (King, 2004). In addition, thematic analysis is applicable to many types of research questions and epistemologies (Nowell, Norris, White, & Moules, 2017). Thematic analysis can be conducted in various ways (Braun & Clarke, 2006). In this study, I follow the process delineated by Nowell and colleagues (2017), as described below.

Data content

The interview and observation questions for data collection were drafted based on the developed criteria sets (see Chapter 3) to gather findings related to the game's characteristics, performance, and potential impacts and outputs. The aim of the first criteria was created to specify and evaluate the characteristics of the design game. Thus, the interview and observation questions were based on the Play Framework, which provided three levels for perceiving design games as a tool, a

mindset, and a structure (Vaajakallio, 2012). The aim of the second criteria set was to evaluate the design game's performance. In line with this intention, the interview and observation questions were prepared based on the evaluation framework by Schöpke and colleagues (2017), which helps to evaluate the effects of transdisciplinary transition management processes (see Chapter 3). These effects include *outputs* in terms of tangible and intangible experiences, and *impacts* in terms of social learning, empowerment, and social capital building.

Data analysis process

As data analysis can be perceived as the most complex part of the qualitative research process (Thorne, 2000), researchers need to conduct it in a systematic way to attain trustworthiness and credibility in the research process (Nowell et al., 2017). Due to the flexible nature of the thematic analysis, it was particularly essential to ensure consistency in the process. Thus, the analysis was conducted by following the six-step approach proposed by Nowell and colleagues (2017), which suggests techniques to carry out a reliable and trustworthy thematic analysis in a multi-method study to ensure its trustworthiness.

Preparation. Before starting the analysis, I read through all the collected data to build a coherent picture of its content, as advised by Nowell and colleagues (2017). I decided to analyze the interview transcripts, field notes, and observation notes separately, due to the large amount of data. I chose to approach the material following a data-driven, inductive logic, as it allows for one to reflect on participants' experiences and feelings without reducing them to the existing themes. Furthermore, inductive analysis enables considering data that conflicts with previous assumptions with an open mind (Nowell et al., 2017). According to Holloway and Todres (2003), the downside of this approach is that the number of generated themes can be extensive, and they may lack structure (Nowell et al., 2017). To overcome this, I applied hierarchical coding as suggested by King (2004), according to which the most relevant themes were analyzed in more detail.

Generating codes and theme reports. I started the analysis by reading through each individual document and *generating initial codes* with color-coding. It was not feasible to identify specific words for coding, as they would reduce the human experience. Instead, I categorized color-coded emergent *themes* in a systematic manner, as advised by Creswell (2014). Thereafter, I combined the color-coded themes in each document into coherent theme descriptions and complemented them with a summary and select quotations, to describe separate experiences and ideas. Finally, I re-read the original document and supplemented the theme descriptions with new observations. Additionally, I created the miscellaneous theme to accommodate all the codes that did not fit elsewhere, as advised by Braun and Clarke (2006). Thereupon, I started searching for themes between the individual documents. Once similar themes were identified, I combined them under common subheadings in a new document. This phase involved comparing the original documents with the identified themes to avoid manipulation of research results. Once all the theme descriptions were gathered under separate subheadings, I compiled them into *theme reports*. These reports gave me an overview of the typical and exceptional elements of the material. Table 7 shows the identified themes from the interviews.

Table 7. The identified themes in each interview (Nielsen, 2020)

Theme / Respondent	H1	H2	K1	K2	K3	K4	I1	I2
1a. Workshop phases	••	••	••	••	••	•	••	••
1b. Workshop experience	••	••	••	••	•	•	••	•
2a. Mindset & thinking	•	••	••	••	••	•	•	•
2b. Experimentation & action	•		••	••	••	••		
3. Target group & context		•	••	••	••	•	••	•
4. Motivation & challenges	•		••	••	••	••	•	•
5. Spreading the impact	•	•	•	•	•	•	••	••
6. Stakeholders & responsibility	••	••	•	•	•	•	••	•
7. Development process							••	•

Reviewing the themes through two lenses. Once the theme reports were compiled, they were analyzed through three criteria sets to evaluate the game's characteristics as a design game and its performance to promote low-carbon lifestyles in accordance with the research questions. In terms of analyzing the characteristics of the design game (Criteria 1), they were compared with the Play Framework (Vaajakallio, 2012) to identify whether they matched with the characteristics of design games. In practice, this included gathering findings from the derived theme reports related to the rules, roles, materials, and the overall workshop experience. The primary data source was the observation notes, which captured the overall experience of multiple workshops. The data derived from interviews complemented these results with stakeholders' perspectives.

In terms of analyzing *the design game's potential to promote 1.5-degree lifestyles*, I used the two criteria sets (Criteria 2 and 3) elaborated in Chapter 3. Regarding Criteria 2, I gathered findings to evaluate the game's performance. When evaluating the data through Criteria 3, I collected findings related to the potential outputs and impacts of the game. The primary data source for this analysis were the interview transcripts, which provided detailed descriptions of the stakeholders' experiences and concerns related to the design game. The observation notes from workshops and field notes from reflection meetings complemented these insights. The findings are reported and discussed in Chapters 5 and 6.

4.6. Ethical considerations

This section discusses the ethical considerations related to the study. These considerations are especially important in this study, as it included human participants. These considerations concern the autonomy of the research participants, avoiding harm, and the handling of data, in line with the recommendations from the National Advisory Board on Research Ethics (2009) in Finland.

The autonomy of the research participants. Participation in the research was voluntary, and the participants could withdraw from the study at any stage. Furthermore, they were informed about the research and the use of collected data. The informed consent forms were prepared for and signed by all of the participants during the interviews (see Appendix B). This form included the research topic, the purpose of the meetings, the method of data collection and the required time, the use of data, the voluntary nature of participation, anonymity, and my contact information. The participants could review direct citations from their interviews used in this report if they wished to do so.

During participant observations, the consent was given by the participant's willingness to take part in the research. The participants were informed about the study at the beginning of each workshop. The informed consent form was not prepared in a written form, as the research was not expected to cause any distress for the participants, and I did not collect any personal information from the participants for research purposes. In reflection meetings, all the participants were informed about the research. I did not collect any personal information from the participants. The study did not involve minors. All the participants were able to decide their participation autonomously. All the participants were presented anonymously in the report. Only the interviewee's position was mentioned, which was also agreed upon with them in advance. The 1o5 team is introduced in this report, as their participation in the study was evident due to the collaboration.

Avoiding harm. I possessed a dual role as a participant and researcher during data collection. Thus, I affected the research participants with my presence. I treated all the research participants politely and with respect during the interviews and participant observations. Moreover, all the data from the participants is presented respectfully.

Handling of data. I was the only person handling the interview records and transcripts and archived them on my computer. The observation notes and fieldnotes from workshops and reflection meetings were collected and filed by me. However, they were also used for improving the game with the core team.

5. Results

5. Results

This chapter introduces the findings from the fieldwork in terms of improvement and evaluation. The first section of this chapter (Section 5.1), provides an overview of the improvements to the design game and presents the final refined prototype. The second section (Section 5.2) presents findings related to the game's characteristics as a design game in line with the first research question (Criteria 1). The third section (Section 5.3) introduces findings related to the design game's potential to contribute to 1.5-degree lifestyles in line with the second research question. The evaluation is introduced in two phases. Firstly, I evaluate the design game against the requirements that was developed based on insights from the literature (Criteria 2). Secondly, I use an evaluation framework proposed by Schöpke and colleagues (2017) for specifying the potential effects of the design game to promote low-carbon lifestyles (Criteria 3).

5.1. Improvement

The design game was improved through five action research cycles (ARC) during the field study. This section introduces the improvements made during each action research cycle, and, after that, presents the revised workshop outline and prototype. All the improvements are described in detail to enable the reader to assess the validity of the design decisions (Nowell et al., 2017). The four phases of the design game are introduced in the next subsection. Figure 16 showcases the implemented changes during each ARC.

ARC 1	ARC 2	ARC 3	ARC 4	ARC 5
context - adapting to several household sizes phases - adding the fourth phase (R4) facilitation - editing the presentation	context - adapting to Japan phases - editing the third phase (R3) materials - new action tiles and play boards for Japan	context - adapting to mixed groups phases - editing the fourth phase (R4) materials - translating to Finnish - visible scale for play boards - updating target for 2030 (R1) facilitation - updating the slides and the presentation	materials - updating the action tiles - proofreading texts - refining play boards facilitation - shortening introduction - preparing instructions and facilitation manual	presentation - editing the introduction materials - new action tiles and smaller play boards for preparation

Figure 16. Changes during each ARC (Nielsen, 2020)

Changes during each ARC

ARC1. The action research cycle included one expert workshop (W1) and one co-creation workshop (C1) with the core team. This ARC provided the opportunity to test and develop the design game with experts before testing it with real households. The design game was well received by the participants and evoked discussions around the urgency for actions for reaching the target for 2030. Based on participant feedback, the design game was adapted to different household sizes instead of the Average Finn, as the average value might be hard to perceive, and the action tiles might not be relevant for many households. Besides, some considerations, such as explaining overlapping actions, were added to the introduction. Besides, we added a third phase, where households could choose actions to implement.

ARC2. The second action research cycle consisted of one household workshop (W2), reflection meetings with the 1o5 team and Sitra (M1, M2, M3), as well as a co-creation workshop with the core team (C2). Thus, this ARC provided an opportunity to try out the design game in a real-life context. In the workshop (W2), the overall atmosphere was enthusiastic, and all the households fulfilled all the four phases, which indicated that they were found relevant. Most of the participants could reach the 2030 target, and one household, even the 2050 target with their actions, thus, showcasing that the task was reasonable. Based on the workshop (W2) and participant feedback session (M3), we edited the action tiles and added new considerations to the introduction. Besides, the third phase was made more understandable. The meeting M2 evoked discussion on the possibility to use the game as a data collection tool, and for testing it with ministries. According to the reflection meeting M3, the design game could be used with households, municipalities, and educators for evoking dialogue, and with municipalities to justify their policies. The aim of the co-creation workshop (C2) was to adapt the design game to another cultural context. In practice, this included making another version of the design game based on Japanese lifestyles with the help of our Japanese colleague.

ARC3. This ARC consisted of two workshops in Japan (W3), four reflection meetings (M4, M5, M6, and M7), and one co-creation workshop (C3). This ARC lasted approximately three months, which gave some time for reflection and improvement. In workshop W3, the design game gained positive and constructive feedback from the Japanese participants. According to them, it helped to bridge lifestyle options and domains and, thus, enhanced systems thinking. The participants came up with ideas for new action tiles and with contexts of use for Japan, including schools, universities, and housewife communities, as well as municipalities and government.

Besides, the reflection meetings provided valuable input for refining the workshop. The environmental educators (M6) ideated possibilities for gamifying the experience by giving participants random actions, which they need to negotiate. The expert meeting (M4) and feedback session (M5) evoked discussions on the possibilities for developing a similar digital tool for reaching larger audiences. Digitalization also evoked concerns, as the tangibility and interactivity of the design game were found valuable. This ARC initiated some changes in the action tiles, and the playboards were edited to include a visible scale for marking the carbon footprint. Furthermore, the target value for 2030 was updated in line with the research results from the 1o5 report. In

preparation for the next workshop, we translated the action tiles into Finnish and updated the workshop outline and speeches. Moreover, the fourth phase of the workshop was updated to accommodate mixed groups.

ARC4. This ARC consisted of one workshop (W4), and co-creation workshops (C4). The workshop included 72 participants and ten organizers from Sitra and the city of Helsinki. This ARC provided an opportunity to try out the game with a broader audience, who were seated in mixed groups. This approach showed to trigger co-learning and peer support amongst the participants, as well as amusing moments when participants pitched potential actions to each other. The feedback from the participants was positive. They were excited, and many came to ask possibilities for playing the game at their workplaces. In the co-creation workshop, both the English and Finnish versions of the game were reproduced. This process included updating the impact size and text content of the action tiles and refining the playboards.

ARC5. The fifth ARC included one workshop (W5), one feedback session (M9), and an expert meeting with Sitra (M8). This final ARC helped to validate the changes made during the earlier stages. Thus, the refined design game and prototype were received well in the workshop and the reflection meetings. In the workshop (W5), all the participants fulfilled all the tasks and seemed to receive the instructions thoroughly. The atmosphere was relaxed, and the small size of the group enabled asking questions one-by-one. Only the correctness of footprint calculations evoked concern, which enhanced the importance of matching the calculations with the provided actions. In feedback session E9, the participants reported that the workshop experience W5 was found valuable and hoped the game could be distributed to several contexts. In the reflection meeting (M8), the participants were convinced of the functionality and effectiveness of the design game, as it made people think and allowed for personalized planning of emission reductions. According to them, several schools and companies had asked to play it online, indicating the design game's feasibility in a digital context. After this ARC, we edited a couple of phrases in the presentation slides, but otherwise, the design game was found successful. Thus, a facilitation manual was prepared based on this version.

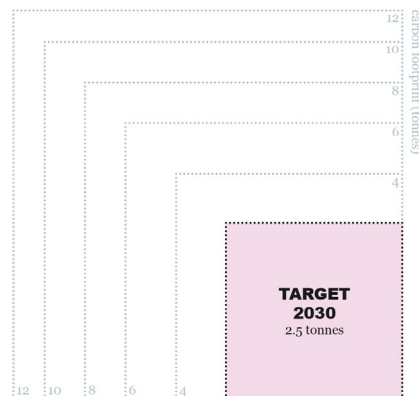
The refined design game

The final prototype, *the 1.5°C Puzzle*, is an interactive design game for encouraging a transition toward lifestyles within the confines of a 1.5-degree Celsius rise in temperature. The purpose of this design game is to help households perceive the ideas, opportunities, and challenges of 1.5-degree lifestyles, as well as to inspire them to move towards low-carbon living. Table 8 introduces the refined workshop agenda, including the time and content of each workshop phase. Figure 17 describes the design game in detail with accompanying pictures. The parts that are marked with *italic* were changed or added during the fieldwork. See Appendix C for the presentation slides and Appendix D for the texts of the action cards. They are written in Finnish as the latest version of the game was prepared in Finnish.

