TAL TECH   **d&tf**   **EKA**

TALLINN UNIVERSITY OF TECHNOLOGY   **ESTONIAN ACADEMY OF ARTS**

SCHOOL OF ENGINEERING   FACULTY OF DESIGN

DESIGN & TECHNOLOGY FUTURES

TOIVAR - A FOOD SHARING SYSTEM FOR HOUSEHOLD COMMUNITIES TO EASE THE ACCESS AND LOWER STIGMATISATION BURDENS OF SHAREABLE FOOD

TOIVAR – LEIBKONDADEVAHELINE

TOIDUJAGAMISE SÜSTEEM JAGATAVA TOIDU KÄTTESAADAVUSE LIHTSUSTAMISEKS JA KAASNEVA STIGMATISEERUMISE VÄHENDAMISEKS

MASTER THESIS

Name: Larissa Maria Pelke

Student Code: 201682MADM

Supervisor: Martin Pärn

Tallinn, 2022

AUTHOR'S DECLARATION

Hereby I declare that I have written this thesis independently.
No academic degree has been applied for based on this material. All works,
major viewpoints and data of the other authors used in this thesis have been
referenced.

".........." 2022

Author: ....
          /signature /

Thesis is in accordance with terms and requirements

".........." 2022

Supervisor: …..........................
          /signature/

Accepted for defence

".........." 2022

Chairman of theses defence commission: ....
                              /name and signature/

Non-exclusive Licence for Publication and Reproduction of Graduation Thesis[1]

I, Larissa Maria Pelke (10-08-1996) hereby

1. grant Tallinn University of Technology (TalTech) a non-exclusive license for my thesis *Toivar - a food sharing system for household communities to ease the access and lower stigmatization burdens of shareable food*, supervised by Martin Pärn,

    1.1   reproduced for the purposes of preservation and electronic publication, incl. to be entered in the digital collection of TalTech library until expiry of the term of copyright.

    1.2   published via the web of TalTech, incl. to be entered in the digital collection of TalTech library until expiry of the term of copyright.

    1.3   I am aware that the author also retains the rights specified in clause 1 of this license.

2. confirm that granting the non-exclusive license does not infringe third persons' intellectual property rights, the rights arising from the Personal Data Protection Act or rights arising from other legislation.

_____ (*signature*)

_____ (*date*)

---

[1] *Non-exclusive Licence for Publication and Reproduction of Graduation Thesis is not valid during the validity period of restriction on access, except the university`s right to reproduce the thesis only for preservation purposes.*

THESIS TASK

Student: Larissa Maria Pelke,

Study programme   MADM10/20, Design and Technology Futures

Main specialty   Design

Supervisor: Engineer, Martin Pärn, +372 513 8791

Thesis topic:

English   Toivar - a food sharing system for household communities to ease the access and lower stigmatisation burdens of shareable food

Estonian   Toivar - leibkondadevaheline toidujagamise süsteem jagatava toidu kättesaadavuse lihtsustamiseks ja kaasneva stigmatiseerumise vähendamiseks

Thesis main objectives:

1. Understanding and analysing the coexistence of food waste and stigmatisation

2. Exploring existing food saving solutions to re-think a food saving solution for the chosen scope of the thesis

3. Designing a system that makes food sharing as a food saving method convenient and unbiased

Thesis tasks and time schedule:

No	Task description	Deadline
1.	Literature research and analysis	10.04.2022
2.	Concept finalization	13.05.2022
3.	Thesis finalization	23.05.2022

Language: English   **Deadline for submission of thesis:**   23.05.2022

Student: Larissa Maria Pelke   …………………………………………   ……… 2022

Supervisor: Martin Pärn   …………………………………………   ……… 2022

Head of study programme: Martin Pärn   …………………………………………   ……… 2022

ABSTRACT

The co-existence of food waste and food insecurity is one of the most reasonless problems of humanity. In Estonia, most food waste occurs on a household level while more Estonians suffer from food insecurity due to increasing prices and unexpected disruptions such as pandemics and wars. Thus, the demand for free food is remarkably high. While for food-insecure people exist solutions to get access to free food, the fact that this access is limited or addressed to food-insecure people supports the stigmatisation of free food. This stigmatisation affects not only food-insecure but also food-secure people. The problem lies not only in the lack of accessibility to free food but also in the psychological burden of accessing free food. Additionally, only a few people take advantage of free food due to physical burdens that lower the individual's motivation and ability to share and redistribute free food. It leads to the question: How to reduce food waste on a household level inside a community by easing access and lowering the stigmatisation burdens of free food? The goal of this master thesis is to design a reliable food saving system for household communities that facilitates and encourages food sharing and makes users feel more comfortable and responsible while accessing shared food.

The designed solution "Toivar" is a smart food sharing system that reduces household food waste inside a community by easing access and lowering stigmatisation burdens of shareable food. The system consists of a food shelf inside the entrance area of an apartment building, food boxes and a smart app for management and communication. Toivar focuses on households inside apartment buildings because it manages specific friction points such as food distribution and maintenance better than existing sharing alternatives. Nudging mechanisms maintain the system and smart functions within the system ease and manage the sharing process. Distribution and maintenance entirely rely on the community.

Toivar is a result of constructive design research in the field of food waste, food saving in Estonia and the phenomenon of stigmatisation of accessing shared food. Stigmatisation has been identified as the reason why people hesitate to take shareable food. A comparative experimentation method has been guidance throughout the solution development process.

EESTIKEELNE KOKKUVÕTE

Toidu raiskamise ja toiduga kindlustamatuse kooseksisteerimine on üks põhjendamatuid inimkonna probleeme. Eestis toimub enamus toidu raiskamisest kodumajapidamiste tasemel, samas kui üha enam eestlasi kannatavad hinnatõusust ja ootamatutest häiringutest, nagu näiteks pandeemiad ja sõjad, tingituna toiduga kindlustamatuse all. Seega on nõudlus tasuta toidu järele väga suur. Kuigi toiduga kindlustamatute inimeste jaoks on lahendused ja ligipääs tasuta toidule olemas, siis puhtalt see fakt, et see ligipääs on piiratud või adresseeritud inimestele, kes kannatavad toiduga kindlustamatuse all, toetab tasuta toidu stigmatiseerimist, mis omakorda mitte ainult ei mõjuta toiduga kindlustamatuse all kannatavaid inimesi vaid ka inimesi kes on sellest murest vabad. Seega ei ole probleem mitte ainult tasuta toidule ligipääsu puudumises vaid ka tasuta toidu tarbimise psühholoogilises koormas. Lisaks, saavad liiga vähesed inimesed tasuta toidust kasu tänu füüsilistele piirangutele, mis vähendavad indiviidi motivatsiooni ning võimekust toitu jagada ning ümber jaotada.

See viib küsimuseni: „Kuidas vähendada toidu raiskamist kogukonna kodumajapidamise tasandil tasuta toidu kättesaamise lihtsustamisel ning stigmatiseerimise koorma alandamisel?"

Selle magistritöö eesmärk on kujundada usaldusväärne toidu jagamise süsteem kogukonna kodumajapidamistele, mis lihtsustab ning julgustab toidu jagamist ning muudab kasutajad toidu jagamisele ning jagatud toidu tarbimisele vastuvõtlikumaks ja selle suhtes vastutustundlikumaks.

Loodud lahendus, „Toivar", on nutikas toidu jagamise süsteem, mis vähendab kogukonna kodumajapidamises toidu raiskamist jagatud toidule ligipääsu parandamise ning stigmatiseerimiskoorma vähendamise kaudu.

Süsteem koosneb kortermaja sissepääsu juures asuvast toiduriiulist, toidukarpidest ning nutirakendusest suhtlemiseks ning süsteemi haldamiseks. Toivar keskendub kortermaja kodumajapidamistele kuna seal on võimalik seni eksisteerivate toidujagamisüsteemide valukohti, nagu näiteks toidu jaotamine ja korrashoid, paremini ohjata. Nügimismehhanismid peavad süsteemi üleval ning süsteemisisesed nutifunktsioonid hõlbustavad ja ohjavad jagamise protsessi. Jagamine ning korrashoid toetub täielikult kogukonnale.

Toivar on konstruktiivse disainiuurimuse tulemus toidu raiskamise ja toidu säästmise alal Eestis ning jagatud toidu tarbimise stigmatiseerimise fenomeni valdkonnas. Stigmatiseerimist peetakse jagatud toidu võtmisel kõhklemise põhjuseks. Disainiuurimuse võrdlev katsetusmeetod on läbi protsessi olnud aluseks lahenduse arendamisel.

Content

1. Introduction

"*Disposing of food in a trash can or toilet is one of the most meaningless steps in human development.*" (Harrik, 2021). This statement by Ulrike Plath (German historian living in Tallinn) brings one of our biggest global paradoxes to the point: more and more edible food is getting wasted in the whole food supply chain, while at the same time the percentage of people suffering from food insecurity and hunger is increasing.

The author grew up in an international family that highly appreciates and celebrates food. She noticed that post-war generations tend to waste more food while losing knowledge and trust in food. Because of her increased desire to fight against food waste, she decided to work on a solution for food waste reduction in and for the city of Tallinn within this master thesis.

Food waste is considered to be something that must be concealed or hidden from the public because it can be connected to negligence and human failure. Even if the goodwill is there, food gets wasted due to a lack of management skills, knowledge and awareness. Food waste can be seen as the opposite of care, commitment and sustainability (Martínez, 2017) and causes negative feelings. But by accepting it as a natural human failure, it can also be turned into a tool for activism, for example through food saving. Saving food means saving personal or others' edible food through consuming, recycling, conserving or sharing before it gets spoiled or wasted to maintain or even higher the value of food as a cultural heritage. The presented work is based on the hypothesis that everyone should have access to free surplus food. No matter what is the reason for taking it, saving food from being wasted means reducing food waste and supporting equality in society.

The thesis relies on constructive design research. Comparative experimentation methods have been a guide throughout the solution development process. The methodology relies on the latest scientific sources of different formats. For example, the Stockholm Environment Institute recently released the SEI report, which contains detailed data about food waste in Estonian private households. Further, a lot of information has been gained from the United Nations and the European Commission. Scientific articles and reports gave more qualitative insights from different disciplines. The reports of Martínez for example allowed the author to see the topic of food waste from a rather anthropological and psychological perspective. The book "Feeding the

other" by de Souza provided in-depth information about stigmatisation related to food insecurity. To explore the field of nudges, the book "Nudge" by Thaler has been studied.

Since the field research and the design testing have been conducted in Estonia, the master thesis looks closer on how and why food gets wasted in Estonian households. The research focused on the situation of food waste on a scientific and psychological level and methods on how to reduce food waste in Europe, with Tallinn as a case example. Further, the author focused on the accessibility to free food in Tallinn and how citizens are affected by the neoliberal stigmatisation of free food access. At the same time, various surveys, interviews and observations have been conducted among Tallinn citizens and institutions to discover their perceptions and feelings about food waste and access to free food, for example through volunteering at the food bank. Existing food-saving solutions in Tallinn have been analysed and evaluated according to their effectiveness, usability and accessibility, for example, the food sharing group Tallinn. The research brought out that food gets wasted in Tallinn while at the same time people suffer from food insecurity. While there currently exist solutions to get access to free food for food-insecure people, the fact that this access is limited or addressed to them supports the stigmatisation of free food. This affects not only food-insecure but also food-secure people. Therefore, the problem lies not only in the lacking accessibility to free food but also in the psychological burden of accessing free food. Additionally, too few people take advantage of free food due to physical burdens that lower the individual's motivation and ability to share and redistribute free food.

This master thesis explores the relationship between food waste reduction and the stigmatisation of accessing free food. The thesis offers a solution to save food by re-thinking the concept of food sharing.

2. Methodology

2.1 Limitations of Data Research

The scope of discussions is limited because the author has limited experience in scientific research and writing. Therefore, the depth and breadth of this thesis might not be on the same level compared to scientific papers of experts with more experience. This fact naturally limits the research and enables extending the thesis in the future. Due to personal interest and the urge of the topic, the author decided to take this thesis as an opportunity to deal with food waste.

Food waste is a global problem but due to different regulations and policies related to waste and food, the research was limited to European sources. Because the author is living and studying in Estonia, Estonia has been chosen as a case study to research food waste and the extent of stigmatisation of free food in the Estonian society in theory but also in practice. Consequently, field research has been conducted in Estonia. Due to pre-set deadlines, the research was limited, and the author was not able to look deeper into all areas that might have been relevant for this thesis. For further elaboration, ongoing research and design testing is needed to develop the solution further. Due to the covid pandemic, some interviews have been conducted online. In exchange, people could have been interviewed outside of Estonia. The surveys were mainly addressed to Estonian people with some exceptions due to the survey's reach. The surveys were timewise limited to keep the timeframes which also constrained the number of participants. An English and Estonian version of each survey existed to avoid language borders and misunderstandings. The surveys were conducted mainly in Estonian.

Since "food waste" can be interpreted in different ways, the term in the context of this thesis is described as follows: Food waste is edible food that is neither rotten nor spoiled. This means that individuals would or could eat it if they had more time, liked the taste, or if the food would fit into their diet. Consequently, the food turns into food waste because a person has no time to consume the food, a person doesn't like the taste, or a person tolerates food poorly. Food waste can be either already opened and partly consumed or unused and unopened food items. Food waste includes all kinds of food, which means raw, cooked, processed, fast, dry, wet, hot, frozen, cooled, or homemade food. Furthermore, this thesis focuses on saving edible food that has already turned into surplus and has no value or use for the owner anymore. Thus, the research is about finding a solution or method to save edible food when it has already turned into surplus.

Because most of the food waste is generated on a household level (see 3.1), this thesis focuses on reducing food waste by a private person or by a household. Food waste generated by a household means food wasted inside and outside of someone's home, for example when eating in a restaurant or cafeteria. Individuals are responsible for their food as soon as it turns into their property by purchasing it or consuming it.

2.2 Terminology

In this thesis, the reader will be confronted with several words that the author created to express certain phenomena and conditions. Abstract terms such as food waste are interpreted individually in the context of the thesis. The words and phrases will be listed and explained as follows:

Food braving: This expression is a generic term for methods that ease food saving and access to free food. Those methods can be for example human interaction, trans-sectionality, normalisation, self-exploration and nudging.