Table 8. *The refined workshop outline (Nielsen, 2020)*

Time	Phase	Activity
15–30 min	Welcome	The participants check-in. One team member expert gives a presentation on relevant concepts related to climate change and lifestyle carbon footprints, and introduces the workshop agenda and the team.
5 min	Intro	The main facilitator gives a short presentation on the background, purpose, and content of the workshop.
25–30 min	Phase 1	The main facilitator introduces the first task, clarifying the available time and other considerations. Other facilitators help and support the participants with their concerns. <i>The participants (calculate and) mark the size of their carbon footprint on the board. Thereafter, they choose actions to fill in the gap between their current carbon footprint and the target for 2030.</i>
10–15 min	Phase 2	The participants place the chosen actions on a timeline from the present until 2030.
10 –15 min	Phase 3	The participants are asked to think which options should be promoted by the private sector and the public sector, and distribute separate tags accordingly.
10 –15 min	Phase 4	<i>Alternative 1. The participants choose three actions that they would like to implement immediately and write them on a card. Alternative 2. The participants choose actions for the experiment period.</i>
5 –10 min	Wrap-up	The participants may ask questions. Thereafter, the facilitators wrap up the event.

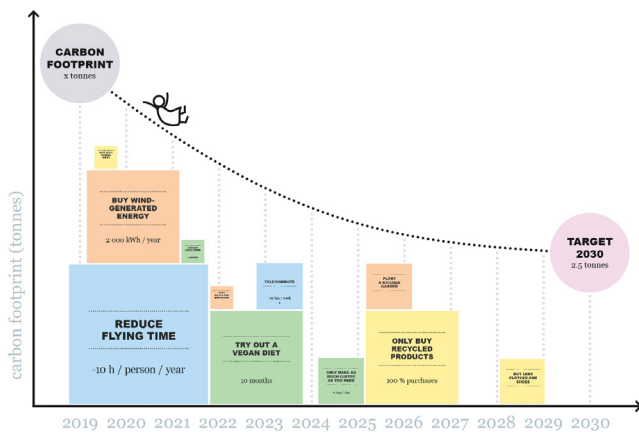
Phase 1a. The participants mark the size of their carbon footprint on the play board with a marker. Inside the footprint, there is a pink square indicating the 2030 target.



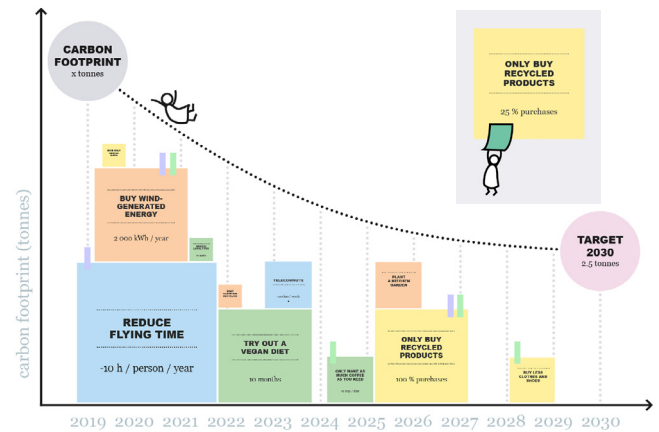
Phase 1b. The participants choose actions to fill the gap between their current carbon footprint and the target for 2030.



Phase 2. When the gap between the present footprint and the target for 2030 is filled, the participants are asked to place the chosen options on a timeline from the present until 2030.



Phase 3. The participants are asked to think which options should be specially promoted by other actors in society, like municipalities or private companies. To indicate their decisions, the participants write their wishes on different color to any of their actions.



Phase 4. The participants choose actions that they would like to implement directly and plan what competences, investments, and behaviours are needed for realizing them.

Name of the action	Savings in carbon footprint	How will I implement the action? e.g.: new competences, resources, investments, etc.
1		
2		
3		

Figure 17. The refined workshop phases (Nielsen, 2020)

5.2. Findings: Characteristics as a design game

This chapter introduces the research findings regarding the game's characteristics as a design game in line with the first research question. The evaluation was conducted by comparing the developed design game against the Play Framework presented by Vaajakallio (2012), according to which design games can be perceived as a tool, a mindset, and a structure.

The design game as a tool

Purpose. Perceiving design games as a tool refers to the purpose of the design activity. In line with the objectives of design games (Vaajakallio, 2012), this design game functioned as an agenda, instrument, and competence. The refined aim of the design game was to

1. enable the participants to understand the abstract targets and options for sustainable lifestyles and to plan their pathways towards low-carbon living (agenda)
2. facilitate dialogue for constructing new collective and subjective understandings on 1.5-degree lifestyle transitions (instrument), and to support policymaking by providing a bottom-up approach for collecting information and ideas on how to promote sustainable living (instrument)
3. explore the design game to support e.g., development of a digital version of the game (competence)

Context of use. The design game was adapted to two different contexts: amongst individual households as a planning tool (W2 and W5) and in mixed groups as a discussion tool (W1, W3, and W4). Based on participant observations and interviews, the design game showed to be an effective method in both these contexts. In the mixed groups, it worked as an effective method for bringing the climate targets to a personal level and evoking discussion amongst the participants around plausible solutions. In the individual household workshops, it was a feasible method for the participants to choose their actions and plan their pathways towards low-carbon lifestyles. What further strengthens this evidence is that the design game evoked broad interest amongst the participants to organize further workshops. Hence, the workshop proved to be an effective method for staging collaboration to fulfill contextual needs, which aligns with the goals of design games (Vaajakallio, 2012).

The design game as a mindset

Magic circle. In line with design games, this game intended to create a learning space, the "magic circle", to enhance a playful atmosphere and help bear feelings of uncertainty and discomfort. Based on both observations and interviews, participants were satisfied with the workshop, and even though the topic was sensitive, all participants went through each phase. According to the respondents, the overall atmosphere in the workshop was perceived as enthusiastic. Respondent H1 describes: "I think the atmosphere was really relaxed (...) sort of the harmony between the people and how excited they were from the start." Along similar lines, respondent I1 states that the expert workshop "facilitated mutual discussion (...) it created that kind of mutual learning atmosphere." These insights indicated that the workshop was able to create a safe, engaging, and playful environment in which the participants were able to reflect their lifestyles.

Serious–play, reality–fiction. According to the Play Framework (Vaajakallio, 2012), the "magic circle" can be generated through activities, which balance between serious and play and reality and

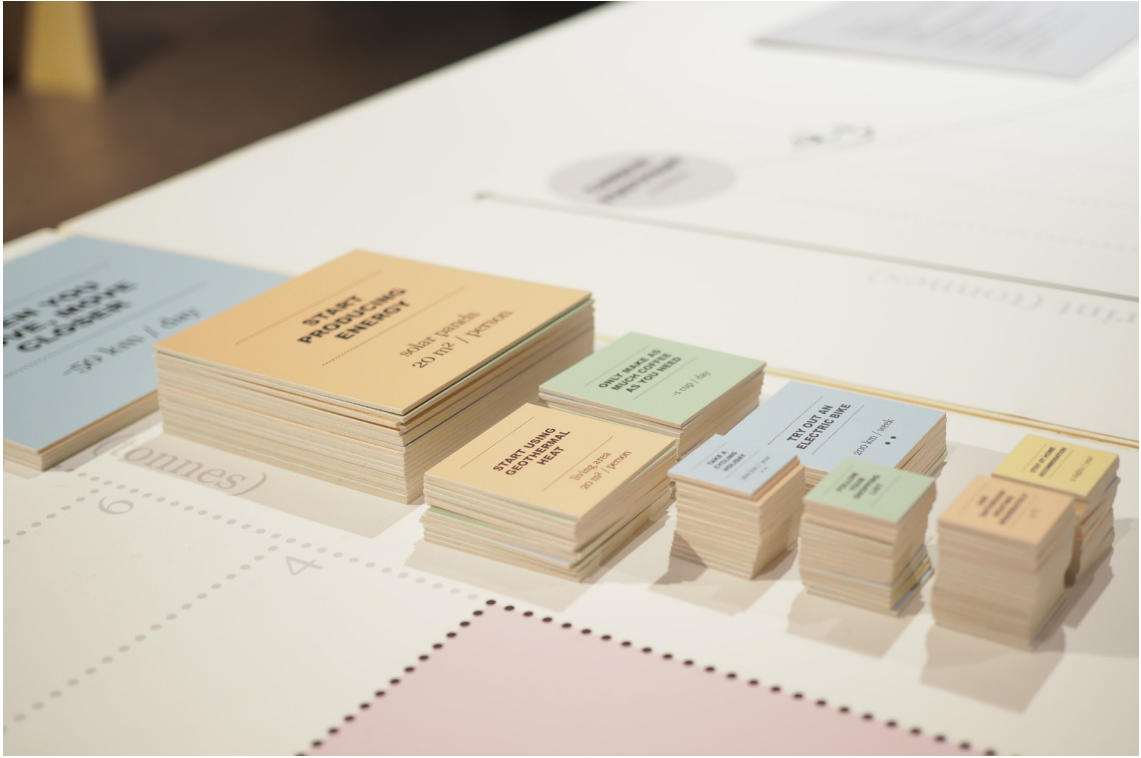


Figure 18. The action cards, August 2020 (Nielsen, 2020)

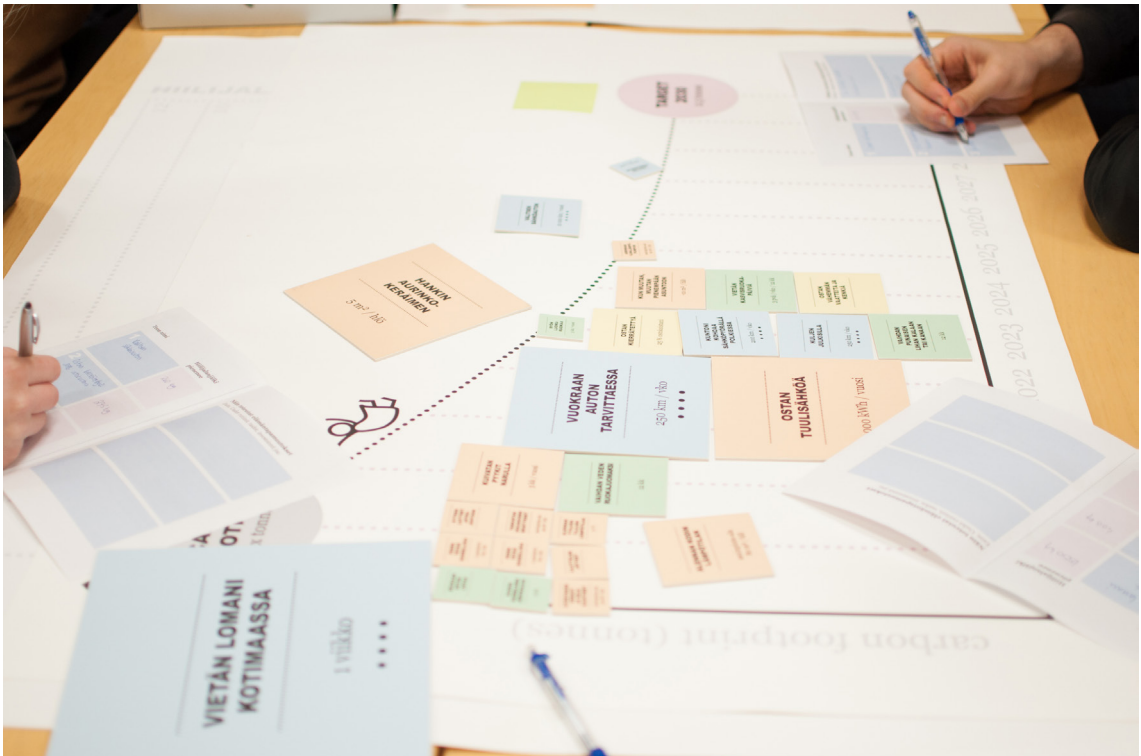


Figure 19. The design game in use, May 2019 (Lahtinen, 2019)

fiction, both of which were present in the workshop. The workshop participants tackled their lifestyle decisions (serious), but the activity did not require immediate actions or consequences (play), hence allowing imagination and creativity to emerge. This notion was supported by respondents I1, I2, K1, H1, and H2, who appreciated the possibility to link abstract targets and actions into their own life. Furthermore, in the second workshop phase, the participants were asked to think about when the chosen actions will be carried out, which required imagining narratives from their everyday life (reality) towards the future (fiction). This phase was well received by the participants, and according to respondents H1 and H2, it helped both the city and the citizens to perceive that there is still time for action, but that the time is limited. To conclude, the findings indicate that the workshop made participants think about their own lives in the long run, thus, created a playful atmosphere.

Rules. According to Vaajakallio (2012), game rules are essential for creating the "magic circle" as they are often connected with traditional games. In the refined prototype, the rules remained largely the same with slight adjustments (see Section 5.1). The participants seemed to understand the rules generally well, as they started working quickly and according to the instructions after the introductory presentation, and no negative feedback on the rules and guidelines during the workshops or interviews occurred. Respondents H2 and K3 reported that shorter introduction would have worked better, as the game adequately explains itself (H2) and as problem descriptions might reduce the sense of self-efficacy (H2 and K3). Thus, in the final version, the introduction part was shortened to get the participants on the same page while still maintaining an enthusiastic atmosphere.

All in all, the game rules allowed the participants to adapt different speeds and strategies for playing, and the researchers to adapt the game to new contexts. This characteristic aligned with the Play Framework, according to which design game rules should be flexible to allow creativity but structured to create boundaries for the game (Vaajakallio, 2012).

The design game as a structure

Facilitation. Facilitation was generally found successful, as participants seemed to understand every phase of the game by taking action and playing the game correctly. One person acted as the leading facilitator (in this case, the game designer), and 1–4 other facilitators or experts rotated around the tables to help and advise the participants. This approach was appreciated, as based on the interviews, many participants came to the workshop to ask for further advice on suitable solutions. Besides, table facilitation was tested in the workshop W3, which proved to be an excellent method for engaging mixed audiences. According to our experiences, the workshop can be organized for 4–18 groups with one primary facilitator and 1–4 experts. At the end of the fieldwork, the revised facilitation lines and workshop presentations were prepared into a facilitator's manual to make others capable of running the design game.

Materials. According to Vaajakallio (2012), design game materials can stimulate thinking and dialogue as well as support the travel between the past and the future. These aspects aligned with the workshop materials, which consisted of two playboards, action tiles in different sizes (approximately 130 in total), a marker, post-its of different sizes, and pens.

Playboards. The playboards received a good response from the participants on average. The

refined play boards are still relatively close to the original ones, although some changes were made based on participant feedback. To accommodate the carbon footprints of different household sizes, we developed a scale that made it easier to mark one's footprint on the first board, which was found successful. The final version of the second board was adjusted with vertical lines to make the action tiles fit between these lines. On practical terms, both the game boards proved durable, and the prints stayed well on the canvases. The boards were relatively easy to move by rolling them together.

Action cards. The action cards were the most beloved and memorable element of the game: They came up most in interviews and discussions when talking about the workshop, even though the pieces or the game itself were not explicitly mentioned. In the final version, there are approximately 72 actions in different sizes, which consider all domains: food, mobility, housing, and other consumption. These actions relate to new habits, investment decisions (such as new electricity contracts), ownership, and time use. Previously, also actions regarding compensations, crowdfunding, and voting were included. However, they were removed due to difficulties in calculating their impact. Furthermore, the actions were proportioned to three household sizes to make the impact more accurate. According to the interviews, the action tiles made the alternatives concrete and tangible and helped to visualize the effectiveness of various actions. As stated by respondent H1, "I think the puzzle itself is engaging, just because it's so concrete, you see it right away: if I do this, then it will have this effect." The contents of the tiles were generally viewed positively, and the emerging unclarities were recorded and reconsidered. The content and composition of the action tiles were edited with each update based on participant feedback and updates in the background data. During the fieldwork, the importance of continually updating the action tiles based on changes in technology and markets became evident.

Roles. According to Vaajakallio, the role division in design games can be done through role-play or personal immersion (2012). In the workshops, three types of role arrangements were applied according to the context of use. Under the first arrangement (W2 and W5), the participants represented their households, and their role was to act as planners to design their low-carbon strategies. The benefit of this arrangement was the personality and the ability to delve into one's own life choices without interference. In such workshops, many participants actively engaged with facilitators and often with other players, thus enabling interaction. Under the second scheme (W4), the participants were divided into mixed groups, and the aim was to reduce the carbon footprint of one group participant. Other players suggested various actions to the selected person, which were either accepted or rejected. The benefit of this arrangement was the interactivity and peer support, as the participants actively shared their experiences with lifestyle choices. Under the third arrangement (W1 and W3), the playing departed from national averages, where the participants stepped into the boots of average citizens and aimed to reduce their carbon footprint. This arrangement was found slightly problematic, as it can be difficult to imagine other people's lifestyles. However, the peer learning this evoked was appreciated in the expert workshops, as stressed by respondent I1: "although they are experts, they exchange opinion ... Oh this works, this didn't work, what about this idea." To conclude, the different roles given to participants during design games supported the facilitation of collaboration and gave each workshop their distinctive characteristics and atmosphere, in line with the characteristics of design games (Vaajakallio, 2012).



Figure 20. The third phase of the design game, May 2019 (Lahtinen, 2019)



Figure 21. The design game as a discussion tool, September 2018 (Nielsen, 2018)

5.3. Findings: A design game for promoting 1.5-degree lifestyles

This section provides an evaluation of the developed design game to achieve its objective, which is to encourage households and other stakeholders towards low-carbon lifestyles. The evaluation is introduced in two phases. Firstly, this section presents the findings from evaluating the game's performance against the requirements derived from the literature (Criteria 2). Secondly, it introduces the findings related to the potential impacts and outcomes of the design game for promoting sustainability (Criteria 3). These findings are derived from participant observations at workshops, field notes at reflection meetings, as well as semi-structured interviews.

Findings: Evaluating the performance of the design game

Considering the context-specific nature of the research, a set of criteria were derived from literature to evaluate the design game's performance. These criteria showcase the theoretical assumptions that the design game was built upon. The fulfillment of these criteria were tested and evaluated during the fieldwork. Table 9 and the following paragraphs reflect on how these criteria were met during the workshops as well as introduce possible changes made to the criteria (in italics).

Table 9. The requirements and how they were fulfilled (Nielsen, 2020)

Code	Phase	Requirement	Status
R1	Phase 1	The design game helps the participants to understand the implications of a normative sustainability target (the target 2030 (and 2050)) <i>in relation to their own individual lifestyles</i> , hence, enabling them to link their present situation on a personal level to the normative vision on a societal level.	Fulfilled
R2	Phase 1	The design game helps the participants to perceive the content and scale of multiple actions for reducing <i>their</i> carbon footprint, hence, making the abstract actions and their impacts approachable and actionable.	Fulfilled
R3	Phase 2	The design game enables the participants to develop pathways towards low-carbon lifestyles informed by a long-term target, hence, enabling them to think and plan in the long-term.	Fulfilled
R4	Phase 3	The design game enables multi-stakeholder collaboration and allows the participants to identify actions the implementation of which requires special efforts from the public and private sector.	Partially fulfilled
R5	Phase 4	<i>The design game enables identifying actions that the participants can implement immediately, thus contributing to low-carbon experiments.</i>	Fulfilled

R1: The design game helps the participants to understand the implications of a normative sustainability target (the target 2030 (and 2050)) in relation to their own individual lifestyles, hence, enabling them to link their present situation on a personal level to the normative vision on a societal level.

This criterion refers to the first phase of the workshop, which included marking one's carbon footprint in relation to the target for 2030. This task was generally well understood and executed by the participants. Moreover, all the participants were able to reach the target with their actions. For some participants, the 2030 target was somewhat close, so we also provided the target for 2050 for raising the bar. In the "mixed group" version of the game, only one participant in each group attended the game with their carbon footprint but could still perceive the 2030 target in relation to the national average, hence, indicating that the criterion was fulfilled.

The results from the interviews partly confirm these findings, as all respondents reported the design game helped to perceive the target for a sustainable footprint to guide action. According to respondent I1, visualizing this gap was the primary benefit of the design game, as it helped to understand the sustainability problem on a personal level "the first benefit is... in Japanese context it was I think their first time to really see this issue as their own thing. So, it's really the biggest benefit." However, respondents K3 and H2 reported that the 2030 target might seem too ambitious, compelling, and even discouraging for some participants, which might paralyze some participants. To overcome this, respondent H2 suggests starting the game by halving the footprint, which is already an ambitious task for many participants. Also, respondent K3 suggests applying an adjustable target "you would not need to strive towards the smallest [LCF], but five or six [tCO₂e] at first and what my choices are there to get there (...) Just so that you would not need to feel guilty." Hence, although the 2030 target was sometimes perceived distressing, the findings show that the workshop enabled the participants to link their individual carbon footprint, or the national average, to the societal target for the sustainable carbon footprint.

R2: The design game helps the participants to perceive the content and scale of multiple actions for reducing their carbon footprint, hence, making the abstract actions and their impacts approachable and actionable.

This criterion refers to the second stage, which was presumably the most appreciated stage of the workshop. During the workshops, the participants quickly understood the idea and could find suitable actions for their households, indicating that this phase was well-received. The content and the impact of some actions evoked questions and discussions, to which we responded by actively recording the feedback and changing the tiles if needed. Some participants who were already knowledgeable on the topic were frustrated not to find enough actions to implement. Throughout the development process, new actions were sought for, and according to our judgment, it seems like the actions cover a majority of calculable, reasonable and sufficiently relevant actions in Finland (approximately 80 actions). According to the interviewees, this stage was considered the most memorable part of the workshop. The interviewees immediately recall the action tiles and how they made it easier for them to perceive the scale of various actions and to choose the most suitable actions for their household. All interviewees appreciated the tangibility of the workshop, especially how the action tiles helped to visualize the impacts of each action. Respondent H2 states that this stage "shows visually and

concretely what I had already realized that there are more effective things and less effective things, so this is very clearly visible." Respondents K1 and K2 reported that the game helped to perceive a range of options, which helps to discuss and focus on actions that matter, and also bring the actions closer: "although these things are not totally new when they see them in a tangible form so that you can even move them up, it brings it more to the present." Likewise, H2 states that: "in my opinion, the benefit of this puzzle approach was that it was so solution-oriented without being completely exhaustive (...) it opens up new perspectives, which help to understand the scale of required actions." Along the similar lines, respondent K3 reported that the most significant benefit of the puzzle was how it made her realize what she was already doing, which she found particularly motivating. There were also differing opinions: Respondent K4 stated that the game was fun and indicative but hoped for more accurate calculations of the impacts and consideration of other sustainability parameters. To conclude, the results from interviews and observations indicated that the participants learned about several actions and their impacts. This notion indicates that the criterion is fulfilled.

R3: The design game enables the participants to develop pathways towards low-carbon lifestyles informed by a long-term target, hence, enabling them to think and plan in the long-term.

This criterion relates to the second phase of the workshop, where the participants place the chosen actions on a timeline from the present year to 2030. There were no changes made to this criterion, and this phase was generally well-received and understood by the participants. During the workshops, all participants were able to accomplish their individual strategies towards low-carbon lifestyles. According to participant feedback, this phase helped to perceive the available time for action, which released the stress for accomplishing all actions at once. However, some older participants mentioned that planning in 10 years' time did not seem feasible for them.

During the interviews, the 10-year-timeframe divided opinions amongst the participants. According to respondent H2, the timeline helps to reinforce the belief that there is still time for action "putting it on the timeline, is a part of the affirmation of faith and hope that there is time to act (...) that you don't have to do it all at once, it surely kind of visualizes this." Likewise, respondent H1 states that the timeline helped to think that "there is the time, but not too much time, all those things don't have to be done all right now." By contrast, respondents K3 and K1 reported that the ten years' timeframe seemed rather long, because they wanted to start implementing all the actions directly (K1), and because the family composition and state of the world change so drastically in that time (K3). Despite the differing opinions related to the timeframe, results from both interviews and observations reveal that the workshop enabled the participants to think and plan in the long-term.

R4: The design game enables multi-stakeholder collaboration and allows the participants to identify actions the implementation of which requires special efforts from the public and private sector.

This criterion refers to the third phase of the workshop, as well as to the overall intention to enable stakeholder collaboration during the workshop. There were some incremental changes made to the criteria based on participant feedback. The first version of this phase was generally well-received. However, some participants found it difficult to understand the task and wanted to

direct wishes to the unchosen actions rather than the chosen ones. Hence, in the refined version, the participants got to ideate freely on bigger tags concerning all actions. According to observations and feedback in the final workshop, the refined version was well received and generated a higher number of wishes. In the interviews, the third phase was reported essential for the municipalities (H1, H2), but otherwise, this phase was generally not much discussed. This result is understandable, as this phase was much shorter and less developed compared to the first ones.

However, all the interviewees appreciated stakeholder collaboration during the workshop. Respondents K1 and K2 reported that co-organizing the workshop with the municipality was essential for idea sharing and communication. Respondent H1 stated that the workshop allowed an open discussion between the city and the citizens, which was the aim of the city from the beginning; "with the open conversation people dare to talk to the city employees." In terms of companies, respondent H1 reported: "what I got to hear from them was that the companies were very enthusiastic and interested in it [the workshop] and that they were positive overall." As stated by respondent K3, the role of companies in the workshop was well-received, although their family was mostly interested in what they can do themselves. Respondents K1 and K2 wished that the role of companies could have been more elaborated, as companies can move faster than cities. Likewise, respondents H1 and H2, who emphasized that the workshop process could enable synergies between businesses and households to enable companies to experiment, develop, and launch products and services. Based on these findings, it seems like both the third phase of the workshop and stakeholder collaboration could be elaborated more in the workshop design. Thus, it can be considered to combine this phase with a facilitated discussion with the participant stakeholders to mutually benefit both the participants, the municipalities, and other stakeholders.

R5: The design game enables identifying actions that the participants can implement immediately, thus contributing to low-carbon experiments.

This criterion relates to the fourth phase, where the participants selected actions for immediate implementation and were added after the first ARC based on participant feedback. This phase differed slightly between the workshops: at the household workshops (W2 and W5), the participants chose actions for a one-month experimentation period, and in the mixed workshops, the participants chose three actions and planned how they would implement them (W4). This stage was generally well-received in both W2 and W5. However, the respondents K1 and K4 would have hoped for even more in-depth information about the various options, as stated by K1 "Maybe the missing link was the person that would tell you more about the different options." In the workshop W4, the participants were asked to choose three actions and plan what their implementation would require in terms of learning, investments, or habit formation. Thus, in all the workshops, the participants fulfilled the task and could find implementable actions, which indicates that the criterion was fulfilled.

To further strengthen the evidence, the results from the Porvoo and Valkeakoski experimentation periods can be briefly mentioned, as they indicate how the chosen actions were implemented in practice. All the participants in W2 and W5 implemented at least some of the chosen actions in their everyday lives during the trial period, and the results from the Porvoo indicate a 27% reduction in the carbon footprints of these households (Toivio & Lettenmeier, 2018). Respondents K1, K3, and K4 highlight that the experiments have become habits, and that it has been easy to continue

experimenting when they get accustomed to it. As stated by respondent K3 "the things that we changed have become integrated in everyday life, so we do not anymore see or remember what was changed." This statement aligns with the feedback from workshop W5, where two participants reported that the workshop triggered the implementation of actions that they had considered for a long time. According to respondents K1, K2, K3, and K4, the project has led to a shift in mindset. These experiences indicate that the chosen actions were implemented in the real-life.

Findings: Evaluating the effects of the design game

The evaluation framework by Schöpke and colleagues (2017) was adapted for distinguishing the potential outputs and impacts of the design game to promote low-carbon lifestyles (Criteria 3). The evaluation is based on findings from participant observations at workshops, field notes from reflection meetings as well as semi-structured interviews. Figure 22 summarizes the findings. What is worth mentioning is that although general conclusions can be drawn on the effectiveness of the design game, their real impact can only be examined case-by-case in each particular workshop situation.

OUTPUTS	IMPACTS – capacity building	IMPACTS – network effects
tangible outputs and intangible experiences <i>action plans for the participants</i> <i>data regarding desired and challenging actions for the researchers</i> <i>insights for developing similar tools and applications for the design game designers</i>	learning <i>perceiving abstract targets in relation to ones life</i> <i>understanding the scale and content of several actions</i> <i>transmission of learning to peers</i> <i>media attention</i> empowerment <i>a shift in mindset and competences</i> <i>intristic motivation</i>	social capital <i>dialogue, support, and peer-learning</i> <i>community building and participatory knowledge-making</i> <i>amount and depth of relationships difficult to estimate</i>

Figure 22. Evaluation of ouputs and impacts of the design game (Nielsen, 2020)

Outputs

The process outputs are divided into tangible and intangible experiences. In terms of tangible experiences outputs, the design game produced action plans, pathways, and immediate experiments for the participants, and data regarding preferred, challenging, and desired actions for the researchers and other stakeholders. Moreover, it provided valuable insights for the design game designer insights for developing similar tools and applications. In terms of methodological experiences, according to observations and three interviews, the workshop managed to create a "mutual learning space" where the atmosphere was enthusiastic and focused. In terms of social experiences, the level of interaction varied depending on the specific design game. However, based on the experiences of two respondents and observations, the participants were contended with the possibility to meet and discuss with people with similar concerns.