Food caring: This word expresses acting with or handling food in a conscious, sustainable and aware way. Food caring means appreciating food not only as a valuable source of nutrition but also as a cultural and social good. Food caring stands against food waste and makes food saving obsolete.

Food courage: The term expresses the ability to accept and appreciate free food as a valuable resource without seeing it as inferior compared to conventional priced food. Furthermore, free food courage is the ability to believe, promote and make free food public while resisting stigmatisation.

Food saving: This word describes the act of saving personal or others' edible food through consuming, recycling, conserving, or sharing before it gets spoiled or wasted.

Food shaming: The generic term stands for all negative emotions based on neoliberal stigmatisation that can occur when accessing and taking advantage of free food, such as shame, guilt and discomfort. Those negative feelings are either subjective (self-indicated) or objective as a reaction to the interaction with the environment.

Food sharing: Food sharing or sharing food is the act of sharing food with another person or institution to prevent food waste or hunger through sharing, donating or

changing food. In general, food gets shared that is considered to be surplus or not needed by an individual. Food sharing doesn't require any money or compensation. Only the idea of (ex-)changing food means that food from one person gets changed with food from another person.

Free food: The term describes all kinds of edible food that is free but not necessarily accessible for everyone at any time.

Shareable food: The expression describes all kinds of edible food that is free and accessible for everyone at any time.

Private food waste: This term describes edible food wasted by a private person or by a private household either at home or outside of the home, for example when leaving food on the plate in restaurants or other households.

2.3 The Research Process

The Research Problem
Food gets wasted while at the same time, people are suffering from food insecurity. For food-insecure people, there currently exist solutions to get access to free food. But the fact that this access is provided only to food-insecure people supports the neoliberal stigmatisation of free food. This affects not only food-insecure but also food-secure people. Consequently, the problem lies not only in the lacking accessibility of free food but also in the psychological burden of accessing free food. Everyone who takes free food that would otherwise go to waste saves food, but not everyone is aware of this value. To sum up the research problems:

- Eatable food is getting wasted all around the world.
- Even if there are various initiatives for reducing food waste or food insecurity by offering free food, few people are using them because of physical burdens or emotional burdens that can lead to direct or indirect stigmatisation.
- Instead of considering themselves as food savers, many people feel or get stigmatised when taking free food.

The Specific Objectives of Research
Food waste is a broad topic. First, it is necessary to create a fundamental understanding of the current situation and get some background knowledge before

digging deeper into specific fields. Therefore, the most important terms are explained and defined in this thesis and should give any reading person a clear picture of all the included topics. Waste and especially food waste are overly sensitive topics. They can be perceived in many ways depending on the culture or the perspective from which someone is looking (economical, psychological, ethnological, etc.). The research process of this thesis started by answering basic questions such as "What is waste?", "Where food is getting wasted?", "Who is wasting food?" and "Why does food get wasted?". Since the cultural setting plays an important role, it was essential to focus on the perception of waste and food waste in the Baltics, especially Estonia.

Another objective at the beginning of the research process was to explore already existing solutions that reduce food waste worldwide and in Estonia. All the findings were then sorted in different ways, for example into the areas where they minimise food waste (solutions for private households or solutions for restaurants, etc.) or according to the nature of the solution, for example, product, digital, or service-based). After building up a solid foundation of information, the next step was to set a focus. Since most of the food still gets wasted in private households, this field was chosen as a specific research objective.

Not only food waste appears on a household level but also food insecurity. In some cases, those two problems can co-exist, which is a paradox. While reasons for food waste can be analysed, the field of food security and poverty is influenced by numerous political, historical, and sociological factors. To understand the relationship between food saving in private households and food-insecure households, the research also immersed into the area of food insecurity and poverty on a rather psychological level. Unfamiliar terms will be explained in the thesis. During the research process, it came out that food-insecure people get access to free food through organisations or communities that collect surplus food either from food retailers, producers or other private households. Because this surplus food would have gone otherwise to waste, food-insecure people or people taking advantage of free food can be seen as food savers. But few people are taking advantage of this access and consider themselves "food savers" while taking free food. This assumption collides with the findings during the further research process about neoliberal stigmatisation of free food and negative emotions such as shame connected to food insecurity and taking free food. Neoliberal stigmatisation is a central topic of this thesis. Thus, the terminology and the connections to other main issues will be clarified. A summarising research map shows the results by combining the system view and field view and serves as a foundation and inspiration for the concept creation.

The Research Focus

The theoretical research consisted of international material from around the world, while the practical research was limited to Estonia due to the author's location. The outcome of this thesis is evaluated in Estonia but might be adaptable to other countries as well. Hence, Estonia is taken as a study case for this thesis. The research focused on the situation of food waste and methods to reduce it in Europe, with Estonia as an example. Furthermore, the author focused on the accessibility to free food in Estonia and how local people are affected by neoliberal stigmatisation of free food. Generally, it can be said that the focus areas of "food waste reduction" and "access to free food" are comprised of an attraction between each other, while the focus area of "neoliberal stigmatisation of free food" is comprised of tension to those two focus fields.

Access to free food

Food waste reduction

Neoliberal stigmatisation of free food
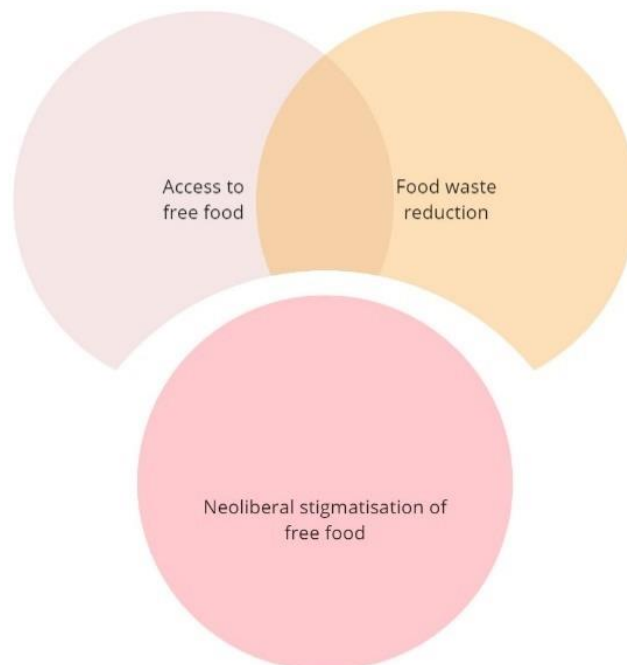
Figure 1 Attraction and tension of the focus fields (made by author)

2.4 The Methodology of Constructive Design Research

Constructive design research allows to gain knowledge based on the capabilities and capacities of the design field itself while staying methodologically and theoretically flexible (Bang, 2012, p. 2). According to Bang, constructive design research is defined as "Design research in which construction – be it product, system, space, or media – takes centre place and becomes the key means in constructing knowledge" (Bang, 2012, p. 2). Therefore, the process doesn't need to be linear and planned but can stay

loose and allows the researcher or designer to drift away into new fields of interest that might otherwise have been unexplored. To gain information and data, a comparative experimentation method in design research has been guided through the process of this thesis. According to Krogh, there are five different methods of knowledge production through design experimentation. These are called "accumulative", "serial", "expansive", "probing" and "comparative" experimentations. The thesis mainly relies on a comparative research method (Krogh, et al., 2015, p. 1; 5). A comparative research method means various design cases will be explored through different frames and perspectives. The method allows to include multiple design aspects simultaneously – the author is interested in ethical, moral, and psychological aspects of human-centred system design. The method can make unexplored friction points or commonalities visible through overlapping or controversial elements. At the same time, relevant knowledge and findings from experiments, surveys and field research flow into the process. More detailed information will be presented in chapter 3.9. New findings give the author a base for further investigations. The basic idea is that any design experiment should uncover additional undocumented values of a concept and confirm some unexplored previously unexplored values (Krogh, et al., 2015, p. 7). This thesis aims to explore the field of food waste reduction and develop a novel concept that reduces food waste and eases access to free food.

The Methods for Data Collection

Relevant data has been collected mainly through field research and online surveys combined with theoretical information from scientific and academic sources such as books, articles and reports. It is crucial to gain data through different angles to prove their validity and reliability as well as their adaptability to the context and the research environment. Field research is a qualitative method of data collection that allows the researcher to observe, interact and understand people while acting in their natural surroundings. This also includes conducting interviews or observing people from a distance to understand how they act in their social network and how they react to situations. Field research also includes direct observation, participation, analysis of documents, interviews, surveys and experiments. Chapter 3.9 presents in detail how the field research has been conducted for this thesis and what results have been gained. Further information about the methodology of constructive design research can be found in appendix B.

Important Thoughts and Ideas that underpin the Field Study

During the research process, the exploration of food pantries gave valuable information and insights, such as the food bank organisation in Estonia, which is based on volunteer work and provides food-insecure people with free food. With the background knowledge of neoliberal stigmatisation and personal information from relevant people in the system, the field study confirmed the assumption of the author that such organisations are crucial. But they also support neoliberal stigmatisation. Furthermore, the idea of public food pantries is very relevant. It underpins the author's opinion that free food should be available and accessible for everyone, no matter if a person is food-insecure or not. The field study showed that the concept is gaining more and more popularity in Estonia. But it is still very immature. Finally, the local and online food sharing community underpins the field study and gives insights into the interpersonal relation and communication when sharing free food.

2.5 Literature Sources

Studying literature was essential to clarify all the terms in this thesis. The literature sources have been divided into categories of waste, stigmatisation and nudging. Food waste and food insecurity are both problems that need to be tackled. In Europe and Estonia, a lot of research is currently running in those fields. A lot of valuable material is provided to the public, such as the lately released SEI (Stockholm Environment Institute) report, which contains detailed data about food waste in Estonian private households. Further, a lot of information has been gained from the United Nations and the European Commission. Scientific articles and reports gave more qualitative insights into the field and how different disciplines approach it. For example, the reports of Martínez allowed the author to see the topic of food waste from a rather anthropological and psychological perspective. The book "Feeding the other" by de Souza provided much in-depth information about stigmatisation related to food insecurity, especially in social institutions. To explore the field of nudges, the book "Nudge" by Thaler has been studied.

3. Theoretical Foundation

3.1 About Waste

The Perception

The term "waste" is defined differently from culture to culture. Thus, ethical and aesthetic aspects influence the perception of what is seen as waste and what is not. Waste doesn't need to be physical. In a philosophical sense, also non-physical goods such as time, energy, beauty and money can get wasted. This shows that waste is deeply connected with the perception of value and ordering or categorising something. From an anthropological point of view, waste is "the by-product of the systematic ordering and classification of matter" (Martínez, 2017, p. 346). The term can be related to ugliness, rubble, debris, ruination and pollution. Waste is considered to be something unwanted that has to be concealed or hidden. It can also be connected to negligence and human failure. Consequently, waste can be seen as the opposite of care, commitment and sustainability. The definition of dirt and waste is subjective and it depends on the individual perspective. But when waste is perceived as dirty, this mental interpretation reflects cultural or individual anxieties because dirt is something humans want to hide or dispose of (Martínez & André, 2020, p. 67). While causing negative feelings, waste could also be seen as a tool for activism, for example through recycling – the process of collecting and processing material - which can be seen as waste because it would otherwise be thrown away – to turn them into new products. When talking about recycling, rather physical material is considered as waste (Martínez, 2017, p. 347). More radical activism, particularly against food waste, is "dumpster diving" where people take eatable food out of dumpsters, mostly from supermarkets and private households. Dumpster diving is not only practised by food-insecure people but also by people who want to set a sign against food waste and want to recreate the value of food. Dumpster diving lies in a grey zone, which means it is not legal but also not particularly illegal. It usually depends on how the dumpsters are secured and how divers are getting access to them. Many dumpster divers are trying to go out at night when it is dark and they can't be seen, either because they don't want to be judged or because they might be afraid of getting caught by the staff or by the police. Some divers also go to the dumpsters during the day. Their motivation might be to uncover food waste and make it "normal" to take it (Martínez & Beilmann, 2020, p. 5). Another perspective on waste is brought in

by Martínez and Beilmann. They point out in a report that waste can be a crucial source of information because it gives researchers and scientists the chance to see and analyse social relations in a particular area. By generating waste, humans are sorting into "keep" and "not keep", which shows that waste is connected to classification, exclusion and separation of something physical. Humans categorise waste based on several factors. Whether something is seen as waste or not relies on symbolic, spatial, economic, legal or technical aspects. Because nothing gets "born" as waste, the generation of waste is based only on the individual human decision or pre-decided by a higher entity such as the government or the economy. Also given by higher forces is a waste management system categorising waste itself (Martínez & Beilmann, 2020, p. 4f.).

To understand the issues about food waste, it should be clarified what waste is and its subcategories. The following pages provide clear definitions of relevant terms:

Food: Food is understood as any processed, semi-processed or raw substance produced for human consumption, including drinks and all substances used during the manufacture, preparation or treatment of food. Spoiled material is also considered to be food. Consumption substances such as drugs, cosmetics and tobacco are excluded from this definition, as well as water for cleaning or for cooking in private households or the food industry sector (United Nations Environment Programme, 2021, p. 19).

Wasted Food: Wasted food is the general term for food waste and food loss which have slightly different meanings. Food loss and food waste are both subcategories of wasted food, while food waste is a specific part of food loss (GRACE Communications Foundation, 2021).

Food Loss: Food loss is the more significant category of wasted food and stands for any kind of edible food that is uneaten at any stage. Food loss includes all the harvest quantities from crops or livestock that are edible for humans but are taken out of the human food supply chain. This kind of food is also not used for the industry or livestock and gets discarded right away. Food loss occurs during storage, transport, import or processing. Reasons for loss can be mouldy, rotten or totally damaged food. (United Nations Environment Programme, 2021, p. 19).

Food Waste: Food waste is edible food that is associated as inedible. Therefore, it is removed from the human food supply chain that gets directly discarded at a

landfill, controlled combustion, sewer, trash bin or dumpster, co-/an-/aerobic digestion, compost or land application. It has to be pointed out that what is considered inedible and edible depends on the person and the culture (United Nations Environment Programme, 2021, p. 19).

Food Surplus: In today's consumer society, surplus is normal and can be used as a metaphor for well-being and stable societies (Martínez & André, 2020, p. 59). Food surplus is food that is redistributed for consumption by humans and re-utilized through animal feed or the production of bio-based materials or biochemical processing. Food surplus occurs when the offer is higher than the demand or when the planned distribution quantity can't get supplied, for example, due to overproduction, damaged packaging, exceeded expiry dates and others (United Nations Environment Programme, 2021, p. 19).

About Waste and negative Feelings

As mentioned above, the term "waste" is related to a wide range of negative associations, such as human failure, dirt, or disgust. When discussing the value of things, waste is definitely seen as invaluable and worthless. This negative perception of waste extends across society, where waste also causes social exclusion and makes poverty visible. Thus, shame arises. Martínez and Beilmann present a good example of collecting cans, as some people do in Tallinn. Economically insecure people or socially disadvantaged people are collecting cans to earn money through deposits. Watching those people causes negative feelings in society. They might feel disgusted about the can collectors or feel disturbed by them. Some also feel sorry for them because they think that can collectors are poor. They automatically classify and exclude those people. But in any case, they don't see the value in the act of collecting cans which is a sustainable act. Russia shows that there is also another way. In St Petersburg, people collecting waste are presented by the press as "geologists" supporting the waste management system and reducing waste (Martínez & Beilmann, 2020, p. 4f.). Besides Russia, also other countries set a sign against social blame and demonstrate that there is a way to include classified people more into the society by lifting their dignity through redesigning. In Denmark for example, the social entrepreneur Michael Lodberg Olsen ushered in the pilot project where public trash bins got extended by a tiny shelf. As a result, people can put their deposited bottles or cans instead of throwing them into the container. The idea was to ease the daily business of bottle collectors, who not only supplement their income but also help to keep the city clean. But most importantly, this slight redesign gives bottle collectors more dignity and security because they don't have

to stick their arms into trash bins filled with rubbish, mould and glass sheets (Marshall, 2015).

Figure 2 A man making use of the redesigned bins in Copenhagen (www.bloomberg.com)

Where Food Waste Occurs

Food loss and food waste occur at every point along the food chain, no matter if it is during the production, in stores, in restaurants or at home, as visualised in the graph below. While food loss mainly gets generated during the production, harvest and processing, food waste gets rather generated during the retail or consumption (Pateman, 2020, p. 2).
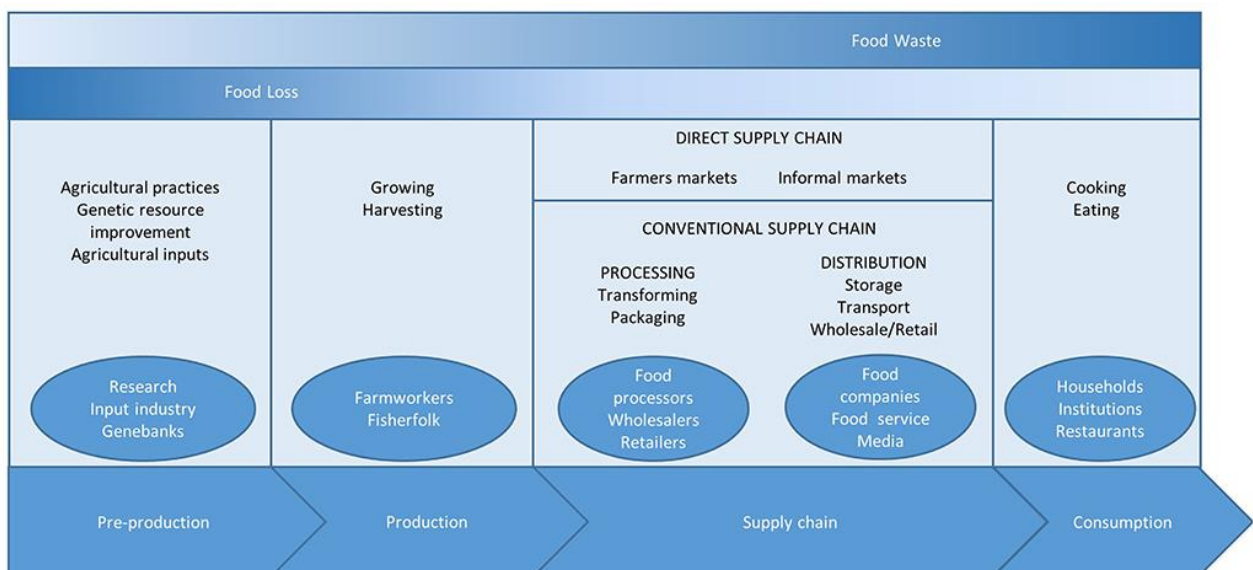
Figure 3 The food system and where food loss and waste get created (Pateman, 2020, p. 2)

As the Food Waste Index Report 2021 shows, around 931 million tons of food get globally wasted among the three main sectors household, foodservice and retail. Private households are responsible for more than half of the generated food waste in 2019. They produce 61% of food waste. But it also has to be considered that private households provide a high amount of data that is needed for research. The estimate is so to say, robust because it is based on a more extensive set of data. However, t confidence in this estimate for the other two services is relatively low (United Nations Environment Programme, 2021, p. 70).

	Global average food waste (kg/capita/year)*	2019 total (million tonnes)
Household	74	569
Food service	32	244
Retail	15	118
Total	121	931

Figure 4 Global food waste estimates (United Nations Environment Programme, 2021, p. 70)

3.2 A Look into the Past

In the past, people had to invest more time in processing food and they had a better connection to food. Due to food shortages, food was handled very carefully. The preservation of food (drying, smoking, fermenting, acidifying, sugaring, boiling) was part of almost every household as well as the recycling of every by-product. Based on old recipes from the first half of the 20th century, a separate dish for nearly every part of each animal existed. Expensive imported products have always been tried to be replaced with local products. Vegetables and fruits came almost exclusively from self-cultivation and cost a lot of time and effort. When the food circulation system was just officially developed, there was no waste in that sense. Although the supreme lord usually had food in abundance, the remaining was left for the high and low employees to eat and the leftovers from them were fed to animals or composted. So, nothing got wasted. Today food waste relies on a lack of management skills, awareness and knowledge. According to Ulrike Plath, disposing of food in a trash can or toilet is one of the most meaningless steps in human development. Large retail chains

contribute immensely to food waste, both directly and indirectly, by increasing helplessness and food insecurity learned through food surplus. In addition, they increase the inability to manage oneself and to take responsibility for one's food. Furthermore, cooking is unlearned. For example, while in the past humans still cooked broth themself from bones and meat remains of old laying hens and vegetables, today you only need to throw bouillon cubes or ready-made broths into the cooking pot. Chicken fillet and EU-wide standardised fruit and vegetables have become the main symbols of food waste. Hence, it can be said: Food waste began and begins where management skills got and get lost. And it comes along with the abundance and alienation of cooking (Harrik, 2021).

3.2.1 Food Waste in Europe

Food waste is undisputedly a global problem. To ease the analysis of the problem, the focus of this chapter lies on food waste in Europe. In the European Union, around 88 million tonnes of food get wasted every year, which corresponds to costs of approximately 143 billion euros. About 20% of the food produced in the European Union gets wasted or lost during the food supply chain. Currently, 33 million people cannot afford a quality meal every second day. European households generate more than 50% of the total food waste in the European Union. The European Union aims to reach the sustainable development goal 12 defined by the United Nations to reduce food waste. Their mission is to halve the amount of food waste per capita in retail and private homes by 2030 and reduce food losses among the whole food production and supply chain. Actions planned against food waste are the creation of a platform on food losses and food waste, the support of "good practices" in food waste prevention, food waste measurement and food donation. Furthermore, an International Day of Awareness of food loss and waste is designated on the 29th of September to raise awareness (European Commission, 2021).

Figure 5 International Day of Awareness of Food Loss and Waste 2021 (www.ec.europa.eu)

3.2.1 General Reasons for Food Waste

Since food waste and loss occur among the whole supply chain, the reasons for it depend on the sector. Still, all sectors deal with the same problems: the lack of awareness and the lack of knowledge about the problem and how each would benefit from reducing food waste. The following list from the European Commission gives an overview of the most occurring reasons for food waste (European Commission, 2021):

- Insufficient shopping and meal planning
- Shopping environment (for example advertisements like "buy one, get one free" that tempt consumers to buy and over-consume)
- Wrong understanding of "best before" and "use by" on packaging leading to the disposal of edible foods
- Insufficient food management skills (for example meal preparation, use of food/food ingredients in stock, use of leftovers)
- Packaging is difficult to empty or too large
- Aesthetic considerations (for example bruised fruit and vegetables)
- Regulated food portions in restaurants and cafeterias

- Inability to calculate the number of customers (a problem for catering services)
- Stock management issues for manufacturers and retailers
- High quality standards
- Overproduction or too little demand for certain products at certain times of the year
- Production errors, products and/or labelling not meeting specifications
- Product and packaging damages (farmers and food manufacturing)
- Inadequate storage/transport at all stages of the food chain, including households
- Missing knowledge and/or misinformation on impacts of food waste
- Low perceived value of food
- Busy lifestyle and conflicting priorities

3.2.2 Food Waste in Estonia as a Study Case

Food waste is undisputedly a global problem. But since the field research has been conducted in Estonia and further steps like design testing will take place in Estonia as well, this thesis takes a closer look at how food gets wasted in Estonia, especially on a household level. Recently the Stockholm Environment Institute published a final report about the generation of food waste and food loss in the Estonian food supply chain, including all sectors and based on a study that was conducted from 2020 to 2021.

Based on the study results, around 167.000 tons of food waste is generated in Estonia and cost around 164 million euros per year. Most of the food waste is generated in households, followed by the food industry, primary production, retail, and the catering sector (Piirsalu, et al., 2021, p. Xf.). In general, contributions coming from food industries in Estonia against food waste are infrequent because they require more work and staff, leading to higher costs and time investment. Many food providers worry about food safety issues connected to food donations and contributions, which could lead to legal matters. Furthermore, most of the industries don't have enough space for storing surplus or for offering free food and they cannot afford or don't want to provide additional space (Malenica & Bhat, 2020, p. 19).

Households generate most of the food waste with 41%. It is a total of 80.564 tonnes of food waste per year, estimated to be 61 kilograms per capita per year. Around 26 kilograms fall under food loss or avoidable food waste. Calculated for one household, the amount of waste is approximately 149 kilograms of food waste, which is between 180 and 220€ worth (Piirsalu, et al., 2021, p. Xf.).

	Food waste generation			incl food loss			The monetary value of food loss	
	t/year	kg/capita	Share	t/year	kg/capita	Share	Mln €/year	Share
Households	80 564	61,2	48%	33 837	25,7	40%	97,5	59%
Catering institutions	10 739	8,2	6%	7 460	5,7	9%	21,3	13%
Food trade sector	19 976	15,2	12%	19 976	15,2	24%	34,6	21%
Food industry	31 622	24,0	19%	3 162	2,4	4%	6,4	4%
Primary production	23 612	17,9	14%	19 261	14,6	23%	4,2	3%
TOTAL	166 513	126,5	100%	83 696	63,7	100%	164,0	100%

Figure 6 Food waste and loss generation in Estonian food supply chain stages (Piirsalu, et al., 2021, p. X)

As figure 10 shows, the wasted food consists mainly of vegetables, cooked food and fruits. Cooked food that got wasted the most were soups, porridge, vegetables, mixed food, pasta dishes, desserts and meat dishes.
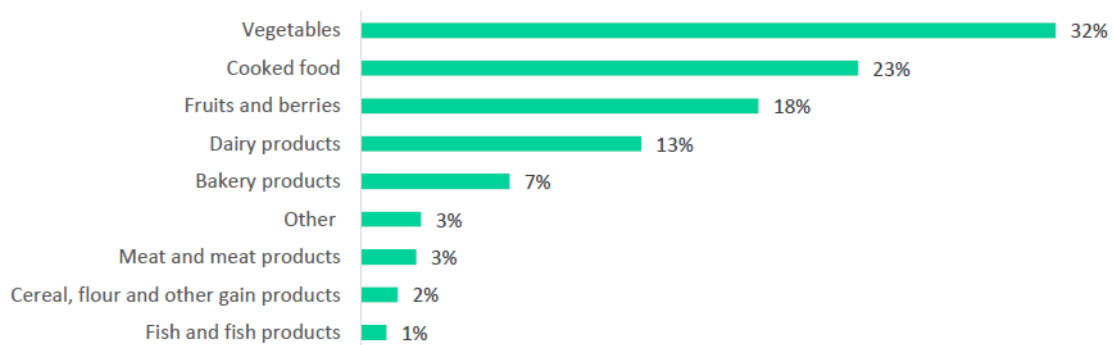
Figure 7 Proportions of avoidable food waste in Estonian households (Piirsalu, et al., 2021, p. XI)

Since 2016, the amount of food waste increased in almost every sector, especially in private households. Most of the food wasted in private households is fruit, vegetables and processed food. In a news article, the author criticises food waste as even more reprehensible. There are still 30.000 people living in absolute and 275.000 people living in relative poverty in Estonia while food prices are steadily rising. Therefore, the need for free food is extremely high. The Foodbank shows that the need for donated food has grown enormously, especially during the Covid-19 pandemic (Voltri, 2021). It is assumed that improving living standards and higher incomes are reasons for Estonian households to care less about wasted food.