Impacts

According to this evaluation framework (Shäpke et al., 2017), impacts can be divided into two categories: capacity building, including social learning and empowerment, and network effects, including social capital development. In terms of impacts through learning, the research findings indicate that the design game was successful in contributing to individual learning regarding the objectives of the design game. In all the workshop feedback and interviews, the participants reported that the workshop helped them to choose the actions that are applicable for them and perceive the impact of them, as well as to plan how the sustainability target can be reached with these actions. All the respondents (representing households) reported that they had found some novel ideas to implement in their everyday.

The media attention that the project received could implicate impacts through knowledge sharing. The household projects (Valkeakoski and Porvoo) have been in the news (national news) several times. Three interviewees highlight the importance of media attention, especially in inspiring other people on the possibilities of sustainable lifestyles. Besides, all the participant interviewees mentioned that the project had evoked interest and discussions amongst their peers, thereby indicating the transmission of individual learning to wider social groups.

When it comes to impacts through empowerment, all the participants found actions for reducing their carbon footprint. Besides, several participants reported that the workshop worked as a springboard for doing things that they had planned to do for a long time. In household workshops (W2 and W5), all the participants reported that they had engaged in low-carbon experiments, and many of these became a pertinent part of their everyday lives. However, this result comes with the limitation that these workshops included a one-month experimentation period. Also, the city employees reported changes in their mindset but did not report any direct impacts on their work.

In terms of impacts through network effects, it is essential to distinguish the two scenarios for playing the game. Based on the observations, it can be generalized that in both situations, the participants were generally happy about the possibility of attending the workshop with people who shared the same concern. However, the interviews can give more accurate information regarding the actual impacts in terms of network effects. Two of the participant interviewees found the community empowering, as they could find people who were concerned with the same things, but one of them reported that it made them feel "outside." In terms of network effects through stakeholder engagement, results are more challenging to measure. Besides, the workshops allowed discussion between the citizens, businesses, and city employees, but although this interaction was reported valuable, the number and intensity of these relationships are difficult to determine. As a result of the workshops, all cities received a list of activities that one or more households wanted. However, for these to be truly effective in supporting decision-making, more input is needed, which would require scaling the design game either through institutional partners or through developing an online tool.

To conclude, these findings indicate that the workshop tool has contributed to learning and empowerment amongst the participants. The implications of these results are discussed further in the next chapter.

6. Discussion & conclusions

6. Discussion & conclusions

This chapter discusses the findings in relation to the research objective and the subsequent research questions. The aim of this chapter is to evaluate the extent to which the research objectives were answered. Furthermore, practical and theoretical contributions, applications, and limitations of this study are discussed.

The overall objective of the thesis was to develop, test, and evaluate a practical application of the 1.5-degree lifestyle research (IGES et al., 2019) to encourage households and other stakeholders to transition towards low-carbon lifestyles. To achieve this objective, the research is divided into complementary research questions:

1. What kind of a design tool could encourage households to transition towards 1.5-degree lifestyles? What are the characteristics of it?
2. What indicates that the developed tool is a valuable method for promoting 1.5-degree lifestyles? What possible outputs and impacts can it have?

To answer these research questions, a design game and related criteria were developed (Chapter 3), and, thereafter, tested and improved during a field study through action research methodology (Chapter 4). The field study phase included five action research cycles for testing, reflecting, and improving the design game in five workshops, nine reflection meetings, and four co-creation workshops. Furthermore, seven semi-structured interviews were conducted for validating the findings.

6.1. Discussion: Characteristics as a design game

This section discusses the results in relation to the first research question. To answer this question, the collected data and the developed design game were compared to the characteristics of design games using the Play Framework by Kirsikka Vaajakallio (2012) (see Criteria 1, Section 5.2).

The results indicate that the developed design game meets the characteristics of a design game as delineated by Vaajakallio (2012) and could hence be identified as such. The purpose of the developed design game aligned with the objectives of design games, as it can be used for "organising dialogue, supporting empathic understanding and gaining several contributions" (Vaajakallio, 2012, p. 219) for addressing context-specific design needs. This is a particular example of a design game, where the participants' design task involves planning their lifestyles, and the researcher's task includes collecting observations on the workshop situation to promote low-carbon living. Moreover, based on observations, the developed design game created a game-like atmosphere, "the magic circle", which, according to Vaajakallio (2012), is central for design games. This atmosphere was enhanced with pre-prepared materials, including game boards and action cards, and phases that allowed the participants to move between reality and fiction as well as past and future. In addition, the facilitation process and role division aligned with characteristics of design games as they aimed to transform participants from partakers to producers, as delineated by Vaajakallio (2012). Moreover, the researchers could adapt the design game continuously to new contexts and audiences as a consequence of its flexible rules and structure, as suggested by Vaajakallio (2012).

To conclude, the developed design game can, indeed, be identified as a design game.

Furthermore, these findings indicate that co-design in general and design games, in particular, could work as a method for engaging collaboration in sustainability transitions projects, as anticipated in the introduction. Thus, this case example denotes that design methods could provide effective tools for creating “learning spaces” in transitions, in line with Erdogan Öztekin and Gaziulusoy (2019). This space was created by combining problems and solutions to generate new understandings through creative activities, as suggested by Buchanan (1998). Moreover, the positive results from the case study indicate that further research can be conducted for exploring the role of design games in promoting collaboration and learning in projects aiming to steer sustainability transitions.

6.2. Discussion: A design game for promoting 1.5-degree lifestyles

This section discusses the results in relation to the second research question. To respond to this question, the collected data was reflected against the criteria derived from relevant literature (Criteria 2, see Section 5.3). Furthermore, the findings were assessed against the evaluation framework by Schöpke and colleagues (2017) for distinguishing the effects of the design game for contributing to low-carbon lifestyles (Criteria 3, see Section 5.3).

The evaluation of the findings revealed that the design game was generally successful in meeting the criteria that were developed prior to the fieldwork (Chapter 5). The design game was effective in enabling the participants to (a) understand the societal sustainability target in relation to their own lives, (b) perceive the content and scale of multiple actions for reducing their carbon footprint, and (c) develop pathways towards low-carbon lifestyles, as well as (d) to identify actions that they will implement directly. Moreover, the developed design game was partially successful in (e) enhancing stakeholder collaboration and gathering actions and ideas for implementation for the public and private sector.

The assessment of the design game against the evaluation framework by Schöpke and colleagues (2017) indicated that the design game was effective in producing feasible outputs and enhancing learning and empowerment amongst the participants, and partially successful in creating impacts through network effects. In terms of outputs, the design game produced low-carbon pathways to participants and provided data on the most preferred and challenging actions to other stakeholders. In terms of impacts through learning, all the interviewees reported knowledge sharing amongst themselves and their peers. Furthermore, several participant's stories were discussed in the media helping to scale up the learnings to a wider audience. In terms of impacts through empowerment, all the household workshop participants found actions for implementation, and the respondents reported change in mindset after the workshop, indicating increased intrinsic motivation and decision-making capabilities amongst them. In terms of impacts through network effects, the design game was observed to create a mutual learning atmosphere, although the amount and depth of the created connections were impossible to determine in the scope of this study. To conclude, the evaluation indicated that the participants found the developed design game valuable in enhancing learning and action and enabling knowledge sharing to wider social groups and amongst the participants.

These results come with limitations. Although general conclusions can be drawn on the

effectiveness of the design game, they do not override the context-specific effects in each particular workshop situation. Thus, the real effectiveness of the design game can only be examined case-by-case. Furthermore, according to the findings, the biggest limitation for the design game was the workshop form, which required significant resources in relation to the number of participants. This challenge could be addressed by distributing the developed design game to multiple partners or by developing a digital tool. Moreover, the workshop participants were generally motivated and interested in the topic and attended the workshop voluntarily. On one hand, these early adaptors might pave the path for others to follow, by adopting new practices and sharing knowledge to their communities and through media, in line with transitions management approach (Rotmans & Loorbach, 2009). On the other hand, to upscale the impact, it would be important to reach a wider public, who are necessarily not convinced by mere social benefit. As suggested by the interviewees, one approach to overcome this challenge would be to expose people to the design game through institutions, such as schools or workplaces, or through events and fairs. These options are discussed in Section 6.5.

6.3. Meeting the objective

The results indicate that the design game effectively meets the main research objective. In the short term, the developed design game made the abstract sustainability targets and options defined in the 1o5 report (IGES et al., 2019) understandable and actionable to the participants. Thus, it gave direction to activities and helped identify options for reducing footprints. Moreover, it created a space of exchanging ideas around sustainable lifestyles between households and relevant stakeholders, which is essential for the systemic and cultural nature of lifestyle changes, as delineated by Gilby and colleagues (2019).

In the long term, the findings indicate that the developed design game could have the potential to contribute to societal change for several reasons. First of all, it was effective in triggering learning and reflection amongst individuals and decision-makers, hence promoting individual change as a bottom-up approach through awareness-raising and education. This aligns with the practice-theorist view according to which decision-makers should be attuned in the everyday practices to draft effective policies (Shove & Walker 2010). Secondly, the developed design game enabled multi-stakeholder dialogue and data collection from the participants to support a bottom-up approach to policy making. This aligns with the transitions management approach that requires engagement and strategies of multiple actors to enable social learning and innovation processes towards sustainable futures (Loorbach, 2010). Third, the design game inspired numerous applications, such as developing a similar web-based tool for reaching larger audiences (discussed in Section 6.5). Consequently, the design game has the potential to initiate learning and reflection amongst individuals and stakeholders alike to realize the multiple ways in how transitions towards sustainable living can be enacted, thus meeting the research objective.

6.4. Theoretical implications

This study has resulted in developing and testing one specific a design game, which has proven to be effective in meeting its goals, has gained widespread popularity and has served as a starting

point for several applications. As such, it provides an empirical case example for combining the characteristics of design games (Vaajakallio, 2012) with the transition management approach (Loorbach, 2010) and the practice-theoretical view on individuals (Shove & Walker, 2010) for initiating sustainable lifestyles transitions. Thus, the results indicate that design – and in particular design games – could enhance transition management processes by creating engaging experiences that allow participation and creativity.

Content-wise the design game draws from the fields of transitions management, practice theory, and studies on sustainable lifestyles. Firstly, the workshop can be seen as a transitions management project as it uses similar future-oriented methods aiming to steer sustainability transitions (Loorbach 2010), but the systems level is smaller, and households work as strategists to design their lifestyles. Households are perceived as integral actors in reconfiguring systems with their actions, thus, responding to the criticism towards the TM approach for erasing the individual from transitions (Rauschmayer et al., 2013). Secondly, it can be perceived as a practice-theoretical process, as it takes the everyday life practices as an integral part of conceptualizing systems transitions (Shove & Walker, 2010). Individuals are seen as practitioners, who play a key role in transitions by generating practices and adapting innovations (Shove & Walker, 2010). Thirdly, it can be perceived as a transdisciplinary sustainability project, as the aim is to steer transitions towards low-carbon lifestyles to achieve wellbeing within the planetary boundaries (e.g., Gilby et al., 2019). To conclude, the design game combines long-term visioning of transitions management, with the practice-theorist view on individuals as key players in transitions and takes the normative target from studies in sustainable lifestyles with the attempt to initiate low-carbon lifestyle transitions.

In line with these conclusions, it can be argued that the design game provides an empirical case study for Design for Sustainability Transitions (DfST) from the perspective of lifestyles. Commonly to several contributions in the field as delineated by Gaziulusoy (2018), the case study highlights the need for systems transitions for achieving sustainability and that design can have a role to play in these transition processes. Moreover, it aligned with the contributions of Irwin and collaborators (e.g., Irwin, 2015; Irwin, Tonkinwise & Kossoff, 2015), which identify lifestyles as a platform for socio-technical transitions. Consequently, it provides a case example of combining design research with transitions studies.

6.5. Application and further steps

Socio-cultural context

As with all design solutions, this design game was designed to fit into the chosen socio-cultural context, in this case, Finland, and the design process was based on contemporary knowledge and worldview. The results indicate that the design game could be used in municipal organizations to support inclusive policymaking, as well as in educational institutions and workplaces in Finland. Furthermore, the changes in Finnish society contributed to the adaptation of the design game. Around the time for launching and developing the design game between fall 2018 and fall 2019, climate discussions deepened in Finland. They were marked by recrimination (Lummaa, 2019) and increasingly also by despair (Lehtinen, 2019). Several surveys from the year 2019 revealed

that Finns are increasingly worried about climate change and needed more information both on the causes of climate change and on ways to mitigate it (Heikkilä & Perälä, 2020). At the same time, the voices of opponents also increased and political confrontation deepened; Climate policy became increasingly an identity policy, which was particularly emphasized in the spring 2019 elections. These themes also emerged in the workshop interviews, where the participants were particularly worried about the antagonistic public discussion characterized by stamping and blaming. According to their views, the developed design game was suitable in this context at this specific time for giving people alternatives, feeling of self-efficacy, and hope. The same conclusions can be drawn from overall workshop experiences, as discussed in chapter 5.

The design game was also tested in Japan, where the public discussion around climate change is substantially different than in Finland. Two workshops and one interview with Japanese participants were organized to discuss the feasibility of the design game in the Japanese context. Before the workshop, our Japanese colleague was worried about the suitability of the game in this context, as the need for lifestyle carbon footprint reductions was not yet widely discussed or recognized amongst Japanese households. However, the workshop in Japan revealed to be somewhat successful, and the Japanese participants found the design game useful for perceiving the extent of the problem and for identifying solutions. They also reported that the design game could potentially be distributed through educational and municipal institutions to Japanese participants. However, the suitability should be tested on several occasions to validate this finding.

Applications

Parallel with the workshops and reflection meetings introduced in this thesis, the design game has been tested on several other occasions between the fall 2018 and winter 2020. Due to the time and space constraints of this thesis, all of these occasions are not included in the study but have inevitably affected the research results. By January 2020, more than 1000 people had attended workshops which have helped to develop the design game and to identify potential areas of application. Moreover, the design game has been tested with environmental educators, sustainability experts, university and high school students, private companies, public servants, and households in 14 municipalities in Finland.

Suitability in other cultural contexts. To prove its applicability in different socio-cultural contexts, the design game has been tested in several countries, in addition to Finland and Japan, in Switzerland, Germany, Spain, and Mexico through the SLA program. To adapt the design game to these contexts, the action tiles were partly modified through cooperation with local partners. The feedback from households in Switzerland, Spain, and Germany showcase that it was a valuable method, which was much discussed also after the workshops. Hence, the applicability of the design game could be further explored in different countries, while working together with local experts to update and adapt the design game to these contexts.