Reasons for Food Waste in Estonian Households

According to the food waste analysis, the main reason for wasting food in private households is food being ruined. This applies to almost 50% of the food waste. The second most occurring reason is too long storage of food in the fridge (Piirsalu, et al., 2021, p. XII).
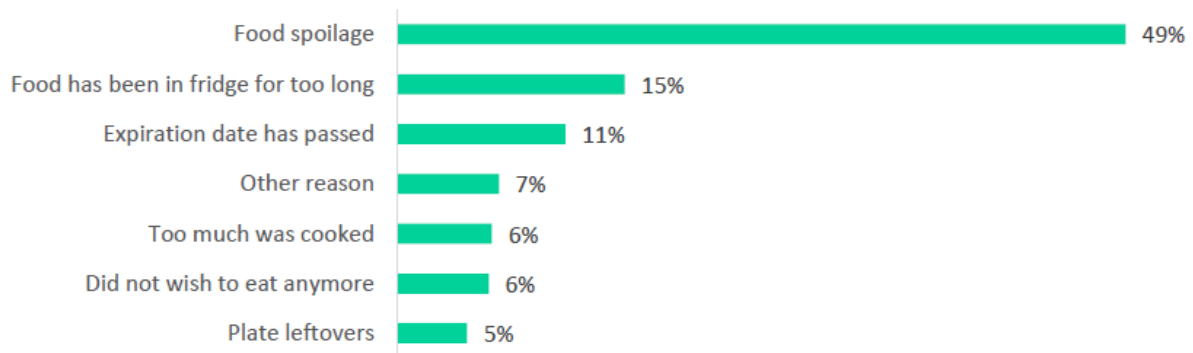
Figure 8 Reasons for discarding food that could have been eaten (Piirsalu, et al., 2021, p. XII)

Awareness of Food Waste in Estonian Households

In the food waste survey, households were also asked how they avoid food waste at home and what they would do with the resulting food waste. 85% said they were committed to reducing food waste through more thoughtful shopping behaviour and more conscious food consumption (Piirsalu, et al., 2021, p. 7 ff.). The following four methods could be identified:

- Go shopping less and plan purchases better
- Buy as much as necessary and as little as possible
- Preparation of food with food that expires soon
- Store leftovers and eat them on the following days
- Freeze leftovers that are not consumed

Nevertheless, the theory does not seem to correspond to practice. Private households still produce the most food waste at home or outside of the home.

3.3 The Impact of Food Waste

Food production is one of the most resource-consuming industries and generates a lot of emissions. Hence food waste has an enormous impact on the environment. In general, when food gets wasted, all the resources used to produce, transport and distribute this food – including water, land, energy, labour and capital – also go to

waste. This has not only consequences for the environment but also for the economy and society.

Environmental Impact:

The disposal of food waste in landfills generates greenhouse emissions contributing to climate change. 8-10% of greenhouse emissions are generated only by food waste (Mbow, 2019, p. 490).

Economic Impact:

On a global scale, food waste causes costs of around one trillion US dollars per year. Environmental costs caused by food waste are estimated to be 700 billion US dollars and the social costs to 900 billion US dollars (Food and Agriculture Organisation of the United Nations, 2014, p. 7).

Social Impact:

As the Food and Agriculture Organization of the United Nations points, around 690 million people suffered from hunger in 2019. It is assumed that this number has increased, especially due to the Covid-19 epidemic. More than one third of the global population can't afford a healthy and nutritious meal (United Nations Environment Programme, 2021, p. 20). Food waste supports food insecurity because it reduces global and local food availability. Food waste is limiting food access due to increased food prices and a decrease in producer income. This also affects future food production due to the unsustainable use of natural resources. The numbers are alarming and show that it is crucial to raise awareness about the impact of food waste. Changing consumer behaviour could reduce over-consumption and potentially improve food security by avoiding related health problems and reducing emissions associated with additional food (Mbow, 2019, p. 490).

3.4 The Political Paradox of Food Waste

Looking at the impacts of the rising food waste, it is not surprising that this topic turned onto the political agenda worldwide. With the submission of the European Green Deal, the impacts of food waste and food loss will be approached on an EU level. The vision of this strategy is to become the first climate-neutral continent with a fair and wealthy society through a modern, resource-efficient and competitive economy (European Comission, 2022). The strategy includes sub-strategies that aim to reduce food waste, for example through the Farm to Work Strategy trying to make food systems fair, healthy and environmentally friendly. Further, the food waste per capita in households and retail should be halved by 2033. New EU policies will be ushered, for example changing the regulations of expiry dates (European Comission, 2020, p. 4; 15).

The reduction of food waste and loss is also on the agenda of the United Nations and included in the sustainable development agenda plan. The so-called "17 Sustainable Development Goals" aim to eliminate hunger, planet protection, and improvement of human well-being worldwide. The goals should be achieved by 2030 (United Nations, 2022).

Figure 9 The 17 Sustainable Development Goals (www.unemg.org)

Food waste is part of goal 12 "Responsible consumption" to ensure sustainable consumption and production patterns until 2030. It also targets to halve the global food waste per capita at the retail and consumer levels and to reduce food loss along the food production and supply chain, including post-harvest losses" (United Nations, Department of Economic and Social Affairs, 2021).

Food waste can be considered as a global paradox. While around one third of the food manufactured in the world gets wasted every year, at the same time, about a billion people are unable to cover their daily needs in food. The government actively contributes to the increase of this paradox as the author of "Feeding the Other"

describes: Through the trust in the trade business with surplus food, global food markets are encouraged through the EU to produce surplus food.

The European Union's food distribution program "Fund for European Aid to the most Deprived" for example buys up surpluses from the food industry to compensate market fluctuations. The purchased overproduction is in turn sold to aid organisations in Europe. This is a contradiction because on the one hand, governments of EU states deny or trivialise food insecurity issues. But on the other hand, they get provided with surplus food from the European Union and support non-governmental and social institutions such as food banks through public funding (de Souza, 2019, p. 49).

3.5 Food Saving Solutions

Benefits of Food Waste Reduction

Saving food can save money in every sector, reduce environmental impacts and support a circular economy. Further, it can improve food security since reducing food waste lowers the negative impact on healthy and resilient food systems. With widespread food insecurity for many hundreds of millions around the globe, addressing food waste is a critical issue in creating low-impact, healthy and resilient food systems (United Nations Environment Programme, 2021, p. 90ff.). The European Commission published a food wastage pyramid that visualises solutions to food waste and can be applied to all levels where food waste appears. The pyramid also includes the idea that "re-use" does not necessarily mean feeding oneself but also feeding others and sharing the food. The pyramid prioritises actions that institutions and private households can take to reduce food waste by suggesting different management strategies. The top-level "Prevention" is suggested as the best way to reduce wasted food because the environment, society and economy benefit most from it among all strategies.
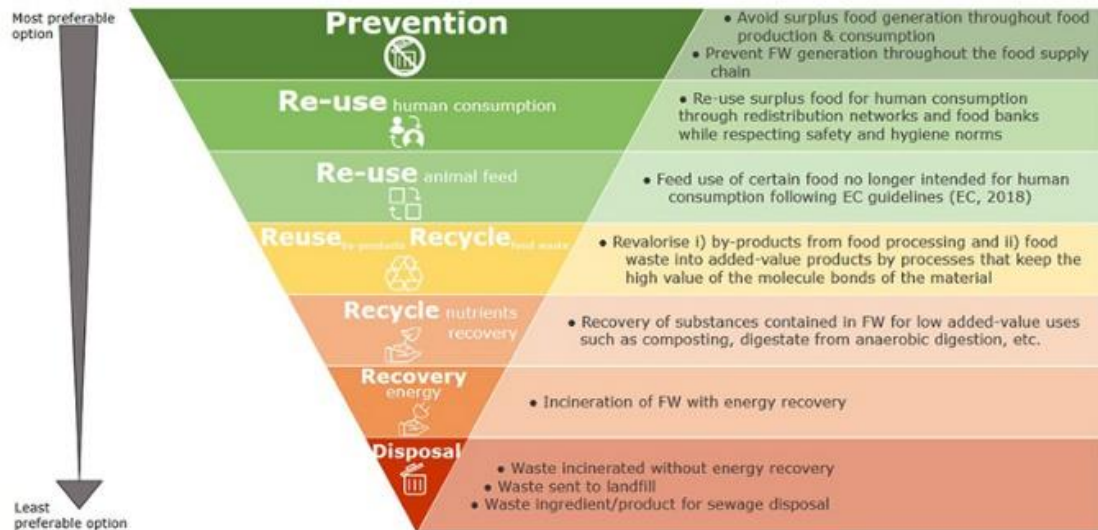
Figure 10 The food wastage pyramid (www.ec.europa.eu)

Food Saving Approaches

According to the author of the thesis, food can be saved through different approaches by a private person:

- Physical (for example product design, redesign of existing products)
- Digital (for example apps, software, portals)
- Service-based (for example sharing, distribution services, delivery)
- Educational (for example campaigns, workshops)

The author has identified two options to deal with household food waste:

a) Edible food can be saved before it gets seen as surplus food (prevention of food waste), for example through taking more care of the purchase, storage and consumption of food or through food saving methods.

b) Edible food can be saved when it has already turned into surplus food (treatment of food waste), for example through food saving methods or food sharing.

As already mentioned in the limitation, this thesis focuses on saving edible food that has already turned into surplus and has no value or use for the owner anymore. The following diagram visualises the categorisation of food saving approaches according to the author:
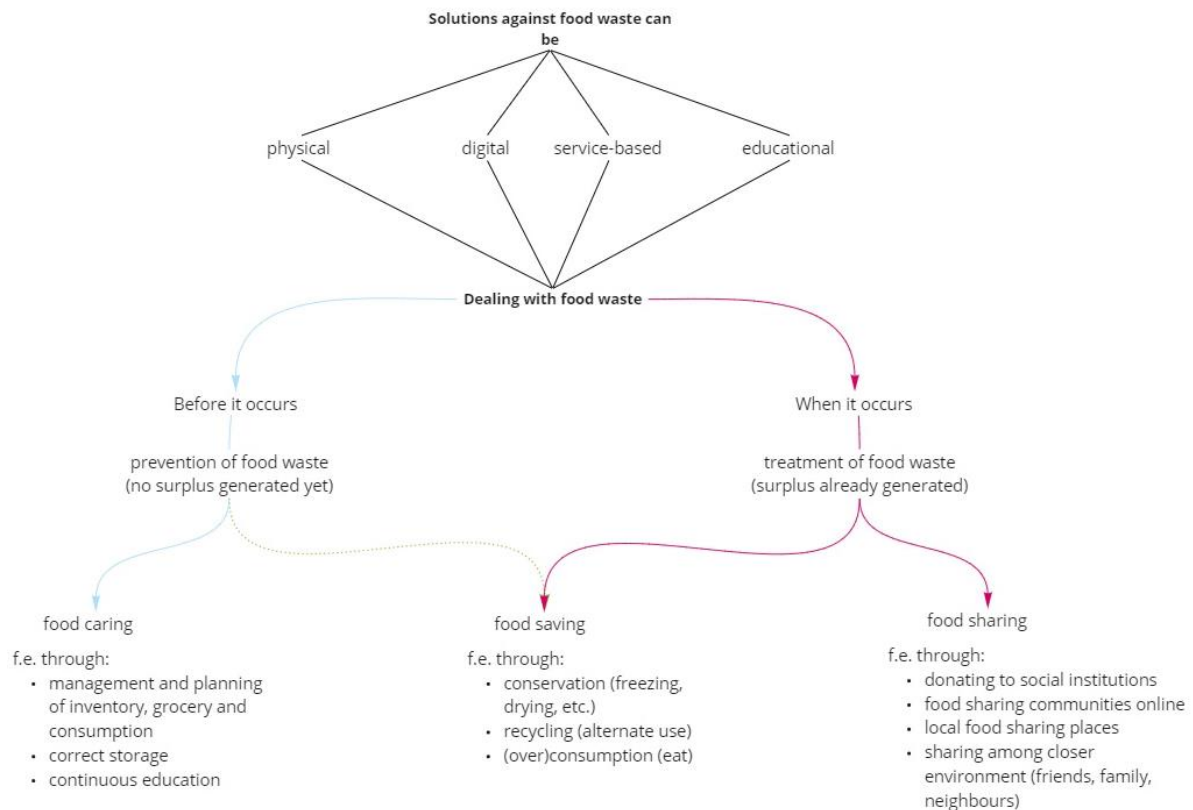
Figure 11 Food saving approaches on a household level (made by author)

3.5.1 Solutions for the Reduction of Food Waste in Private Households

Among all sectors exist a wide range of digital, technical or service-based solutions to fight food waste as well as campaigns and events that should educate and raise awareness of food waste issues. Because this thesis focuses on private households, only food saving solutions on a household level will be presented in this chapter. This includes food wasted by a household in- and outside of the home through a private person, for example when visiting a restaurant or eating in the cafeteria. In the following, a few examples of food saving solutions will be presented to point out the immense variety of existing food saving methods for private households. The solutions come from different countries since the concepts might be adaptable to other countries or even already exist in a modified version.

Smart Fridges as a Physical Solution

Samsung launched a smart fridge, the "Family Hub", which has built-in a touch screen and Alexa, the virtual assistance technology from Amazon to control the fridge. Besides entertaining the household with music and video streaming and digital photos on the

fridge, the Family hub should reduce food waste through an integrated camera that allows users to see the fridge content through the touchscreen or outside from home through a connected app, for example when going to the supermarket. This enables them to do groceries more efficiently and not buy too much. Further, the app makes recipe suggestions based on the fridge's content. Through the app, users can also shop for groceries online.

Figure 12 Samsung's Family Hub (www.samsung.com)

The fridge comes in different sizes and designs. Unfortunately, this solution is with prices starting from 2000$ very expensive (Samsung, 2022).

Sharing Food with the MIT's "Foodcam" as a Physical Solution
Another innovative idea to save food was developed in the MIT's Media Lab. Students recognized that there are often food leftovers in the office kitchen that were not clearly marked as free food. If it was marked as free to take, the food was usually gone very quickly and some people felt disadvantaged because they hadn't been informed about it

in time. Hence, they developed a system where a camera is installed above the kitchen counter, showing a specific area of the counter reserved for free food only. The filmed place was visible to everyone thanks to streaming. Whenever somebody put left-over food in the recorded area, the whole lab got informed through an alert by slack or email immediately (Garfield, 2016).

Figure 13 Camera view of the foodcam (www.businessinsider.com)

Figure 14 Setting of the environment (www.businessinsider.com)

The 2Good2Go App as a Digital Solution

Through the app, food surplus from restaurants and cafes can be rescued and purchased for a very low price. Usually, the leftovers are sold in portions or surprise packages – so-called "magic bags". App users can see on a map which restaurants have food left, buy the portion in advance and pick it up in a certain time frame. The app initially came from Denmark but runs in many European countries. The idea doesn't give access to free food but makes high-quality and nutritious food more affordable for everyone. It actively promotes users as food savers and prevents food waste in the catering sector (2Good2Go, 2021).