Digital tool. Parallel to these experiments, the workshops have functioned as a testbed for developing a similar digital tool for the SLA program. This tool could reach a wider audience and allow personalization and continuous follow-up of the results. To enable this development, developers and designers have visited workshops to gather in-depth knowledge on user behavior patterns of the design game. Subsequently, the distinctive phases of the workshop were transformed

into digital features. The first prototype of the webtool is launched in spring 2020 for test users in Finland, Spain, Switzerland, Germany, Spain, Denmark, Mexico, and India.

Scenario tool. In addition to these experiments, the design game has also been used by experts for developing societal scenarios towards low-carbon futures. This application showed to be a valuable method for imagining various personas and their lifestyles and identifying their main challenges and barriers to adopting sustainable behaviors. Based on this task, the consultants were able to identify key actions from public and private sectors for enabling 1.5-degree societies, stemming from the needs and aspirations of individuals.

Next steps

The design game has shown to have its distinctive advantages in facilitating discussion and has evoked wide interest amongst stakeholders for adapting it to different contexts. Hence, the next steps for developing the design game include scaling up the production and facilitation process for increasing the accessibility of the design game, while making it less resource and time-intensive for the core team to run. The application areas for this scaling-up could include municipalities and educational contexts.

6.6. Limitations

This section discusses the limitations of the study regarding the qualitative research approach, the chosen methods and methodology, cultural context, and language use. It also discusses how these limitations were addressed in the study.

Limitations related to qualitative research

The qualitative nature of the study imposes limitations to the study regarding the self-reported data, research design, and amount of research participants. First of all, the collected data represents the views of the participant individuals, which might cause bias to the results, as the respondents might not remember the events or exaggerate their responses. Furthermore, as the researcher was involved in developing and analyzing the design game, the proposed solutions might become affected by her attitudes and mindsets (see Muratovski, 2016). Also, the researcher's presumptions on the cultural context of the study might affect the results. These limitations were addressed by using multiple data collection methods and including several experts in developing and reflecting the design game. Secondly, the research process progressed iteratively, and, thus, all the phases of the research were not planned in advance, which is recommended when conducting an empirical study (see Muratovski, 2016). To ensure that the research was conducted systematically, the research questions, the methods, and the ethical considerations were prepared in advance. Thirdly, the limited amount of research participants might limit the generalization of the results. To address this challenge, the research participants covered both expert participants as well as individual households to provide multifaceted perspectives regarding the topic. Furthermore, the chosen methods, semi-structured interviews, participant observations, and qualitative field notes, provided in-depth information on the studied topic. Thus, the chosen research participants offered sufficient evidence for improving and evaluating a context-specific tool, which was the intention of

this study, therefore justifying the limited participant amount.

Methodological limitations

The chosen methodology and methods imply limitations to the study. First of all, the action research methodology poses limitations to the study. Applying co-creation methods involves subjectivity in deciding the direction of actions amongst a restricted number of the participants, which might provide a narrow view of the studied topic (see Muratovski, 2016). This challenge was addressed by engaging external actors in improving and reflecting the design game to include various perspectives in the development process. Moreover, the participatory research activity may lead to weak compromises (see Muratovski, 2016), which was addressed by organizing several iterative rounds of testing and development. Furthermore, commonly to action research methodology and qualitative research in general, the replication of this study might be challenging: This study was formed by the specific set of participants involved in it. This limitation was addressed by documenting all the stages of the research process to enable other researchers to find inspiration to conduct similar studies. The same limitations apply to the design process that took place at the beginning of the research process.

Besides, the chosen methods set limitations to the study. Firstly, in participant observations, the researcher's presence may distract the research situation, which may lead to controlled behavior amongst the participants. Furthermore, the researcher may have insufficient skills and a limited focus on observing the research situation (see Creswell, 2009). These aspects were addressed by including several facilitators on the research site, who supported observation. Secondly, interviews set limitations to the study, as interview responses depend on the respondents' ability to articulate their views (see Creswell, 2009). Additionally, the respondents might portray themselves as more rational than they are (see Moore, 2000), or provide answers that they feel are expected from them (see Muratovski, 2016). Besides, the researcher's presence and the setting may influence the responses (see Creswell, 2009). These limitations were addressed by explaining the roles and rights of the participants before the interview. Furthermore, the interviewees could decide the interview location to make them feel safe to express their views. Thirdly, fieldnotes sets limitations to the study. The main limitation relates to the subjective process of notetaking, where the researcher decides what information to obtain from different situations. Thus, the researcher may choose to document only such issues that support her aspirations and goals. This subjectivity was inevitably present in this study. However, as the main objective of using this method in this particular study was to improve and reflect the performance of the design game, it was in the interest of the researcher to collect multifaceted opinions related to it.

Moreover, thematic analysis poses limitations to the study. In qualitative research, the data collection and data analysis processes cannot be separated as they often coincide (Nowell et al., 2017). Thus, the researcher comes to the analysis stage with some prior knowledge, which might affect the analysis. This limitation was addressed by documenting the first impressions and insights in a project log throughout the data collection and analysis phase to keep track of findings, as advised by Nowell and colleagues (2017).

Theoretical limitations

The theoretical framework places limitations on the study. The product of this study is built on several strands of research, which integration has not been explored extensively in empirical studies. This aspect limited the comparison of the design game to theoretically similar case examples. The results of the study indicate that combining these strands of research may be beneficial, but further research is needed to validate this claim.

Limitations related to the cultural context of the study

Furthermore, the cultural context of the study might imply limitations to the study. The research was primarily conducted in Finland, which might limit the validity of the results and applicability of the design game in other cultural contexts. This choice of context was based on the intention to test the developed design game in one cultural context before applying it to other settings. Moreover, the applicability of the design game was tested in three workshops and one interview with international participants (W1 and W3), which gave some indication to the design game's potential in other contexts. Nevertheless, commonly to design methods, the context of use for this design game needs to be tested and adapted to each cultural context separately.

Limitations related to language use

Moreover, language use might place limitations on the results, as two languages were used for collecting and analyzing the results. One interview and two workshops were organized in English that is not the native language of the researcher, which might pose limitations to interpreting the results. Moreover, six interviews and four workshops were organized in Finnish, and translating the related documents into English may limit the analysis of the results. To avoid possible misinterpretations, the researcher translated the text herself to make sure that the translations matched the original data as closely as possible. Despite these precautions, the results are inevitably affected by the specific characteristics of each language.

6.7. Final words

Summary of the conclusions

The transition towards a low-carbon society requires exhaustive changes in contemporary lifestyles and the socio-technical system that shapes these lifestyles. Individuals' thinking, values, and choices play a central role in shaping these socio-technical systems and, thus, form an integral part of the solution package to climate change mitigation. Nevertheless, contemporary climate discussion is characterized by uncertainty and misinformation, whereby, despite good intentions, people cannot find their ways to act. This study emerged from the urgent need for developing systemic tools to initiate transitions towards lifestyles within the confines of the 1.5-degree aspiratory target.

The study resulted in developing, testing, and evaluating a design game, the 1.5 Puzzle, for encouraging transitions toward 1.5-degree lifestyles. The results indicate that the developed

design game made the abstract sustainability targets and options defined in the 1o5 report (IGES et al., 2019) understandable and actionable to the participants. Moreover, by incorporating play-elements with co-design methods, it created a mutual learning space for exchanging ideas around low-carbon lifestyles between households and relevant stakeholders to recognize the multiple ways transitions towards sustainable living can be enacted. The evaluation against the evaluation framework by Schöpke and colleagues (2017) implicated the design game's potential to trigger learning and empowerment amongst individuals and stakeholders alike. Furthermore, the design game gained widespread popularity and served as a starting point for several applications.

Thus, these results indicate that the developed design solution was suitable in this socio-cultural context, Finland and Japan, at this specific time for giving people alternatives, feeling of self-efficacy, and hope. The development process continues in Finland and abroad in the municipal and educational contexts for increasing its accessibility and impact. Moreover, the time and space limitations of the workshop-formed design game underscore the importance of developing further applications and additional tools, which can reach wider audiences, and are targeted at political and business actors to further initiate rapid societal change towards low-carbon societies.

Personal reflections

During this thesis project, I have recognized the importance of combining practice and theory to address sustainability problems. Action research and design research have proved to be valuable methods in enabling this, as they allow creating and testing interventions through practical experimentation. Furthermore, action research allows systematic evaluation throughout the research process. Based on this experience, I believe that both of these approaches and their integration can provide valuable methods in addressing the sustainability challenges of the contemporary society.

This research project has allowed me to collaborate with numerous experts, organizations, and households, which I am grateful for. The importance of collaboration, peer learning, experimentation, and dialogue have been emphasized during this process. The result of the project and its implications have been unexpected and surprising to me. The project has taught me that simple and tangible solutions to complex issues can be the key to getting people involved.

References

References

- Akenji, L., & Chen, H. (2016). *A Framework for Shaping Sustainable Lifestyles*. Nairobi: United Nations Environment Programme.
- Akenji, L. (2019). *Avoiding Consumer Scapegoatism: Towards a Political Economy of Sustainable Living* (Doctoral dissertation, University of Helsinki, Helsinki, Finland). Retrieved from <http://urn.fi/URN:ISBN:978-951-51-5354-8>
- Akerlof, K., & Kennedy, C. (2013). Nudging toward a healthy environment: How behavioral change research can inform conservation. *White paper for the Gordon and Betty Moore Foundation*. George Mason University, Fairfax, VA.
- Bamberg, S. (2002). Effects of implementation intentions on the actual performance of new environmentally friendly behaviours—results of two field experiments. *Journal of environmental psychology*, 22(4), 399–411.
- Berkhout, F., Smith, A., & Stirling, A. (2004). Socio-technological regimes and transition contexts. *System innovation and the transition to sustainability: Theory, evidence and policy*, 44(106), 48-75.
- Bobbe, T., Krzywinski, J., & Woelfel, C. (2016). A comparison of design process models from academic theory and professional practice. In *DS 84: Proceedings of the DESIGN 2016 14th International Design Conference* (pp. 1205–1214).
- Brandt, E. (2006, August). Designing exploratory design games: a framework for participation in Participatory Design?. In *Proceedings of the ninth conference on Participatory design: Expanding boundaries in design-Volume 1* (pp. 57–66).
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77–101.
- Brinkmann, S., & Kvale, S. (2018). *Doing interviews*(Vol. 2). Sage.
- Buchanan, R. (1998). Education and professional practice in design. *Design Issues*, 14(2), 63–66.
- Cass, N., Schwanen, T., & Shove, E. (2018). Infrastructures, intersections and societal transformations. *Technological Forecasting and Social Change*, 137, 160–167.
- Ceschin, F. (2012). *The introduction and scaling up of sustainable product-service systems: A new role for strategic design for sustainability* (Doctoral dissertation, Politecnico di Milano, Milan, Italy) Retrieved from <http://hdl.handle.net/10589/56785>
- Ceschin, F., & Gaziulusoy, A. İ. (2020). *Design for Sustainability: A Multi-level Framework from Products to Socio-technical Systems*. Taylor & Francis. <https://doi.org/10.4324/9780429456510>
- Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*. Third Edition. Sage publications.
- Creswell, J. W. (2014). *Educational research: Planning, conducting and evaluating quantitative and qualitative research* (4th ed.). Essex, England: Pearson Publishing.
- Crouch, C., & Pearce, J. (2012). *Doing Research in Design*. Berg.
- Design Council. (2007). *Eleven lessons: Managing design in eleven global companies. Desk research report*. Retrieved on the March 4, 2020, from https://www.designcouncil.org.uk/sites/default/files/asset/document/ElevenLessons_DeskResearchReport_0.pdf

- Eckert, C. M., & Stacey, M. K. (2010). What is a process model? Reflections on the epistemology of design process models. In *Modelling and Management of Engineering Processes* (pp. 3–14). Springer, London.
- Erdoğan Öztekin, E., & Gaziulusoy, A. İ. (2019). Designing Transitions Bottom-up: The agency of design in formation and proliferation of niche practices. *The Design Journal*, 22(sup1), 1659–1674 <https://doi.org/10.1080/14606925.2019.1594999>
- Figueres, C., Le Quéré, C., Mahindra, A., Bäte, O., Whiteman, G., Peters, G., & Guan, D. (2018). Emissions are still rising: ramp up the cuts. *Nature* 564, 27–30
- Finnish Innovation Fund Sitra. (n.d.-a). *100 smart ways to live sustainably*. Retrieved February 24, 2020 from <https://www.sitra.fi/en/projects/100-smart-ways-to-live-sustainably/>
- Finnish Innovation Fund Sitra. (n.d.-b). *Sitra Lifestyle test*. Retrieved February 24, 2020 from <https://lifestyletest.sitra.fi/>
- Gaziulusoy, A. İ. (2010). *System Innovation for Sustainability* (Doctoral dissertation, The University of Auckland, Auckland, New Zealand). Retrieved from https://catalogue.library.auckland.ac.nz/permalink/f/ta4ieu/uoa_alma21129114400002091
- Gaziulusoy, A. İ., & Ryan, C. (2017). Roles of design in sustainability transitions projects: A case study of Visions and Pathways 2040 project from Australia. *Journal of Cleaner Production*, 162, 1297–1307.
- Gaziulusoy, A. İ., & Erdoğan Öztekin, E. (2018). Design as a Catalyst for Sustainability Transitions. In *Design Research Society International Conference: Catalyst*. Design Research Society.
- Gaziulusoy, A. İ. (2018). Postcards from “the edge”: toward futures of design for sustainability transitions. *Cuadernos del Centro de Estudios en Diseño y Comunicación* 73(19), 67–84.
- Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research policy*, 31(8–9), 1257–1274.
- Geels, F. W. (2005). *Technological transitions and system innovations: a co-evolutionary and socio-technical analysis*. Edward Elgar Publishing.
- Geels, F. W., & Schot, J. (2007). Typology of sociotechnical transition pathways. *Research policy*, 36(3), 399–417.
- Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental innovation and societal transitions*, 1(1), 24–40.
- Gilby, S., Mao, C., Koide, R., Watabe, A., Akenji, L., & Timmer, V. (2019). *Sustainable Lifestyles Policy and Practice: Challenges and Way Forward*. Institute for Global Environmental Strategies, Hayama, Japan.
- Green, S., Southee, D., & Boulton, J. (2014). Towards a design process ontology. *The Design Journal*, 17(4), 515–537.
- Grin, J., Rotmans, J., & Schot, J. (2010). *Transitions to sustainable development: new directions in the study of long term transformative change*. Routledge.
- Hargreaves, T., Longhurst, N., & Seyfang, G. (2013). Up, down, round and round: connecting regimes and practices in innovation for sustainability. *Environment and Planning A*, 45(2), 402–420.
- Heikkilä, A., & Perälä, A. (2020, January 1). *Kotitalouksien päästöt kasvavat, vaikka suomalaiset*

- sanovat tekeväsä aiempaa enemmän ilmaston eteen. Suomen kuvalehti. <https://suomenkuvalehti.fi/jutut/kotimaa/kotitalouksien-paastot-kasvavat-vaikka-suomalaiset-sanovat-tekevansa-aiempaa-enemman-ilmaston-eteen/>
- Hickel, J. (2019). Is it possible to achieve a good life for all within planetary boundaries? *Third World Quarterly*, 40(1), 18–35.
- Holloway, L., & Todres, L. (2003). The status of method: Flexibility, consistency and coherence. *Qualitative Research*, 3, 345–357.
- Howard, T. J., Culley, S. J., & Dekoninck, E. (2008). Describing the creative design process by the integration of engineering design and cognitive psychology literature. *Design studies*, 29(2), 160–180.
- Hyysalo, S., Lukkarinen, J., Kivimaa, P., Lovio, R., Temmes, A., Hildén, M., ... & Peljo, J. (2019). Developing policy pathways: redesigning transition arenas for mid-range planning. *Sustainability*, 11(3), 603.
- Institute for Global Environmental Strategies, Aalto University, and D-mat ltd. (2019). *1.5-Degree Lifestyles: Targets and Options for Reducing Lifestyle Carbon Footprints. Technical Report*. Institute for Global Environmental Strategies, Hayama, Japan.
- IPCC. (2018). Summary for Policymakers. *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. *World Meteorological Organization, Geneva, Switzerland*, 32 pp.
- Irwin, T., Kossoff, G., & Tonkinwise, C. (2015). Transition design provocation. *Design Philosophy Papers*, 13(1), 3–11.
- Irwin, T. (2015). Transition Design: A Proposal for a New Area of Design Practice, Study, and Research. *Design and Culture*, 7(2), 229–246.
- Jackson, T. (2012). The challenge of sustainable lifestyles. In *State of the World 2008* (pp. 73–88). Routledge.
- Jalas, M., Hyysalo, S., Heiskanen, E., Lovio, R., Nissinen, A., Mattinen, M., ... & Nissilä, H. (2017). Everyday experimentation in energy transition: A practice-theoretical view. *Journal of cleaner production*, 169, 77–84.
- Jensen, C. L., Goggins, G., Fahy, F., Grealis, E., Vadovics, E., Genus, A., & Rau, H. (2018). Towards a practice-theoretical classification of sustainable energy consumption initiatives: Insights from social scientific energy research in 30 European countries. *Energy Research & Social Science*, 45, 297–306.
- Joore, P. (2010). New to improve: The mutual influence between new products and societal change processes (Doctoral dissertation, Delft University of Technology, Delft, Netherlands). Retrieved from <https://doi.org/10.4233/uuid:447d8e32-25f5-4d16-b1dd-f11cc245829c>
- Järvensivu, P. (2017). A post-fossil fuel transition experiment: Exploring cultural dimensions

- from a practice-theoretical perspective. *Journal of Cleaner Production*, 169, 143–151.
- Keinonen, T. (2009, November). Design method: Instrument, competence or agenda. In *Swiss Design Research Network Symposium, Lugano, Switzerland*.
- Kemmis, S., & McTaggart, R. (2005). Communicative action and the public sphere. I P. Reason & H. Bradbury (Eds.). *The handbook of qualitative research*, 559–603.
- King, N. (2004). Using templates in the thematic analysis of text. In Cassell, C., Symon, G. (Eds.), *Essential guide to qualitative methods in organizational research* (pp. 257–270). London, UK: Sage.
- Kossoff, G. (2011). *Holism and the Reconstitution of Everyday Life: a Framework for Transition to a Sustainable Society* (Doctoral dissertation, Dundee, University of Dundee). Retrived from <https://ethos.bl.uk/OrderDetails.do?uin=uk.bl.ethos.699805>
- Kossoff, G., Tonkinwise, C., & Irwin, T. (2015, August). Transition design: The importance of everyday life and lifestyles as a leverage point for sustainability transitions. In *6th International Sustainability Transitions Conference*.
- Leedy, P. D., & Ormrod, J. E. (2010) *Practical Research: Planning and Design*. Boston, MA: Pearson.
- Lehtinen, I. (2019, July 15). *Toivottomuuden puolesta*. Medium. Retrieved from <https://medium.com/@iljalehtinen/toivottomuuden-puolesta-5a86266eae4d>
- Lettenmeier, M. (2018). *A sustainable level of material footprint—Benchmark for designing one-planet lifestyles* (Doctoral dissertation, Aalto University, Espoo, Finland). Retrieved from <http://urn.fi/URN:ISBN:978-952-60-8001-7>
- Lindberg, T., Meinel, C., & Wagner, R. (2011). Design thinking: A fruitful concept for it development?. In C. Meinel, L. Leifer & H. Plattner (Eds.), *Design thinking* (pp. 3–18). Springer, Berlin, Heidelberg.
- Loorbach, D. (2007). *Transition Management: New Mode of Governance for Sustainable Development*. (Doctoral dissertation, Erasmus University Rotterdam, Utrecht, Netherlands). Retrieved from <hdl.handle.net/1765/10200>
- Loorbach, D. (2010). Transition management for sustainable development: a prescriptive, complexity-based governance framework. *Governance*, 23(1), 161–183.
- Lummaa, K. (2019, June 8). *Tekojen ja valintojen merkityksestä*. Bios. Retrieved from <https://bios.fi/tekojen-ja-valintojen-merkityksista/>
- Manzini, E. (2015). Design in the transition phase: a new design culture for the emerging design. *Design Philosophy Papers*, 13(1), 57–62.
- Manzini, E. (2016). Design culture and dialogic design. *Design Issues*, 32(1), 52–59.
- Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research policy*, 41(6), 955–967.
- Martínez-Alier, J. & Muradian, R. (Eds.). (2015). *Handbook of ecological economics*. Edward Elgar Publishing.
- Mattelmäki, T. (2006). *Design Probes*. (Doctoral Dissertation, University of Art and Design Helsinki, Helsinki, Finland). Retrieved from <http://urn.fi/URN:ISBN:951-558-212-1>
- Meyer, J. (2000). Using qualitative methods in health related action research. *BMJ*, 320(7228), 178–181.

- Miettinen, S., Rontti, S., & Jeminen, J. (2014, September). Co-prototyping emotional value. In *19th DMI: Academic Design Management Conference. Design Management in an Era of Disruption* (pp. 2–4).
- Moore, N. (2000). *How to do research: The complete guide to designing and managing research projects*. Library Association.
- Moore, J., Kissinger, M., & Rees, W. E. (2013). An urban metabolism and ecological footprint assessment of Metro Vancouver. *Journal of environmental management*, 124, 51–61.
- Muratovski, G. (2016). *Research for Designers*. Sage.
- National Advisory Board on Research Ethics. (2009). *Ethical principles of research in the humanities and social and behavioural sciences and proposals for ethical review*. The Finnish National Board on Research Integrity (TENK). Retrieved from <https://www.tenk.fi/sites/tenk.fi/files/ethicalprinciples.pdf>
- Nicolini, D. (2012). *Practice theory, work, and organization: An introduction*. OUP Oxford.
- Nissinen, A., & Savolainen, H. (2019). Julkisten hankintojen ja kotitalouksien kulutuksen hiilijalanjälki ja luonnonvarojen käyttö-ENVIMAT-mallinnuksen tuloksia. *Suomen ympäristökeskuksen raportteja*, 15, 2019.
- Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods*, 16(1), 1609406917733847.
- Onali, A. (2018, November 7). *Oikeutta ilmastolle*. Hyvän sään aikana. <https://hyvansaanaikana.fi/oikeutta-ilmastolle/>
- Pettersen, I. N. (2016). Fostering absolute reductions in resource use: the potential role and feasibility of practice-oriented design. *Journal of Cleaner Production*, 132, 252–265.
- Popa, F., Guillermin, M., & Dedeurwaerdere, T. (2015). A pragmatist approach to transdisciplinarity in sustainability research: From complex systems theory to reflexive science. *Futures*, 65, 45–56.
- Rajantie, L., Mänty, A., & Poussa, L. (2017). *Suomalaisten ympäristötietoisuus siirtyy hitaasti sanoista tekoihin*. Finnish Innovation Fund Sitra. Retrieved from <https://www.sitra.fi/uutiset/suomalaisten-ymparistotietoisuus-siirtyy-hitaasti-sanoista-tekoihin/>
- Rauschmayer, F., Bauler, T., & Schäpke, N. (2013). *Towards a governance of sustainability transitions: Giving place to individuals* (No. 17/2013). UFZ Discussion Paper.
- Raworth, K. (2012). A safe and just space for humanity: can we live within the doughnut. *Oxfam Policy and Practice: Climate Change and Resilience*, 8(1), 1–26.
- Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., ... & Nykvist, B. (2009). A safe operating space for humanity. *Nature*, 461(7263), 472–475.
- Røpke, I. (2015). Sustainable consumption: transitions, systems and practices. In *Handbook of ecological economics*. Edward Elgar Publishing.
- Rotmans, J., & Loorbach, D. (2009). Complexity and transition management. *Journal of industrial ecology*, 13(2), 184–196.
- Salminen, A., & Vadén, T. (2015). *Energy Experience: An Essay in Nafthology*. MCM Publishing.
- Sanders, E. B. N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *Co-design*, 4(1), 5–18.

- Schatzki, T. R., Knorr-Cetina, K., & Von Savigny, E. (Eds.). (2001). *The practice turn in contemporary theory* (Vol. 44). London: Routledge.
- Schwandt, Thomas A. *The SAGE Dictionary of Qualitative Inquiry*. 4th edition. Thousand Oaks, CA: SAGE, 2015.
- Schäpke, N., Omann, I., Wittmayer, J. M., Van Steenberg, F., & Mock, M. (2017). Linking transitions to sustainability: a study of the societal effects of transition management. *Sustainability*, 9(5), 737.
- Scupelli, P. (2015). Designed transitions and what kind of design is transition design? *Design Philosophy Papers*, 13(1), 75–84.
- Shove, E. A. (2003). *Comfort, Cleanliness and Convenience: The Social Organization of Normality*. Berg.
- Shove, E. & Walker, G. (2010). Governing transitions in the sustainability of everyday life. *Research Policy*, 39, 471–476.
- Shove, E., Pantzar, M., & Watson, M. (2012). *The dynamics of social practice: Everyday life and how it changes*. Sage.
- Smith, A., Voß, J. P., & Grin, J. (2010). Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. *Research policy*, 39(4), 435–448.
- Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., ... & Folke, C. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, 347(6223), 1259855.
- Steffen, W., Rockström, J., Richardson, K., Lenton, T. M., Folke, C., Liverman, D., ... & Donges, J. F. (2018). Trajectories of the Earth System in the Anthropocene. *Proceedings of the National Academy of Sciences*, 115(33), 8252–8259.
- Sustainable Lifestyles Accelerator (n.d.). *Sustainable lifestyles Accelerator*. <http://suslife.info/>
- Swann, C. (2002). Action research and the practice of design. *Design issues*, 18(1), 49–61.
- Thorne, S. (2000). Data analysis in qualitative research. *Evidence-based nursing*, 3(3), 68–70.
- Toivio, V. & Lettenmeier, M. (2018). *Kestävien elämäntapojen kiihdyttämö 2018, loppuraportti*. City of Porvoo. Retrieved from https://www.porvoo.fi/library/files/5c18cb08ed6b97f4b1000a4a/Kesta_vien_ela_ma_ntapojen_kiihdytta_mo__Loppuraportti_rev4.pdf
- United Nations (n.d.). Sustainable development goals. Sustainable development goals knowledge platform. <https://sustainabledevelopment.un.org/>
- Vaajakallio, K. (2012). *Design games as a tool, a mindset and a structure* (Doctoral dissertation, Aalto University, Espoo, Finland) Retrieved from <http://urn.fi/URN:NBN:fi:aalto-201312037994>
- Weber, E. U. (2010). What Shapes Perceptions of Climate Change?. *Wiley Interdisciplinary Reviews: Climate Change*, 1(3), 332–342.
- Wensveen, S., & Matthews, B. (2014). Prototypes and prototyping in design research. In *The Routledge Companion to Design Research* (pp. 278–292). Routledge.
- White, D., Rudy, A., & Gareau, B. (2015). *Environments, natures and social theory: Towards a critical hybridity*. Macmillan International Higher Education.
- White, K., & Habib, R. (2018). *SHIFT – A review and framework for encouraging ecologically*

sustainable consumer behaviour. Sitra studies 132. Helsinki: Sitra.

Wittmayer, J., & Roorda, C. (2014). Governing urban sustainability transitions–inspiring examples. *International Journal of Sustainable Development*, 15(1), 19–36.

References of figures

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*. Third Edition. Sage publications.

Schäpke, N., Omann, I., Wittmayer, J. M., Van Steenberg, F., & Mock, M. (2017). Linking transitions to sustainability: a study of the societal effects of transition management. *Sustainability*, 9(5), 737.

Lahtinen, S. (2019). Figure 19. The design game in use (Lahtinen, 2019). Image taken on the 7th of October, 2018 in Lahti.

Lahtinen, S. (2019). Figure 20. The third phase of the design game (Lahtinen, 2019). Image taken on the 4th of May 2018 in Lappeenranta.

Lindberg, T., Meinel, C., & Wagner, R. (2011). Design thinking: A fruitful concept for it development?. In C. Meinel, L. Leifer & H. Plattner (Eds.), *Design thinking* (pp. 3–18). Springer, Berlin, Heidelberg.

Vaajakallio, K. (2012). *Design games as a tool, a mindset and a structure* (Doctoral dissertation, Aalto University, Espoo, Finland) Retrieved from <http://urn.fi/URN:NBN:fi:aalto-201312037994>

Appendices

Appendix A

Interview questions

Outcomes: How was the experience to participate in the workshop? What thoughts did the workshop experience evoke?

Impact & social learning: Did it help you to understand something new? Did it help you to act or think in a new way?

Empowerment: Have you made lifestyle changes after the workshop? Have you talked to people about your experiences?

Network effects: How did you experience the role of other stakeholders in the workshop? What do you think is the role of stakeholders in general? In what context could the design game be used? Who could use the design game?