Figure 15 Example of a rescued portion (www.dieguteminute.ch)
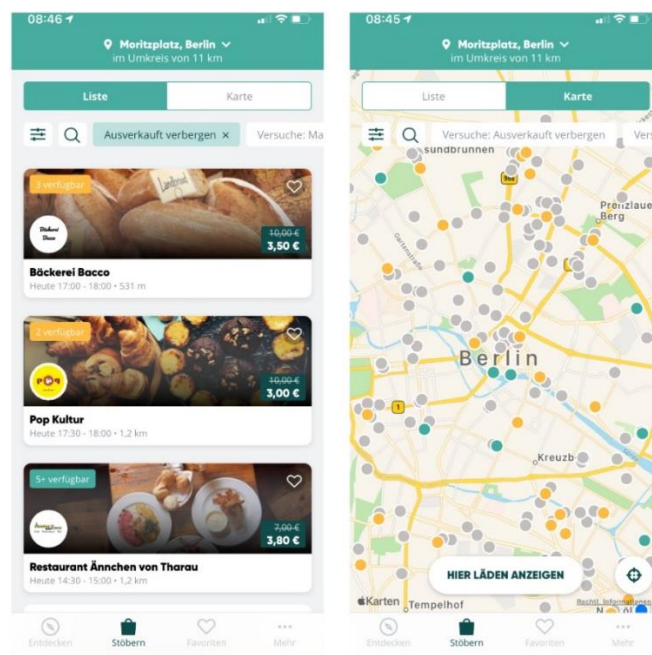
Figure 16 App Layout (www.t-online.de)

The disadvantage is the amount of packaging waste. Some restaurants allow customers to bring their own food containers. But for portion calculations and food hygiene, the left-over food is usually pre-packed. Another disadvantage is that especially the idea of magic boxes is not suitable for people with special diets. Further, the definition of what is still edible and what is not, belongs to the food providers. Thus, it already happened that people paid for food portions that they consider as not edible anymore.

The "NoWaste" App as a Digital Solution

Among all the food waste tracking apps, the "NoWaste" app seems to be the most promising regarding functionality, design and usability. The app lets users track, organise and manage food at home by creating inventory lists. This allows the user to check what food is still left, which food is expiring soon and what has to be eaten first. Furthermore, users can create shopping lists and plan meals based on their stock. The idea is to avoid unnecessary purchases, save money and reduce food waste. Very useful features are the option to share lists with other household members and the barcode scanner for quickly adding products. The app also tracks wasted food and analyses the monthly food waste and savings (NoWaste, 2021).
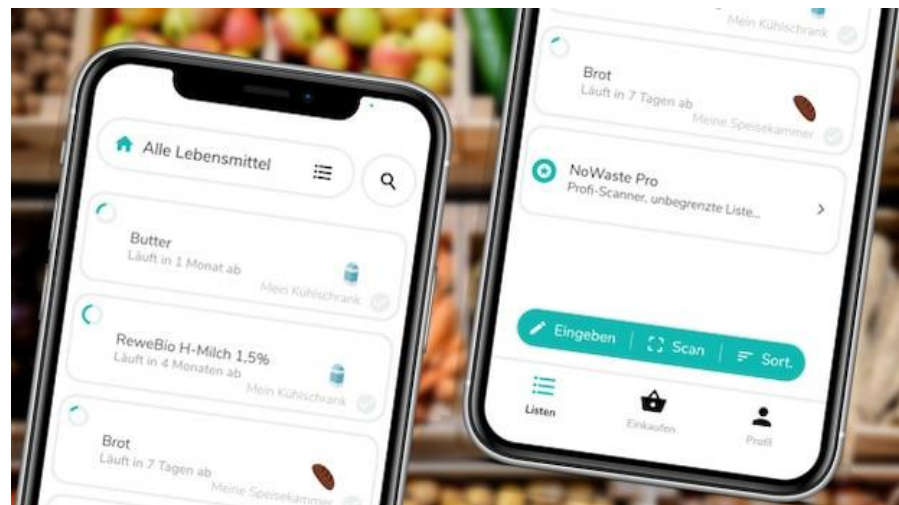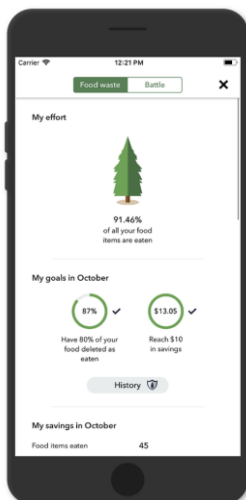
Figure 17 Tracking food waste, www.nowasteapp.com

Figure 18 App Layout (www.chip.de)

Even if the app is well-thought-through, there are still some issues with technology and usability. It is time-consuming to insert or update data and many functions are hard to find. For the barcode scanning function, the app is connected to an enormous library but doesn't cover everything that's out there in the supermarkets, especially in other countries. The app might help prevent food waste but does not seriously deal with it.

The Sirplus Supermarket as a Service-based Solution

A service-oriented food saving concept that gets more and more attention in Germany is the concept of "Sirplus": A German impact startup that rescues food by bringing surplus food back into the cycle by offering it for sale in their online grocery shop. Through direct cooperation with 700 producers and wholesalers, Sirplus can save valuable food that the food banks do not take but that is still edible. The food does not come from supermarkets but directly from producers and traders. This food is usually close to or slightly over the printed expiration date. The motivation of Sirplus is to make the topic of food waste mainstream and give incentives for the society and economy to start re-thinking. To not support the system of surplus production, Sirplus purchases its products only for a low "symbolic" price. Besides selling single items, they also offer food box subscriptions that even take different diets into account. The content of the boxes is unknown but guaranteed to contain items for breakfast, basic food, food for quick dishes, snacks and fresh fruits and vegetables (Sirplus, 2021).
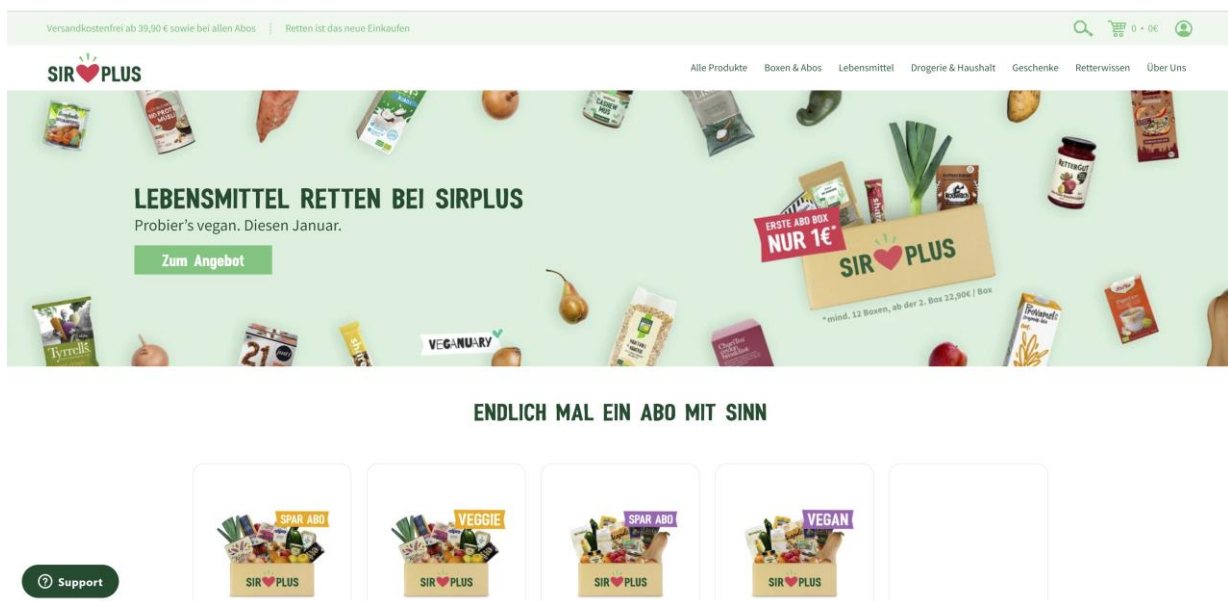
Figure 19 The website of Sirplus.de (made by author)

This business concept is very promising and seems to cover all issues that come along with the distribution of free food. The prices for the products are incredibly low and the offer very wide. The only disadvantage can be seen in the packaging since the order can't be picked up but will be delivered by post.

Ikea Campaign "Plates instead of Bins" as an Educative Solution

IKEA is committed to a more mindful approach to food in various ways and actively promotes this to sensitise and educate customers and employees about food waste. On

food rescue day, Ikea and the WWF are initiating the campaign "Plates instead of bins" to draw attention to the economical use of food. Ikea's concern is to show that reducing food waste in the kitchen contributes to the environment. In the stores, Ikea has introduced the so-called "Food Waste Watcher": A traffic light system based on artificial intelligence that shows employees in cafeterias and bistros when the demand for food is higher and when it is lower based on visit and sales data from the respective locations. At the same time, it shows the customers that Ikea is taking responsibility and encourages customers to do so as well. For that reason, the cookbook "The best rest" with recipes preventing food waste has been added to the product range. In 2020, Ikea released a Christmas commercial against food waste at Christmas where giant food falls down the sky and, in the end, shows Ikea storage products as a solution for reducing food waste (Ikea, 2021).

Figure 20 The Food Waste Watcher system (www.ikea.de)
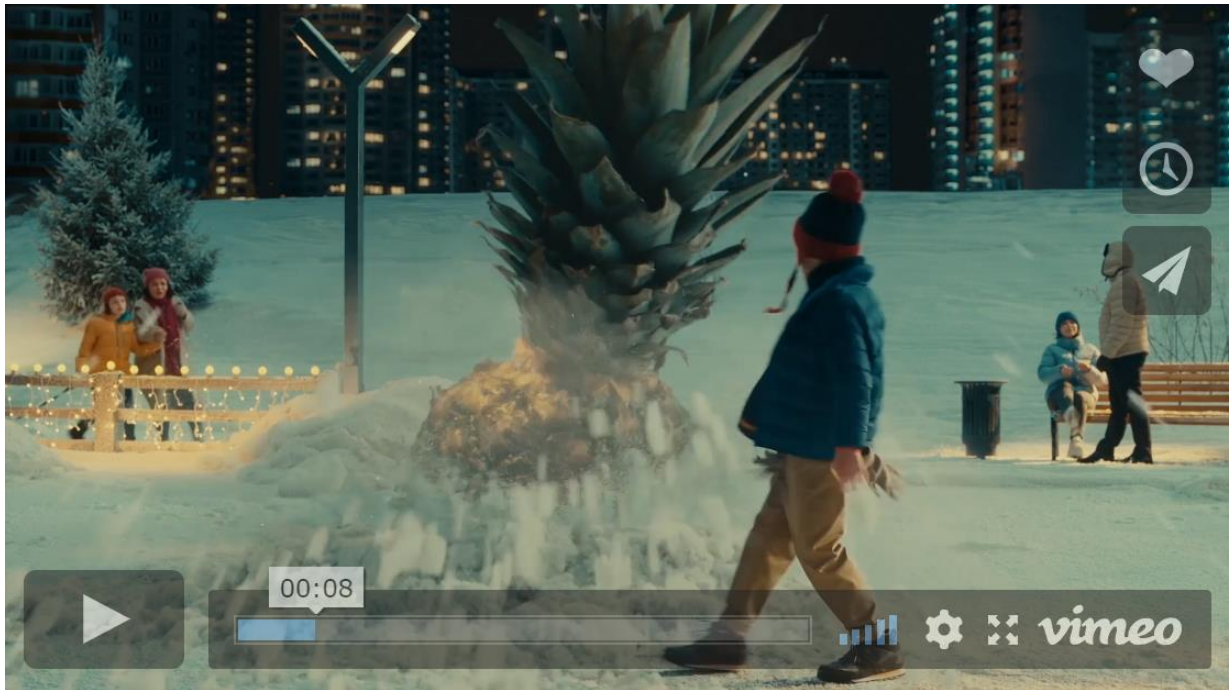
Figure 21 Ikea Christmas spot (www.vimeo.com)

3.6 Food Saving Solutions in Estonian Households as a Study Case

Since the field research for this thesis about food waste has been conducted in Estonia, this chapter will give an impression about food saving methods in or for Estonian households. "The Sustainable Development Forum" from Tallinn discussed several strategies that could reduce food waste in private homes. It was discussed for example, to raise consumer awareness after it has been proven that many consumers have difficulties interpreting food labels correctly – one of the reasons why edible food gets thrown away. Further, supporting waste separation habits has been discussed since waste is not separated correctly by households in Estonia. A solution would be to improve the waste collection system. Increasing food prices to make people more reluctant to dispose of food is also being questioned. Because food insecurity is still present in Estonia, this suggestion hasn't been discussed any further. Another discussed idea was the concept of informal food sharing systems such as public fridges or supermarkets that only offer free food, as they already exist in other European countries (Malenica & Bhat, 2020, p. 4). In the following pages, selected food saving concepts that are currently spreading in Estonia will be reviewed.

Public Pantries provided by Food Sharing Tartu as a Physical Solution

In Tartu, public food distribution cupboards are spreading because they gain popularity among citizens. At the moment, there exist five different cupboards around Tartu – some are equipped with a fridge and a freezer – and more are planned. The system is relatively simple: People who have surplus food can leave their food in the cupboards at any time and everybody can access those cupboards and take food out at any time. Parallel to the distribution points, people post in the food sharing Facebook group whenever there is new content in the pantries so that the food is usually taken very quickly. The project is part of the Food sharing Tartu movement and is entirely based on volunteer work. Volunteers are responsible for the maintaining the cupboards and regularly fill them with food given from partners such as supermarkets or cafes. The organisation stresses that the project is about saving food and the food is for everyone (Foodsharing Estonia, 2021).