Observation questions

Experience: How was the overall atmosphere? What thoughts did the workshop experience evoke?

Interaction: What were the roles of the participants, facilitators, and experts?

Materials: How were the materials used and perceived? How were the rules understood and interpreted?

Social learning, empowerment & social capital: Did the game help understand something new? Did the game help to act in a new way?

Context of use: In what context could the game be used?

Appendix B

Informed Consent Form

I write my thesis related to sustainable lifestyle transitions. My supervisor is Professor Idil Gaziulusoy from Aalto University Department of Design. As part of my research, I collect research material from households, city employees and research team members (IGES et al., 2019) who have participated in or contributed to the development of the 1.5 °C Puzzle. The results will be used to develop and evaluate the design game to answer the research objective and questions in my thesis.

The interview takes about 20-30 min and is recorded with a voice recorder. The recordings are for my use and are used only for this study. The topics are discussed at a general level, and I also take citations from the interviews. If you wish, you can review and confirm the use of your citations before the report is published. The participants are presented anonymously in the final report. I will mention only the position of the person (household, city employee, or research team member) in the report.

Participation in the interview is voluntary. You can decline participation or withdraw from the interview anytime or without any consequences.

I declare my willingness to be interviewed for the study. I also agree that the interview will be recorded and that the interview will be used as research material.

It has been made clear to me that this is voluntary consent and that I can withdraw from the study if I wish without any consequences.

Name: _____

Phone: _____

Date and place: _____

Signature: _____

- o I want to review my citations for review before publishing a research report. I hope they will be delivered to the address below

Email address: _____

As a researcher, I commit to respecting and protecting the interviewee's anonymity. Below you can find my contact information. If you have any questions regarding the study, I will be happy to answer.

Sonja Nielsen, Aalto University, Department of Design
phone number: 0404184506
email: sonja.nielsen@aalto.fi

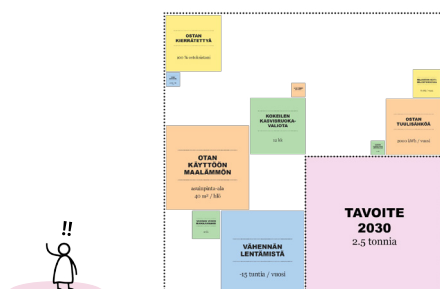
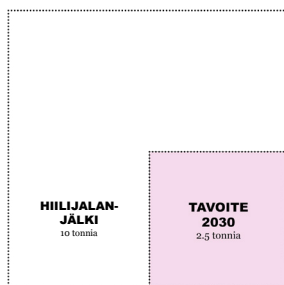
The presentation slides

Tausta

- 1.5 degree lifestyles - tutkimuksen soveltaminen käytännössä.
- Tavoitteena kestävien elämäntapojen tekeminen
ymmärrettäväksi ja helposti lähestyttäväksi kotilouksien
näkökulmasta.
- Kokeiltu kuntien, kotilouksien, tutkijoiden, yritysten,
kouluttajien ja opiskelijoiden kanssa Suomessa, Japanissa,
Sveitsissä, Espanjassa ja Meksikossa.

Työpaja

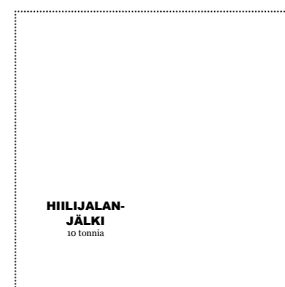
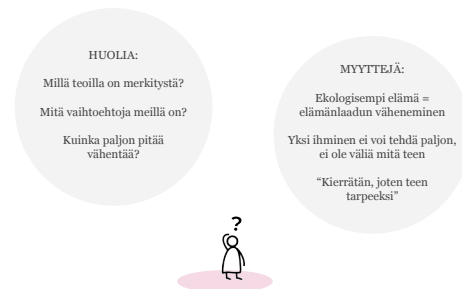
- | | |
|-------------------|--------------------------------------------------------------------------|
| TEHTÄVÄ 1: | Täytä kuilu teoilla (20 min) |
| TEHTÄVÄ 2: | Järjestä valitut teot aikajanalle (15 min) |
| TEHTÄVÄ 3: | Valitse kolme tekoa tälle vuodelle (5 min) |
| TEHTÄVÄ 4: | Keneltä ja minkälaista apua toivoisitte tekojen toteuttamiseksi? (5 min) |



1.5°

Työpaja

Lukio-seminaari
XX
7.10.2019



Tehtävä 1

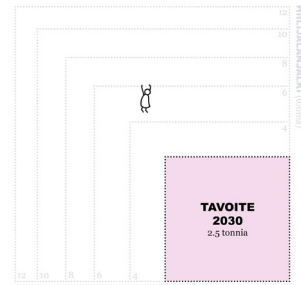
20 minuuttia

Laske kotitaloutesi
hiilijalanjälki
www.elamantapatesti.sitra.fi

Tehtävä 1

20 minuuttia

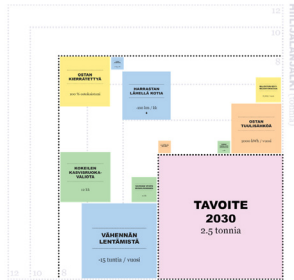
Merkitkää
kanvaasille valitun
kotitalouden
nykyinen
jalanjälki



Tehtävä 1

20 minuuttia

Täyttäkää nykyisen
hiilijalanjäljen ja
tavoitteen välinen
kuilu teoilla!



Huomioitavaa:

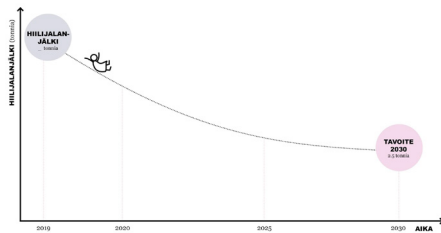
- Valitkaa tekoja, jotka ovat valitulle kotitaloudelle sopivia ja joita kyseinen kotitalous ei vielä tee.
- Jotkut teoista ovat päällekkäisiä.
- Muista, että tekojen toteuttamiseen on 10 vuotta aikaa.
- Monet teoista löytyvät eri kokoisina. Voitte myös yhdistellä eri kokoja.
- Siirtäkää sivuun teot, jotka on jo käyty läpi.
- Kysykää apua!



Tehtävä 2

15 minuuttia

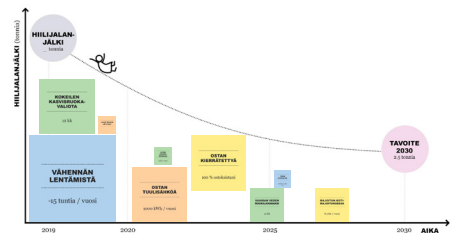
Järjestäkää
valitut teot
aikajanelle
2019 - 2030



Tehtävä 2

15 minuuttia

Järjestäkää
valitut teot
aikajanelle
2019 - 2030



Tehtävä 3

5 minuuttia

Valitse kolme
tekoa, jotka
toteutat vuonna
2019

Kolme tekoa vuodelle 2019		
Teon nimi	Hiilijalanjäljen pienentäminen	Näin totesaan elämäntapamuutokset (tietä, määri, taitoja, taitoja, taitoja)
1		
2		
3		

Tehtävä 4

5 minuuttia

Kirjoita toiveesi
post-it lapuille
ja sijoita teon
päälle

Keneltä ja minkälaisista apua
toivot teon toteuttamiseksi?
Sijoita itsenäisesti kaksi post-it
lappua toimijaa kohden.

- Julkinen sektori
- Yksityinen sektori



Kysymyksiä:

- Mitä ajatuksia työpajakokemus herätti?
- Mitä muuta voit tehdä kuin vaikuttaa elämäntapoihin?



Appendix D

Texts for action cards

Osa-alue	Teko	Teon selite
Asuminen	Alennan kodin lämpötilan	Laskemalla kodin lämpötilaa kahdella asteella asunnossasi (20 m ² /hlö) pienennät lämmityskulujasi noin 10 % vuodessa.
Asuminen	Tarkistan ikkunoiden eristykset	Korjaamalla tai vaihtamalla tiivisteet ja teippaamalla ikkunat talveksi voit parantaa asumisen viihtyvyyttä. Lisäksi voit säästää jopa 5% lämmityskuluissa.
Asuminen	Otan lyhyempiä suihkuja	Vähentämällä suihkuaikaa 4 minuuttia päivässä säästät sekä rahaa että energiaa.
Asuminen	Asennan vesimittarit ja seuraan vedenkulutusta	Tarkkailemalla vedenkäyttöä ja reagoimalla kulutukseen voit laskea vedenkulutusta jopa 15–20 prosentilla henkilöä kohden.
Asuminen	Pidän huolta jääkaapista ja pakastimesta	Puhtaana pidettyinä ja oikein huollettuina kylmälaitteet voivat säästää energiaa jopa 10%.
Asuminen	Ryhdyn energiantuottajaksi	Korvaa ostosähkö asentamalla kotiisi 5 m ² verran aurinkopaneeleja.
Asuminen	Otan käyttöön ilmalämpöpumpun	Asenna asuntoosi ilmalämpöpumppu, jonka avulla vuotuinen kaukolämmön kulutus voi vähentyä jopa 50%.
Asuminen	Otan käyttöön maalämmön	Maalämmön käyttöönotto vähentää kaukolämmön tai öljylämmityksen tarvetta 60%.
Asuminen	Käytän kylpyhuoneen lattialämmitystä kohtuudella	Laskemalla kylpyhuoneesi lämpötilaa 2°C kylpyhuoneen lämmitysenergian tarve vähenee 10%.
Asuminen	Lauteille vain kerran viikossa	Säästät merkittävästi lämmityskustannuksissa vähentämällä yhden sähkösaunakerran viikossa.
Asuminen	Huomioin piikit sähkönkulutuksessa	Huomioi piikit sähkönkulutuksessa 20/40 m ² asunnossa. Tarkkailemalla ja säätelemällä sähkön käyttöä voit vähentää sähkönkulutustasi jopa 10%! Vähentämällä sähkönkulutusta kulutuspiikkien aikana voit pienentää sähkölaskuasi sekä voimaloiden sähköntuotantotarvetta.
Asuminen	Tarkkaile sähkönkulutustasi sähköyhtiön e-palvelun kautta	Tarkkailemalla sähkönkulutustasi voit pienentää jopa 10% sähkönkulutustasi.
Asuminen	Hyödynnän taloyhtiön yhteistiloja	Muuta pienempään asuntoon (3 m ²) ja korvaa vähentynyttä tilaa käyttämällä taloyhtiön yhteistilaa, esimerkiksi pesutupaa.
Asuminen	Ostan tuulisähköä	Vaihda ostosähkö tuulisähköön (500/1000 kwh)! Tuulivoima on yksi puhtaimmista tavoista tuottaa sähköä.
Asuminen	Vaihdan LED-lamppuihin	Vaihda lamput LED-lamppuihin. Päästöjä säästyy, koska ledit kuluttavat vähemmän energiaa ja kestävät pidempään.

Asuminen	Ostan energiatehokkaat kodinkoneet	Energiatehokas laite käyttää jopa 40% vähemmän energiaa kuin vanha laite.
Asuminen	Hankin aurinkokeräimen	Korvaamalla osan ostosähköstäsi aurinkokeräimellä (5m ² / henkilö), pienennät sähkönkulutustasi ja päästöjäsi.
Asuminen	Vuokraan vierashuoneen matkailijoille	Vuokraa huone turisteille viikon ajaksi vuodessa. Säästö päästöissä syntyy kun asunnon ylläpitoon tarvittavat materiaalit ja lämmitysenergia jakautuvat useammille käyttäjille.
Asuminen	Kun muutan, muutan pienempään asuntoon	Muuttamalla 10 m ² pienempään asuntoon pienennät hiilijalanjälkeäsi ja säästät asumisen kustannuksissa. Säästö syntyy vähentyneistä rakennus- ja ylläpitokuluista.
Asuminen	Alennan tyhjien tilojen lämpötilaa	Laskemalla varaston, huoltotilan tai tyhjän huoneen (koko 3 m ² henkilöä kohden) lämpötilaa viidellä asteella vähennät lämpöenergian kulutusta ja säästät kuluissa.
Asuminen	Pesen pyykit ja astiat matalissa lämpötiloissa	Pesulämpötilan laskeminen 60 asteesta 40 asteeseen näkyy sähkön säästönä. Matalammassa lämpötilassa peseminen pidentää myös vaatteiden käyttöikää.
Asuminen	Hyödynnän verhot ja sälekaihtimet lämmitykseen ja viilennykseen	Säästät lisälämmitykseen tai -viilennykseen tarvitaan vähemmän energiaa, mikä näkyy myös energialaskussa.
Asuminen	Perustan hyötynuutarhan	Korvaa 1/3 kesäkauden kasviksista itsekasvateilla 3 kuukauden ajan.
Asuminen	Kun rakennan, rakennan A-energialuokan puutalon	Rakentamalla energiatehokkaan ja kompaktin puutalon, voimaloissa tarvitsee tuottaa vähemmän lämpöä ja rakentamisessa käytetään resurssitehokkaampia materiaaleja.
Asuminen	Lasken tyhjiällä olevan kesämökin lämpötilaa	Vaihtamalla peruslämmityksen kuivanapitolämmitykseen vähennät lämmitysenergian tarvetta ja säästät jopa useita satoja euroja vuodessa.
Asuminen	Kuivatan pyykit narulla	Kuivaa pyykit ulkona kuivausrummun sijaan kolmen kuukauden ajan (20 viikkoa).
Asuminen	Pesen vaatteita harvemmin	Vähennä pyykinpesukertoja kolmanneksella. Vettä tarvitsee täten lämmittää vähemmän ja vaatteiden käyttöikä pitenee.
Asuminen	Kytken laitteet katkaisijalla varustettuun jatkojohtoon	Virtojen kytkeminen pois jatkojohtoon katkaisijalla tai ajastimella on nopea ja arkinen tapa säästää jopa 5-10% viihde- ja elektroniikkalaitteiden sähkönkulutuksesta.
Asuminen	Pesen täysiä koneellisia	Pese täysiä koneellisia, jolloin säästyy yksi pyykkäyskerta henkilöä kohden viikossa. Päästöjä säästyy, koska voimaloissa tarvitsee tuottaa vähemmän sähköä.
Asuminen	Ostan uusiutuvilla tuotettua kaukolämpöä	Vaihda tavallinen kaukolämpö uusiutuvilla tuotettuun kaukolämpöön.
Asuminen	Käytän kohtuudella auton lohkolämmittintä	Käyttämällä lohkolämmittintä X tuntia vähemmän loka–maaliskuussa vähennät auton bensankulutusta sekä moottorin rasittumista ja kulumista.

Arkiliikenne	Valitsen sähköauton	Korvaa bensiinikäyttöinen auto sähköautolla. Huomioi kuitenkin, että vaikka liikkuminen sähköautoilla on polttomoottoriautoon verrattuna ekologisempaa, kuluttaa niiden valmistaminen enemmän luonnonvaroja.
Arkiliikenne	Autoni käy biokaasulla	Korvaa bensiinikäyttöinen auto bioetanoliautolla. Polttoaine on biojätteestä valmistettu kotimainen ja ympäristöystävällinen valinta.
Arkiliikenne	Kuljen työpaikalle lihasvoimin	Korvaa autoilua pyöräilyllä viikossa 20 viikon ajan. Lihasvoimalla työmatka taittuu terveellisesti ja usein lyhyillä matkoilla myös autoa nopeammin.
Arkiliikenne	Matkustan kimppekyydillä	Jaan kyydin kolmen henkilön kanssa X km kuukaudessa yksityisautoilun sijaan vuoden ajan.
Arkiliikenne	Liikkuminen palveluna (MaaS)	Kokeilen auton omistamisen sijasta liikkumista palveluna, mikä tarkoittaa eri liikkumismuotojen, kuten julkisten, yhteiskäyttöautojen, tai kaupunkipyörien yhdistelemistä tarpeen mukaan.
Arkiliikenne	Tarjoan autoni yhteiskäyttöön	Korvaa automarkettikäynnin (5 km kotoa) käymällä kävelen lähikaupassa (2 km) kerran viikossa.
Arkiliikenne	Vuokraan auton tarvittaessa	Käytä vuokra- tai yhteiskäyttöautoa auton omistamisen sijaan.
Arkiliikenne	Kävelen autoilun sijaan	Korvaamalla autoilua kävelyllä kolme kertaa viikossa voit pienentää hiilijalanjälkeäsi ja parantaa omaa hyvinvointiasi.
Arkiliikenne	Harrastan lähellä/ lähempänä kotia	Korvaa autolla liikkumista viikossa kävelemällä tai pyöräilemällä. Omasta lähiympäristöstä voi löytyä yllättävän paljon harrastusmahdollisuuksia.
Arkiliikenne	Kuntoni kohoaa sähköpyörällä polkiessa	Korvaan autolla ajamista sähköpyörällä polkemiseen kerran viikossa 10 kuukauden ajan.
Arkiliikenne	Kuljen julkisilla	Kulje julkisilla oman auton sijaan 40 viikon ajan. Bussissa, junassa tai raitiovaunussa ajan voi käyttää hyödyksi: lue, neulo, kuuntele podcasteja tai selaa päivän uutiset.
Arkiliikenne	Teen etätöitä	Yksi etätöypäivä viikossa. Etätöypäivänä säästät työmatka-autoiluun tai matkoihin kuluvat eurot ja hiilidioksidipäästöt.
Arkiliikenne	Kun muutan, muutan lähemmäs	Muuttamalla lähemmäs työpaikkaa ja palveluita kuljet vähemmän autolla päivässä 10 kuukauden ajan.
Arkiliikenne	Tilaan ruokakassit suoraan kotiin	Hoida viikon ruokaostokset kotisohvalta ja säästä ajan lisäksi myös autoilukilometrejä 10 km viikossa. Samalla vältät ruuhkaiset ruokakaupat ja heräteostokset.
Vapaa-aika ja matkustus	Lomailen junailemalla	Korvaa autolla ajoa junamatkailulla vuodessa. Junalla matka taittuu tasaisesti vaihtuvissa maisemissa, ja mikä parasta, kaikki saavat levätä tai leikkiä leikkivaunussa!
Vapaa-aika ja matkustus	Vähennän lentämistä	Lennä vähemmän. Lentämisen vaikutus hiilijalanjälkeesi on täysin omassa luokassaan, joten turhasta lentämisestä luopuminen on todellinen ympäristöteko.
Vapaa-aika ja matkustus	Vietän lomani kotimaassa (korvaan Espanjan matkan)	Korvaa Espanjan matkan (lennot + hotellit) kotimaanmatkalla matkustamalla kotoa 500 km autolla ja yöpymällä 3 vrk kansallispuistossa teltassa ja 2 vrk hotellissa.

Vapaa-aika ja matkustus	Vietän lomani kotimaassa (korvaan Thaimaan matkan)	Korvaa Thaimaan matkan (lennot + hotellit) kotimaanmatkalla matkustamalla kotoa 500 km autolla ja yöpymällä 3 vrk kansallispuistossa teltassa ja 2 vrk hotellissa.
Vapaa-aika ja matkustus	Lomailen viikonlopun kotona	300km vähemmän ajamista ja kaksi yötä vähemmän hotellissa. Kotiloma rentouttaa ja virkistää.
Vapaa-aika ja matkustus	Matkustan harvemmin, mutta olen perillä pidempään	Pidän kahden viikon loman Euroopassa sen sijaan, että tekisin yhden Aasian matkan ja yhden viikonloppuloman Euroopan kohteeseen.
Vapaa-aika ja matkustus	Laitan kesämökkini vuokralle	Vuokraan kesämökkini turisteille 30 päivää vuodessa. Yhteiskäytössä oleva kesämökki jakaa kustannuksia ja vuokraaminen voi tuoda jopa lisätienestettä.
Vapaa-aika ja matkustus	Lomailen pyöräilemällä	Korvaa autolla ajamista pyöräilyllä vuosittain. Pyöräillessä maisemat ja kohteet tulevat läheltä tutuiksi. Matkakohteet löydät pyörällä yhtä lailla lähiympäristöstä kuin kauempaakin.
Vapaa-aika ja matkustus	Majoitun kotimajoituksessa	Majoitun kotimajoituksessa (esim. AirBnB) X päivää vuodessa hotellin sijaan. Päästöjä säästyy vähentyneestä uusien hotellien ja muiden majoituskohteiden rakennustarpeesta.
Vapaa-aika ja matkustus	Vaihdan uimahallin järveen	Pulahdan järveen uimahallin sijasta kerran viikossa kesän (3kk) ajan. Päästöjä säästyy sisäuimatilojen lämmittämisen ja koska uusia tiloja tarvitsee rakentaa vähemmän.
Ruoka	Keitän kahvia vain tarvitsemäni määrän	Keitän kupillisen vähemmän kahvia (1,25dl) tai teetä (2,5dl) päivittäin kahvin- tai vedenkeittimellä. Keittämisen, viljelyn, käsittelyn ja kuljetuksen tuottamat päästöt vähenevät.
Ruoka	Valitsen lähiruokaa (kaupasta ja toreilta)	Suosi lähiruokaa 3/6 kuukauden ajan. Päästöjä säästyy kuljetusmatkojen lyhentyessä ja polttoaineenkulutuksen pienentyessä.
Ruoka	Syön luomuruokaa	Osta 25% / 100% luomuruokaa vuodessa. Luomutuotteiden tuottaminen synnyttää 10% vähemmän päästöjä tuotantovaiheessa.
Ruoka	Kokeilen kasvisruokavaliota	Lakto-ovo-kasvisruokavalio sekasyönnin sijaan. Kasvisruoka on edullista, terveellistä ja herkullista, ja pääset kokeilemaan uusia reseptejä!
Ruoka	Vaihdan punaisen lihan kalaan tai kanaan	Korvaa punaisen lihan kanalla ja kalalla (50-50) 1/6 kk ajan. Päästöt vähenevät märehitijöiden ja rehuntuotannon aiheuttamien kasvihuonepäästöjen vähentyessä.
Ruoka	Ryhdyn vegaaniksi	Kokeilen vegaanista ruokavaliota sekasyönnin sijaan. Päästöt vähenevät tuotantoeläinten ja rehuntuotannon aiheuttamien kasvihuonepäästöjen vähentyessä.
Ruoka	Vietän kasvisruokapäiviä	Lakto-ovo-kasvisruokavalio sekasyönnin sijaan 3 kertaa viikossa. Muutaman viikottaisen kasvisruokapäivän pitäminen on helppo tapa keventää niin omaa oloa kuin hiilijalanjälkeä.

Ruoka	Suosin suomalaisia järvikalvoja	Suosi järvikalvoja viljellyn kalan sijaan kuuden kuukauden ajan. Järvikalaa ostamalla tuet samalla suomalaisia kalastajia. Päästöt vähenevät rehuntuotannon pienentyessä.
Ruoka	Taion ruokaa tähteistä	Käytä tähteitä aterian valmistamiseen kerran viikossa perheenjäsentä kohti. Ruokahävikin vähentyessä pienenee myös hiilidioksidipäästöjen määrä, koska ruokaa tarvitsee tuottaa vähemmän.
Ruoka	Ostan lähellä eräpäivää olevia tuotteita	Osta lähellä eräpäivää olevia alennustuotteita. Ruokahävikin vähentyessä pienenee myös hiilidioksidipäästöjen määrä, koska ruokaa tarvitsee tuottaa vähemmän.
Ruoka	Pelastaan ylijäämälounaan	Pelasta 1 ylijäämäateria / 2 ylijäämäateriaa viikossa perheenjäsentä kohden tai osta edullinen ylijäämälounas työpaikkaravintolasta.
Ruoka	Vaihdan kasvipohjaisiin maitotuotteisiin	Korvaa maito kasvipohjaisilla tuotteilla. Päästövähenys syntyy märehtijöiden ja rehuntuotannon aiheuttamien kasvihuonepäästöjen vähentyessä.
Ruoka	Vaihdan ruokajuomaksi veden (maidon sijaan)	Vaihda ruokajuomaksi vesi maidon sijaan 3kk ajan. Säästöjä päästöissä syntyy märehtijöiden ja rehuntuotannon aiheuttamien kasvihuonepäästöjen vähentyessä.
Ruoka	Mitoitan ruuan yhden lautasen taktiikalla	Yhden lautasen taktiikka on helppo keino noudattaa terveellistä lautasmallia, hillitää annoskokoja ja vähentää ruokajätteen määrää.
Ruoka	Ostan "viallisen" vihanneksen	Osta viikon aikana 500g/hlö "viallisia" ruokatuotteita, kuten käyriä kurkkuja. Päästöjä säästyy ruokahävikin vähentyessä.
Ruoka	Suosin perunaa ja ohraa riisin sijaan	Korvaa 100g riisiä viikossa perunalla. Päästöt pienenevät, koska riisin viljelystä muodostuvat kasvihuonekaasut vähenevät ja kaukomailta kuljetetun ruuan sijasta lautaseltasi löytyy lähiruokaa.
Ruoka	Suosin mikroa, vedenkeitintä ja induktioliettä ruuanvalmistuksessa	Suosimalla mikroa, vedenkeitintä ja induktioliettä ruoanvalmistuksessa kulutat 30% vähemmän energiaa verrattuna keraamiseen liekeen.
Ruoka	Seuraan ostoslistaa	Kun teet ostoslistan ennen kauppaan menoa ja ostat vain tarvitsemasi määrän ruokaa, vähennät ruokahävikkiä ja heräteostoksia. Päästöt putoavat, kun ruokaa tarvitsee tuottaa vähemmän.
Tavarat	Ostan kierrätettyä	Osta 25/50% kaikista kodin tavaroista käytettynä. Päästöt vähenevät ja materiaalia säästyy, koska uusia tavaroita tuotetaan vähemmän ja kuljetustarpeet pienenevät.
Tavarat	Tavarat yhteiskäyttöön	Kun yksityisomistamisen sijaan jaat puolet käyttämästäsi tavaroista muiden kanssa esimerkiksi taloyhtiössäsi, säästyy niiden valmistamiseen ja käyttöön kuluva energia ja materiaalia.
Tavarat	Korjaan hyvät tuotteet	Korjaa tai korjauta vuodessa viisi vaatetta, yksi huonekalu ja yksi sähkölaite perheenjäsentä kohden.

Tavarat	Käytän pesuainetta harkiten	Mittaamalla pesuaineen huolellisesti säästät rahaa, pesukonetta ja ympäristöä. Uudet ympäristöystävälliset pesuaineet myös mahdollistavat pesemisen matalammassa lämpötilassa.
Tavarat	Perustan yhteisen lehtihyllyn	Yhteinen lehtihylly tarjoaa iloa koko naapurustolle ja säästää rahaa. Säästöjä syntyy, kun painotuotteiden määrä vähenee.
Tavarat	Menen kirjastoon	Lainaamalla yhden kirjan kuukaudessa ostamisen sijaan säästät rahaa ja ympäristöä. Päästöt säästyvät kirjojen valmistamiseen vaadittavien materiaalien ja energian vähentyessä.
Tavarat	KonMaritan kotini	Osta ja omista vain asioita, jotka tuottavat sinulle iloa. Vanha tavarasi voi olla jollekin aarre. Energiaa ja materiaalia säästyy, kun tavaroita tuotetaan vähemmän.
Tavarat	Ostan vähemmän vaatteita ja kenkiä	Osta ja omista vain asioita, jotka tuottavat sinulle iloa. Vanha tavarasi voi olla jollekin aarre. Energiaa ja materiaalia säästyy, kun tavaroita tuotetaan vähemmän.
Tavarat	Lajittelen jätteet kierrätykseen	Lajittelemalla jätteet päästöjä säästyy materiaalien uusiokäytön vuoksi.
Tavarat	Lisään "ei mainoksia, kiitos" -tarran kotioveeni	Liimaamalla "Ei mainoksia, kiitos" -tarran postiluukkuun vähennät pienellä vaivalla paperijätteen määrää.
Tavarat	Käytän omaa kauppakassia	Käyttämällä kauppareissuilla omaa kestokassia muovikassin sijasta voi perheessä säästää 5kg muovia henkilöä kohden vuoden aikana.
Muut teot	Pidän enemmän vapaapäiviä	Kun tienaat ja käytät vuodessa 1000 euroa vähemmän pitämällä useammin palkattomia vapaapäiviä, saat enemmän aikaa itsellesi.
Muut teot	Suosin vastuullisia palveluntuottajia	Suosimalla vastuullisia ravintola- tai hotellipalveluita, päästöjä säästyy palveluiden pienemmästä energiankulutuksesta ja resurssiviisaammasta tarjonnasta.
Muut teot	Annan lahjaksi tarpeellista	Anna vain tarpeellisia ja hyödyllisiä lahjoja koko vuoden ajan. Ota selvää, mitä lahjan saaja todella tarvitsee. Lahjana voi olla myös ruokaa tai vaikka aineeton palvelu.

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