Figure 22 Filled food cupboard (made by author)

Figure 23 The first installed food cupboard in Tartu (made by author)

Although the system is comparably easy, the biggest problem is the lack of volunteers. This is also the reason why food pantries in Tallinn couldn't have been installed yet. Since volunteers are also responsible for cleaning and some people don't stick to the rules when putting in and taking out food, the cupboards are sometimes very dirty – especially problematic during the pandemic - and not very appealing.

Food Sharing Facebook Communities as a Digital Solution

Facebook food sharing groups such as the "Foodsharing Tallinn" group exist in almost every city worldwide and are free for everyone to join. The site is intended to help better connect all food sharers, food rescuers and food activists and give food the appreciation it deserves. The aim is to save food and avoid waste effectively. The Facebook group makes it possible to pass on food that a person cannot or does not want to use anymore. Informative contributions to food waste are also welcome, as the group also acts as an exchange and discussion platform. The food sharing group is not commercial and it is not allowed to sell or change food against other food. Only donations are permitted. People can offer food by posting a photo or just a text that tells the other members what to share and where to get it. Interested members can then contact this person through comments or a private message.
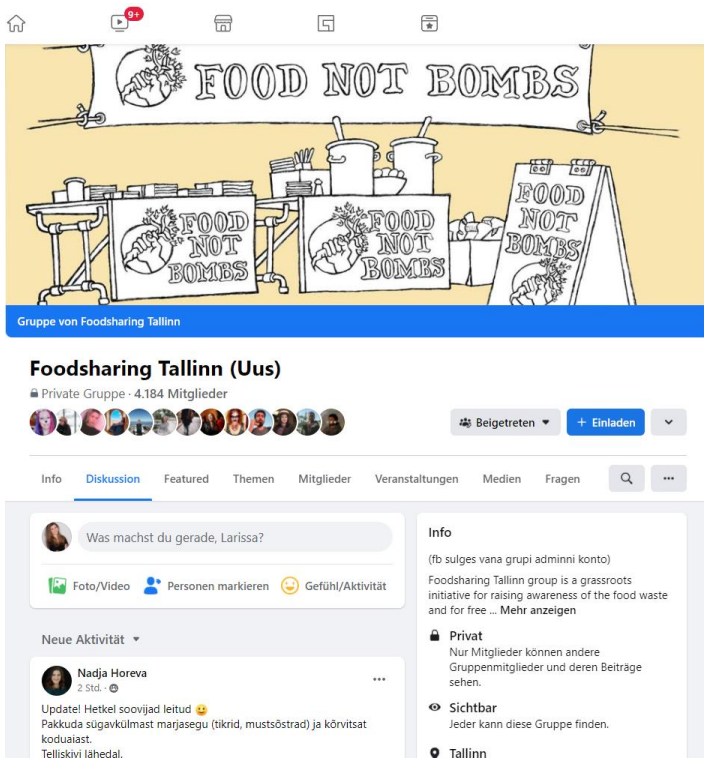
Figure 24 Facebook page of Foodsharing Tallinn (made by author)

Figure 25 Example of a post in the food sharing group (made by author)

An advantage for food sharing groups is that it is very discrete and there are no emotional burdens, making it less shameful to ask for free food. Usually, the community is very responsive and supportive. Also, the community has a broad reach. While at local food distribution spots people who are close by have a "first come first serve"-advantage, food sharing groups also enable people from a distance to get access to free food. Time and place of pick-up are usually discussed individually. A

disadvantage or advantage – this depends on the perspective - is that the food distribution requires at some point human interaction, latest when the food gets handed out. This can bring people into uncomfortable situations, especially if they are ashamed of their food insecurity or feel judged when taking free food.

RingKarp as a Service-based Solution

RingKarp is a circular economy startup that spreads reusable food and drinks containers among restaurants and cafes and their clients to avoid packaging and food waste. The usage itself is free for the end-user. Only a deposit has to be paid when ordering food in the containers for the first time. After use, the containers can either be returned to any cooperating restaurant and users get the deposit back or they just keep the containers at home for the next order (RingKarp, 2021).

Figure 26 Products of RingKarp (www.ringdisain.ee)

Figure 27 Flyer of RingKarp (www.keskkonnatehnika.ee)

The focus of the business lies in the reduction of packaging waste. Still, it could be an opportunity for RingKarp to also communicate that those boxes allow users to save food by taking left-overs home ("doggy bags"). A disadvantage is that as soon as users already have the box and order food again, they have to either bring the box with them or rent another one at the food place.

Supermarket Campaigns as a Solution

Some large food retailers in Estonia are slowly starting to prevent food waste. For example, the supermarket chain Rimi has set itself the goal to halve food losses by 2025. The aid is expected from both technological solutions and cooperation with the food bank. To encourage customers donating surplus food, boxes have been installed where customers can throw in food products that don't need to be cooled. But still, Estonian stores donate only 12% or about a tenth of unsold food (Voltri, 2021). The question remains open about what happens to the remaining 88%.

Figure 28 Food boxes for donations (made by author)

Estonian Food Bank

The Estonian food bank ("Toidupank Eesti" in Estonian) is an Estonian-Dutch charity foundation that delivers surplus food to where there is a food shortage. The founder and manager of the food bank in Tallinn is Piet Boerefijn. The foodbank in Tallinn has been operating for ten years and currently has fourteen different food banks in Estonia that provide food to about 10,000 people and 145 different organisations. Thanks to 200 volunteers, surplus food can be redistributed daily from supermarkets, wholesalers and food producers. Private individuals can do charity work, donate money to the food bank or donate closed food through the collection boxes in selected supermarkets, as shown in the picture in the previous paragraph. The aim of the food bank is to fight poverty, reduce food waste and create solidarity between people. The EU finances the food bank by purchasing around 60 000 food packages from the food bank four times a year. Last year, almost two million kilograms of food were distributed in Estonia. The food bank has set itself the goal of increasing the amount of redistributed food by 20% annually.

Üle Eesti vajab nädalas abi keskmiselt
13 661 inimest.

2020. aastal saatis Toidupank ringlusse
2,47 miljoni kilo toitu
millest **73** protsenti oli päästetud toit,

…**17%** Euroopa Liidu ostetud toiduabi
ja **10%** annetatud (eraisikud) ja
ostetud.

Figure 29 Distribution chain of Toidupank Eesti (www.toidupank.ee)

The foodbank only provides and delivers food to people who have been identified as food-insecure by social workers or charity organisations. This means that the food rescued by the food bank is not accessible to everyone. Presently, registered clients can come every day during a certain time slot to the main distribution and storage quarter in Lasnamäe – a city district in Tallinn – and receive a food box with mixed food and sometimes other products like hygiene articles. Some clients who are physically unable to come, such as elderly or disabled people, receive the food through home delivery. (Toidupank, 2022). Even though the foodbank does not fully represent an example of unconditional access to free food, still it successfully saves edible food from being wasted and might have become irreplaceable for many people in Estonia that are dependent on their service.

Figure 30 The Toidupank Team of Tallinn (www.toidupank.ee)

3.7 Conclusion about Food Waste

To summarise the theoretical research about food waste, it can be said that everyone can play a role in reducing food waste. Often with minimal effort, food waste can be reduced, save money and help to protect the environment. Since the research has shown that there exist a lot of different solutions to prevent or reduce food waste on a household level, it seems to be even more surprising that private households of all sectors are generating the most food waste. It can be assumed that the reason for that lies in a lack of awareness. Especially when talking about food waste with other people, it came out repeatedly that people either don't know that food waste is such a big problem, or they don't know about all the tools they could use to fight against food waste. Others are aware of the solutions but forget to apply them. And some people just don't care about food waste. What all those people connect is the fact that they do not have education and awareness of how and why they should save food. Education usually sounds like an easy way to solve all kinds of problems, but it is not that easy. Food and the act of eating are deeply rooted in the culture and express the values of a society but also of the individual. Food and eating habits change from culture to culture and are influenced by many factors such as the historical background, food access, age, income and many others. Hence, there is also not "the one" way to educate people. For example, raising awareness through food management apps might help a single mid-aged household to reduce food waste but seems to be entirely useless for the 70-year-old neighbour! But educating cultures and societies is not impossible. It just takes patience and time and constantly growing solutions. An approach to inform people and raise awareness in the long-term could be the use of nudges which are already successfully used to raise the awareness of sustainability and change the people's behaviour toward a healthier lifestyle. Nudging is described more detailed in chapter 5.

To reduce food waste across the food system, all involved actors have to be sensitised and change their behaviour – no matter if they are consumers or producers. But at the moment, food waste is rather pointing out the inequality in the food system because it is increasing along with the rate of people suffering from food insecurity. The status quo is so to say that edible and valuable food gets wasted in our society while there exist people that want or need access to free food to ease life or simply save food. The research brought out that there already exist many solutions and ideas on how food can be saved and shared in and outside of private households. Also, it is possible to get access to free food,

no matter if a person is food-insecure or not. And from a comprehensive point of view, there exists enough edible food for everyone that can be offered for free because it falls under the category of surplus food. As in the interviews came out, it is not about a lack of strategy and functionality. It is the fundamental connection between food waste and access to free food that is missing. But there are physical and emotional burdens that make it hard to build up this connection. Those burdens are either set through society or the individual through neoliberal stigmatisation, which will be described in the following chapter.

3.8 Neoliberal Stigmatisation of Free Food

3.8.1 About Neoliberal Stigmatisation

The survey results brought out that taking advantage of free food is often connected with negative emotions such as shame, guilt and discomfort – in this thesis called "food shaming". It is assumed that the reason for it lies in the neoliberal stigmatisation of free food – when individuals blame themselves for accessing free food. The following pages will introduce this phenomenon in detail in the context of food waste. To understand the issues about neoliberal stigmatisation and other terms related to the topic, some definitions should first give an overview of the field:

Definition of Neoliberalism: Neoliberalism is a political and economic ideology. It stands for the liberation of individual entrepreneurial freedom and skills with strong private property rights, free markets and free trade. The political characteristics of a neoliberal government are freedom of choice and market security but also minimal governmental intervention. In a neoliberal ideology being a "good citizen" means hard work, being responsible for oneself and being self-reliant, especially in the Western world. Thus, citizens who are not meeting those expectations are seen as lazy, irresponsible and underproductive (de Souza, 2019, p. 22). From an ethnological perspective, the ideology of neoliberalism creates a shift in identity and relationship. Therefore, it influences how humans behave in a community. They get subjectified in a way that they start to think and act according to the ideal of neoliberalism (de Souza, 2019, p. 161).

Definition of Stigmatisation: The word stigma itself means a simplification and differentiation of the reality and appears on an individual or social level. On the one hand, stigmata help us to understand something that we (initially) cannot understand or justify. On the other hand, they are an expression of our rejection. They create distance and spare us the confrontation and interaction with the stigmatised (Stiftung Gesundheitswissen, 2018). In connection to free food, the burden of stigmatisation is usually experienced through the approach to hide or mitigate food insecurity. It is not the fact that the individual lacks food. It is the interaction with the environment and the perception from both sides that creates a stigma and causes feelings of being observed or surrounded by suspicion when accessing free food. Being marked as food-insecure is not the stigma itself. The stigma is about the social process of linking this mark to power which automatically leads to a judgement of food insecurity. And judgement is expressed on an interpersonal level within individuals or within an organisation (de Souza, 2019, p. 16; 20). More abstractly, stigma is about "the power to present and represent - the power to mark, assign, stereotype, and frame issues, people, and situations in particular ways. Stigma is about the power to levy accusations, cast suspicion and be heard. Stigma is the power to shut up and silence others." (de Souza, 2019, p. 19).

Definition of Food Access: Food access is the ability to produce and consume healthy nourishing food, whereas nourishing is meant in a nutritious and emotional way (Bruckner, et al., 2021, p. 100).

Definition of Hunger: According to the United Nations hunger is "an uncomfortable or painful physical sensation caused by insufficient consumption of dietary energy" (Food and Agriculture Organisation of the United Nations, 2022). De Souza also adds that hunger is based on a systemic issue because it is not necessarily caused by a lack of food. Hunger is caused by the inability to access existing food (de Souza, 2019, p. 37).

Definition of Food Insecurity: According to the United Nations, a food-insecure person lacks "regular access to enough safe and nutritious food for normal growth and development and an active and healthy life" (United Nations, 2022).

Definition of Food Justice: Ensuring that the benefits and risks of where, what and how food is grown and produced, transported and distributed, and accessed and eaten are shared fairly." (de Souza, 2019, p. 17).

Definition of Food Security: According to the United Nations, food security is a situation that exists when "all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. Household food security is the application of this concept to the family level, with individuals within households as the focus of concern" (Food and Agriculture Organization of the United Nations, 2003).

The Tools of Neoliberalism

There are seven tools of neoliberalism that can be identified:

- Privatisation
- Marketisation
- State rollback or deregulation
- Market-friendly reregulation
- Use of market proxies
- Volunteerism
- Individualisation

In the context of this thesis, the last two tools are of particular interest. Volunteerism as a tool of neoliberalism means that volunteer work is strongly encouraged by the neoliberal government because it is used to cover the absence of social support provided by the state. Individualisation is used as a tool of the neoliberal government because it creates self-sufficiency for individuals and communities. Individualisation unfolds the rights of freedom but also the responsibility for individual problems. Through the encouragement towards individualisation, the responsibility for the abundance but also the lack of food is shifted to the local and personal level under the assumption that this is where the origin of the problem lies. This gives the government more capacity to focus on the ease of money circulation and profit generation. Through this shift of focus and the ignorance of problems in the food supply chain, the neoliberal government supports the waste of food and signalises that the value in food lies in its ability to generate profit instead of maintaining the health and cultivating the society (Blake, 2015, p. 2f.).

3.8.2 The Social Impact of Neoliberal Stigmatisation

Stigmatisation is separating society into groups. The process of stigmatisation completely depends on access to social, economic and political power because it serves as an orientation for the society on how to identify groups and what makes them different. It leads to the categorisation of people into prototypes and encourages the rise of negative biases as well as suspicion and doubts towards each other (de Souza, 2019, p. 18). Suspicion does not exist because food-insecure people are necessarily different from secure people. But they have to overcome more governmental procedures to prove their inabilities and insecurities. This happens when the power or superiority of food-secure people comes to the foreground (de Souza, 2019, p. 162). The categorisation creates social distances between groups. Because the neoliberal government is shifting responsibility towards the individuals of a society, social problems like hunger are not anymore seen as a problem of the government, but as a problem of the ones that are suffering from it – a process called subjectification that leads to situations where people silently get blamed or blame themselves for their "failure" (de Souza, 2019, p. 22). This neoliberal subjectification often appears within social organisations such as food banks because they frame people as "the ones that deserve it" and as "the ones who need it" not necessarily with a bad intention but rather indirectly by perpetuating neoliberal values (Bruckner, et al., 2021, p. 101). Because the people who receive the food feel bad about themselves for the need for exclusive access to free food, it is difficult to build up relationships with others in a similar or different situation. Hence, neoliberal stigmatisation also serves as a deterrent towards community building (Bruckner, et al., 2021, p. 104). The following flowchart visualises the subjectification flow and shows how the neoliberal government causes stigmatisation of food-insecure people, ending in a wicked connection between food-insecure people and neoliberal stigmatisation.
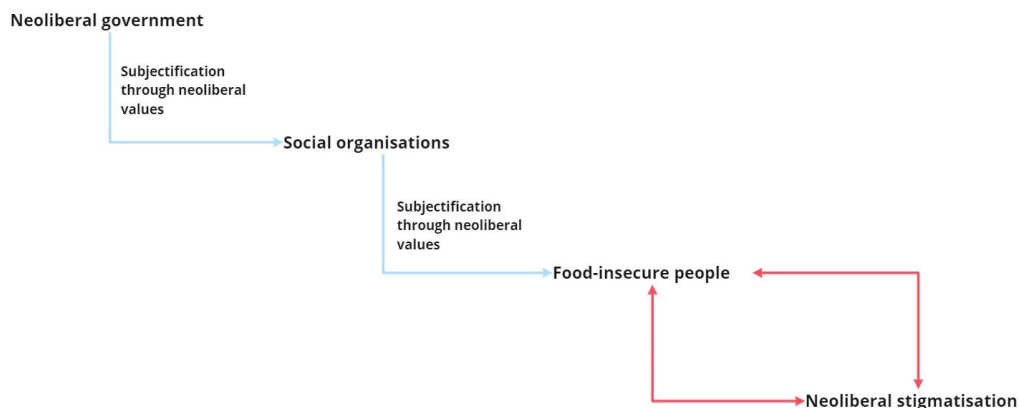
Figure 31 Subjectification flow (made by author)

3.8.3 Reasons for Neoliberal Stigmatisation

In Western society, a neoliberal government recognises and appreciates individualism, hard work, and personal responsibility. People who are not able to live according to these parameters get stigmatised by society because they are seen as irresponsible and out of control. Usually, disadvantaged people fall under this stigmatisation, while their personal background is not of relevance to those who are judging them. Thus, neoliberal stigma arises when people get categorised according to the neoliberal ideology (de Souza, 2019, p. 17).

3.8.4 Consequences of Neoliberal Stigmatisation

So far, food access has been tried to be eased through technical, informational and strategic solutions which rather focus on the distribution of surplus food. This might lower the problem of hunger and food waste in the short term, but it doesn't lower the emotional burden of accessing free food or protects from mental and emotional damage. Instead, neoliberal stigmatisation is causing and increasing it.

Neoliberal stigmatisation does not only affect people on a social and political level but also on an emotional level. It builds up psychological burdens of embarrassment and shame, especially among food-insecure people but also among food-secure people accessing free food. Those psychological burdens can be perceived objectively and subjectively but are in any case maintained by neoliberal stigmatisation. Food-insecure people additionally have to face physical burdens of economic nature and further psychological burdens connected to that such as anxiety, worry, stress and sadness. Due to the psychological burdens, those who are food-insecure tend to hide their weaknesses and hold back personal information to avoid judgement and rejection. It has a so-called silencing effect on individuals and the community. The social consequence is the disconnection and isolation from society and individuals, which is against the nature of the human being. It keeps people away from each other and oppresses cross-sectional human interaction (de Souza, 2019, p. 24).

3.8.5 Why Social Organisations are not a Solution

Non-governmental organisations such as food banks are the place where neoliberal stigmatisation occurs because they are the strategies of the government to deal with hunger. They are – so to say – the "Handlanger" for the government to regulate social

inequality. Consequently, organisations have to take over responsibility and stand in for the government. By doing so, non-governmental organisations get politicised but depoliticise the issue of food insecurity itself because it is made personal and private. But it also has to be pointed out that those organisations are currently the most effective and vital solutions to provide food-insecure people with food. Non-governmental organisations can be seen as solution-providers and problem-creators at the same time. They serve the ones that are in need but at the same time categorise and point out who is in need and who is not (de Souza, 2019, p. 19f.). They create a hierarchy by dividing into givers and receivers. Further, many organisations are treating the problem but not its origin. Social justice won't be reached only by distributing free food or donating food. It is more important to make the injustice transparent and to point out that there is maladministration. Or, as de Souza describes it:" Having a social justice sensibility means identifying with others from a position of solidarity" (de Souza, 2019, p. 55).

Another problem that often occurs with social organisations is the environment setup and the management. Food banks don't have ordinary opening hours and are usually not centrally located, such as supermarkets. Because there is usually only one foodbank in a city, people have to take waiting lines into account. All those "exclusive" burdens are creating a feeling of exclusion and dependence among visitors, which further supports feelings of shame and discomfort. Bruckner further describes that an emotional barrier arises due to the organisations' extra effort to overcome stigmatisation. It makes clients feel as if they have to blend out their pride and show thankfulness towards the staff (Bruckner, et al., 2021, p. 103f.).

3.8.6 Why Campaigns are not a Solution

There exist a wide range of campaigns against food waste as well as against hunger but those might not be effective enough. Anti-hunger campaigns calling for food donations usually compliment the donators or the cooperating partners for their social care and responsibility, which cannot be questioned. But while the donors receive all the recognition, the ones for whom the campaign is collecting donations are totally left out of the discourse and instead stigmatised as victims (de Souza, 2019, p. 46ff.). Especially when grants consist of surplus food from shops or private households, food receivers could and should not be left out. Instead, they should be appreciated for their act of saving food. If citizens are not engaged enough in processes but are only seen and treated as the target group of anti-food waste or anti-hunger campaigns, this might

not lead necessarily to a higher engagement. But engagement is essential to break or transform behavioural patterns, habits and perceptions (Pateman, 2020, p. 2f.).

3.8.7 Dealing with Stigmatisation of Free Food

The following approaches by Bruckner suggest how to deal with stigmatisation of free food:

- Society should get sensitised to social justice, which requires more engagement and altruistic action (Bruckner, et al., 2021, p. 101).

- Access to free food requires procedural justice, thus it should be more dynamic through relationships which are the key to procedural fairness. Because relationships or human interaction communicate trust, respect and comfort (Bruckner, et al., 2021, p. 101).

- Access to free food should "feel good" (Bruckner, et al., 2021, p. 101).

- Raising interest in food saving and involving people in the (re-)distribution of free food that is neither food-insecure nor working for social organisations could weaken the emotional burdens and avoid classification and stigmatisation of free food (Bruckner, et al., 2021, p. 105).

- The research results of Bruckner show that people participating in research processes related to free food and food access feel valuable and appreciated through sharing their own experiences, skills and knowledge about it (Bruckner, et al., 2021, p. 105).

Based on the design research results presented in chapter 3.9, the following approaches could be possible solutions to lower stigmatisation of free food:

- People taking free food should see themselves as food savers because they actively reduce food waste - just like food givers.

- By making food sharing environments appealing and inviting, more people would share food which could help to make the society accept this food saving method as something "normal". Consequently, food takers might feel more comfortable and less stigmatised.

- A wider spread of food pantries in public places would not only ease the access to free food but also sensitise society to food saving. This could bring the topic more to the foreground and weaken stigmatisation.

3.9 Design Research

3.9.1 Direct Observation as a Method of Field Research

To find out how stigmatisation affects the local food sharing system, field research has been conducted through the following methods:

- Direct observation
- Participant Observation (Toidupank food distribution, food sharing groups)
- Qualitative interviews

For the observation, different methods have been practised during the field research, for example the method of direct observation, which allows the observer to collect qualitative and quantitative data via subjects in a natural environment without interfering with the behaviour or the situation. This was very useful for observing people who feel uncomfortable when taking free food. Stigmatisation is a critical topic. Especially when it is about social maladministration, it is difficult to get in touch with people who are or feel stigmatised. Another insightful method was participant observation, where the author herself was involved in the research process as an observer and volunteer in the Estonian Food Bank ("Toidupank" in the Estonian language). The method enabled open and deep discussions with people from the organisation. The observation phase happened during the whole research process, while active observation happened between October 2020 and January 2021.

Direct Observation has been conducted at the following places:

- Keskturg Tallinn (26.11.2021)
- Food distribution cupboards in Tallinn (15.09.2021)
- Food distribution cupboards in Tartu (08.01.2022)
- Toidupank Eesti (08.11.2021, 10.11.2021, 15.11.2021)
- Food Fair Estonia (29.09.2021)

Participant Observation took place through the participation in:

- Toidupank food distribution (15.11.2021)
- Facebook food sharing group, participating as a food giver and receiver (02.05.2021, 27.05.2021, 03.07.2021, 20.07.2021, 14.10.2021, 28.01.2022)

More detailed information can be found in appendix B.

Key Take-outs from Observations

The following impressions gained through direct and participant observations have been influential during the research process:

- Places of free food distribution are provisional and functional but not inviting and decentral.
- The delivery of free food is mainly based on volunteer work.
- Places of free food distribution from human to human are extremely limited and fixed to specific dates and times during a week.
- For food receivers, the current offer is usually unknown.
- More free food could be distributed if there were more volunteers.
- Volunteer work requires a lot of time investment and physical strength and is not suitable for everyone.
- Free food distribution based on self-service (public fridges) is accessible at any time, but the places are often in poor condition.
- The system "First come, first serve" is perceived as unfair among food savers.
- Disruptors of food sharing are failed arrangements of the meeting time and location, non-appearing receivers or donators.
- Whether private or public free food distribution, the priority of givers is to get rid of the food as quickly as possible.
- One member of the Facebook food sharing group posted this interesting thought: "Is it necessary to encourage shy people who don't dare to take something out of the fridges because others might see them? (…) I feel that it is because getting access to free food doesn't feel natural or normal.".

- Some people are asking online directly for help from the food sharing community and express their feeling of shame for asking. Other members react with empathy and strong immediate support to those calls for help.

Key Take-outs from the Interviews

Various persons related to food waste or food saving have been interviewed, such as the head of food sharing Tartu or the CEO of the Estonian startup Food Angels. More detailed information about the interviews can be found in appendix A. The following statements gained through interviews have been influential during the research process:

- "We think that restaurants are ashamed of admitting that they throw away food." (Kaljuvee)
- "Wasting food is one of the most meaningless acts of humanity!" (Plath)
- "Many people are very vain (…) maybe vanity is just a façade to hide the shame." (Pelke)
- "It should be more stressed that our offer is not only for needy people but also that they are saving food! Those people should not only feel like a load for society, but they should also feel like food savers." (Pelke)
- "Public fridges are cool but in Summer…" (Boerefijn)
- "Yes, shame is there." (Koha)
- "I don't even feel like I am doing something good. People see me as a hero but also as a poor worker – usually people from the upper class." (Lucas)
- "Sometimes I take my flatmates with me. For them, it's super fun and they are so excited!" (Lucas)
- "What is missing is the fundamental connection between food waste and food insecurity." (Lucas)
- "I don't understand why free food is not for everyone. This exclusiveness is just underlining the problem that there are poor people who need it. But everyone would be happy about free food!" (Lucas)
- "Some people are too friendly. They are like 'I am not poor myself enough, I will wait until someone else takes the free food' or 'I will not take it at all. But it's about saving food. If I don't take it now, it might go to waste anyway!" (Annaliis)
- "The challenge is how to encourage people to not only see free food as something for poor people!" (Annaliis)
- "People are scared of looking poor." (Annaliis)

3.9.2 Gaining Data through Online Surveys

For investigating phenomena of food shaming and free food stigmatisation, online surveys have been chosen as media to gather quantifiable data that either support or deny assumptions and set hypotheses. The surveys were conducted between November 2021 and January 2022. 90 people participated in total that identified themself as food sharers, volunteers or food-insecure. The participants were recruited through social media posts, personal contact and physical posters at food sharing locations with a QR code. Many participants were Estonian. The surveys analysed the physical and emotional circumstances when giving and taking food, what makes access to free food difficult and what are the negative or positive experiences when giving or taking free food. The aim was to collect qualitative and quantitative data to understand better how free food gets perceived and how it gets emotionally and physically accessible. More accurate information can be taken from appendix C. The following pages present the most important survey results.

Key Take-outs of Survey 1

This survey aimed to find out whether volunteers, whose work is related to the distribution of free food to those who need free food, have another relation to free food. Since it is assumed that volunteers have access to free food themselves due to their work, the question is if they feel comfortable taking advantage of it or if they have similar feelings about it as their clients, which is often shame. The target group of this online form were volunteers in – and outside of Estonia that are currently involved in projects distributing or donating free food, such as food banks or food pantries or at least have had experience with this field of work. The most important results are as follows:

- The primary motivation behind food-related volunteer work is to rescue food, followed by providing insecure people with free food.
- The majority wishes to get more appreciation for their work from society.
- The majority is not satisfied with how food gets distributed at their workplace.
- All volunteers have access to free food and feel good about it.
- 40% admit that through their work the perception of food value has changed.
- Most of the volunteers promoted their work by putting food waste into the foreground.

Key take-outs of Survey 2

The intention of this survey was to find out how people feel when giving or receiving free food and what is their motivation behind it. The survey has been posted in different Estonian food sharing groups on Facebook. Thus, participants have been active or passive members of the food sharing community that either share or receive free food and post topic-related content. The most important results are as follows:

- 40% feel guilty because they think others deserve it more.
- 15% feel ashamed because they need it.
- 17% worry about how others think about them.
- 12% feel judged by the people who give free food.
- 17% feel classified, separated and excluded.
- About one quarter admits taking advantage of free food.
- The participants of this survey are rather food receivers than food givers.
- 85% think that fixed locations for bringing and taking free food would make it easier to share.
- 70% wish to have an attractive location to share free food.
- 50% think better communication between givers and receivers would ease the distribution.
- 42% could imagine having a collecting system for surplus food at home.

An interesting connection could have been crystallised when reading individual answers of the participants of survey 2, which consisted of people that are rather receiving free food. According to them, exchanging food at fixed locations is connected with less effort than meeting in person, especially when it is about receiving food. Thus, the effort is the act of meeting a person whereas "effort" can be interpreted as the physical effort of moving or the communication effort of agreeing on a date and time. In the broader sense, "effort" could be also seen from a psychological perspective as the experience of negative emotions that might arise when meeting in person. In any case, less effort would not only ease the access to free food but also ease the reduction of food waste. The following graph visualises this interpretation:

More people <u>get</u> free food from the facebook foodsharing group than give free food.

The majority is fully aware of the problems which come along with food waste and they try to reduce it. At the same time they are not necessarily willing to do more in order to reduce the food waste.

Many participants can imagine fixed locations where you exchange the food

Many participants pointed out that the food exchange would be easier if you don't have to meet the person

Figure 32 Interpretation of survey 2 (made by author)

Key Take-outs of Survey 3

The purpose of this survey was to directly get feedback from people who are leaving or taking free food from public food pantries or from people who are just stopping and passing by. For this survey, a poster with a QR code has been attached to all the four public food pantries in Tartu. By scanning the QR code a short feedback form will open with five questions about the experience at the food pantry. Eleven people submitted the form.

Figure 33 Survey poster on spot (made by author)

The most important results are as follows:

- The majority visit the food sharing spots at least once a week or more.
- Almost 78% come to the spots spontaneously, while around 56% come because of Facebook posts and 44% come because they feel hungry.
- The majority visit the food sharing spots in the evening.
- Nobody usually gets what was expected, but around 56% of the participants are still happy with the acquired "surprise" food.
- Around 22% admit to not find something useful on spot.
- The majority admit trying to be unseen while taking free food from the food sharing spots or when only checking out what's available.
- Almost everyone admits feeling uncomfortable when taking free food or when only checking out what's available.
- Only people who brought food to the food sharing spots feel proud and responsible for their act.

3.9.3 Conclusion about Design Research Results

Observations have already brought out that there is a lot of food that gets wasted in Estonian households. But the will among citizens to share and save free food is very present. The interviews pointed out that a lot of food could get rescued from being wasted and that there are enough people who would be happy to take it. But due to the way how free food is made accessible, people are shy or feel embarrassed to take it, no matter what their social background is. The observations, especially the participative observations, have been essential for the author to explore this paradox herself and make the lack of emotional access to free food tangible. At the same time, it even made the problem space unreal since it is hard to understand how such small actions as giving and receiving free food can create so profoundly rooted feelings of shame, suspicion and discomfort. At that point, it was necessary to build up the theoretical framework and understand the connection between food waste and neoliberal stigmatisation, which is considered to be the reason for occurring destructive emotions regarding accessing free food. With the newly gained data and a deeper understanding of the problem, the research has been continued through surveys. The surveys were crucial to prove if the phenomenon of food shaming also appears in Estonia. Especially the results of survey 2 and survey 3 made it evident that all the assumptions can be

proved. Further, the results gave some hints on how the distribution of free food should be and how it should not be. The effort of taking or receiving free food is still one of the main burdens – physical and emotional. But also, there must be a change in the attitude of the people. Especially people who would or could take free food, regardless of the motivation behind it, seem to need incentives or more encouragement to overcome their doubts and vanity against free food. In a capitalistic world, free food might not feel natural or normal. Hence, one of the objectives of this thesis is to think about a solution that makes the act of accessing free food feel more natural and obvious in a food-saving context.

4.   Reflection and Reframing

Based on the theoretical and practical research, it is concluded that access to free food should be given to everyone, not only to food-insecure people and outside of social organisations. The aim is not to feed those who are food-insecure but to motivate everyone to save food. The research about food waste brought out that there is enough food for everyone and much more surplus could be saved if there was more time, space and human force to distribute and share it. Making free food accessible for everyone in a more public and proactive way could sensify a broader range of people for food saving. At the same time, it could encourage people from different sections to share food or even meet and connect on a joint base. The focus should not lie on food as a tool to survive and so should free surplus food not be seen or treated as waste. Food and free food are valuable sources of nutrition and a cultural good that can connect people and should be taken care of. It is essential how the access to free food is eased and optimized but it is even more important to think about how to make access to free food convenient for everyone. With this understanding, the initial research question has been changed and reframed during the research process, while specific topics changed their grade of relevance. A visualisation of the research question development can be viewed in appendix D. The final research question reads as follows:

**"How to reduce food waste on a household level
by easing the access and lowering the stigmatisation burdens
of free food?"**

Consequently, the hypothesis reads as follows:

**"Design can be used as a tool to reduce food waste in households while
lowering stigmatisation burdens of accessing free food and ease the
access to it."**

Neither the problem of stigmatisation for accessing free food is novel, nor is the fact that it collides with food waste. Hence, there do exist projects that try to connect free food access with a food saving approach, for example so-called "no-cost" food programs. They are designed to build down emotional and physical burdens to food access and to increase the commitment and engagement of individuals in a community. Examples of no-cost food projects are local supermarkets that only "sell" free food or restaurants where the guests can pay what they want. Usually, the projects or places

are run by members of the community, which automatically reduces the stigmatisation and negative feelings of customers.

In Colorado, the initiative "Boulder Food Rescue" aims to reduce food waste by distributing it directly to low-income communities by bike. Couriers pick up food from shops or other donors, load it into bike trainers and bring it to food distribution locations where recipients can come at any time and take free food (Anon., 2022).

Figure 34 Boulder food rescue courier at work (www.boulderfoodrescue.org)

The greatest advantage of this model is its decentralised character. The access to free food is not limited to certain places but relatively flexible in terms of location and time. Storage is not necessarily needed if the food gets distributed immediately and bike delivery is environmentally friendly. But as with all volunteer-based projects, the problem is hiring volunteers who can afford money- and timewise to work without being paid.

Another approach comes from "SavingFood", a collective awareness platform that connects food donors, charities and citizens through citizen science. The platform describes its function as follows: "Through citizen science methods the platform could simultaneously extend the network and raise awareness of food waste while gaining a

deeper understanding of motivations and barriers for donors and volunteers. Sharing their findings within the research community enabled other food redistribution platforms to learn from the project and involve as many citizens as possible with food surplus redistribution" (Anon., 2022). The advantage of this initiative is the power of collaborators. Partners with solid expertise in marketing or from the IT sector and researchers support the project and share information or motivate others to join. But it can be criticised that this approach is more addressed to influential stakeholders such as food donors, companies and policymakers. It doesn't involve citizens directly. Solutions might be developed in the background in the long term but do not intervene acutely.

A still unexplored way to overcome stigmatisation of accessing free food through encouraging food saving is the use of nudges. In the context of food, Feeding America defines a nudge as "a subtle environment change in a food distribution setting, designed to make a healthy choice the easy choice" (Anon., 2022). This method could be beneficial for areas where free food is made accessible. The potential of nudges will be further described in the next chapter.

5. Saving Food through Nudging

5.1 About Nudges

The verb "to nudge" means "gently push" someone or "lightly thrust into the ribs, especially with the elbow«. It's about giving humans a push in a way to draw their attention to something, to remind them of something or to warn them gently (Thaler, 2009, p. 24). Nudges guide consumers toward a "better" behaviour in a long turn through minimal changes in the environment that might not be even recognizable to them. The principles of nudges can be applied both to the private and the public sector. Nudges take advantage of the fact that the human brain is divided into two parts that work differently. The automatic cognitive system is uncontrolled, quick, unconscious and intuitive. The reflecting system is controlled, slow, conscious and rule-oriented. Nudges make use of the automatic system that can be trained through many repetitions, eventually initiated by nudges (Thaler, 2009, p. 28ff.). An example would be the installation of memorial crosses on the side of a highway. Car drivers would see them and unconsciously slow down their speed because they relate the crosses with car accidents and death.

As this example already points out, nudges can play an important role in preventing humans from making mistakes. They help to make right decisions when humans have difficulties to decide. In most cases, those decisions rely on an action that would take a lot of effort and which consequences are timewise separated from the moment of decision. Hence, the costs are more tangible than the consequences people will experience later. This tempts people to stay inactive or to react to less. Nudges keep humans active in a non-overwhelming and comfortable way without any extra effort. Further nudges train the human brain to change its behaviour and generate new habits (Thaler, 2009, p. 100ff.).

5.2 Categorisation of Food Nudges

There are many ways to categorise nudges. Regarding their mode of action, nudges can be categorised into cognitive, affective and behavioural nudges:

Cognitive Nudges: They work by providing consumers with information and trusting that they will use it to make better choices, for example making the healthy option more visible.

Affective Nudges: They appeal on an emotional level by making healthy food sound more exciting or appealing. By using signs, displays or verbal encouragement, humans can be guided towards making better choices. An example of this might be an attractive arrangement of fruits and vegetables.

Behavioural Nudges: The final category of nudges is the most effective in changing behaviour. Behavioural nudges modify behaviours without influencing what people think or what they want. This method does not require any engagement or willpower on behalf of a person. An example of this might be enhancements that make healthier options easier to eat – such as pre-cutting fruits and vegetables or modifying plate size (Chandon, 2019).

Usually, nudges work on different levels and apply to different sectors or topics, as the following graph visualises:

The 3 categories of nudging and their mode of action

	cognitive	Nudges that support self-regulation and self-responsibility and thus take on a decision-making assistance function	provide memories support self-obligation underline the right decision	
Nudges	affective	Nudges that act by directly changing the decision context (i.e. the decision architecture)	change defaults change effort of decisions change composition of decision options change decision consequences reach the emotional level direct or indirect encouragement	Green nudges Social nudges Food nudges Smart nudges
	behavioural	Nudges that change behavior without affecting the thought pattern and where active action and thinking by the individual is not necessary	modivy environment modivy behaviour attach unconsciousness	

Figure 35 categorization of nudges (made by author)

5.2.1 Green Nudges

Green nudges aim to reduce environmental impacts through behavioural change. They seek to encourage more sustainable practices and nudge people toward a greener

lifestyle. Since the reduction of food waste and the choice of organic food also contributes to the environment, many green nudges focus on eating habits and food purchases. An example of green nudging would be to place more sustainable food in a visible position in a cafeteria. Simple changes like that make the sustainable choice a little easier, more present and more "normal" (United Nations Environment Programme, 2020, p. 6).

5.2.2 Social Nudges

Social nudges aim on increasing people's voluntary provision of public goods. Social nudges also try to make people decide on something they do not believe to be optimal given their individual preferences. The aim is to benefit society in broad terms. A Characteristic of social nudges is non-rivalry. It means that someone's consumption or action doesn't influence others in a negative way. Another characteristic is non-excludability which means that nobody will be excluded from the benefits due to social nudging (Nagatsu, 2015, p. 485). There are two ways to influence and improve social behaviour: the first way is to inform as many people as possible about something to encourage them to do or think correctly. This can also cause others to take these actions or adopt thoughts since it is a human habit to gain information socially. The second possibility is peer pressure, to which many people succumb. If persons care what others think of them, they are probably also inclined to orient themselves to the majority to win their goodwill and not to attract their anger. Often this behaviour is due to the false assumption that others are interested in what we do (Thaler, 2009, p. 75).

5.2.3 Food Nudges

So-called "food nudges" focus on changing human behaviour and habits toward a healthier diet and a more conscious way of food consumption. Food nudges can be applied in environments where humans have the choice of which food to purchase or to consume, for example supermarkets, cafeterias and also food banks. Nudging consumers towards more healthy food choices in supermarkets can be caused through manageable implementations like the correct placement of more healthy food. In a study, it came out that clients care less about their choices at the beginning of their shopping trip when the basket is still empty. Thus, healthy food might be placed first on the shopping path. Price tags cause the impression that a product is more valuable.

And waiting areas can be surrounded by attractive advertisements or images of healthy food to influence the client's choices. A controversial nudge towards food waste is the visible abundance of a healthy food selection since it came out that consumers rather get attracted by shelves or containers that are fully stocked than by empty ones (Feeding America, 2022).

Figure 36 Full boxes of fresh fruit at an Estonian supermarket (www.ulemistecity.ee)

But also, in places where food gets directly consumed exist various ways to nudge people towards eating healthier and more controlled. A study about the effectiveness of food nudges brought out that behavioural nudges were more successful than cognitive and affective nudges regarding healthy food choices.

Besides making healthier meals more visible and attractive through strong words, images or food presentation and visible nutrition labels can make people think twice about whether they eat a fried schnitzel or better a healthier alternative. Colour coding eases the identification of healthy food. Green could be used to mark healthy food or good nutrition and red for unhealthy food or bad nutrition. A food nudge that is easy to implement is to change the order of dishes listed on the menu so that healthy dishes come first. Another way to influence the choice of customers is the price. Offering vegetarian or vegan dishes for a lower price than meat options might change someone's choice (Chandon, 2019). A very radical nudge is introduced by the nudging expert

Richard H. Thaler: To help people lose weight, a strategy in cafeterias has been tested where mirrors were installed all around the area so that overweight people see themselves while eating. The outcome was that the people automatically ate less or chose more healthy food than usual (Thaler, 2009, p. 301).

Figure 37 Example of making daily food wastage visible (www.valuearth.com)

Unfortunately, food nudges dealing with food waste – especially in private households – are not developed yet. According to von Kameke and Fischer, the need is there because only educating people about food waste seems ineffective. Further, nudges could support good habits of saving food and consuming more consciously instead of pointing out the bad habits (von Kameke & Fischer, 2018, p. 33). Nevertheless, studies have been conducted to experiment with nudges to reduce food waste in other fields. For example, the size of plates has been reduced to make people take less from the buffet in hotels. As a result, less food was left on the plates and people took into account going to the buffet multiple times. To lower discomfort among the guests, the hotel actively encouraged their guests through shields to visit the buffet more often instead of overloading the plates. Through those nudges, food waste was reduced by about 20% (Kallbekken & Sælen, 2013, p. 325ff.). Another study explores a nudge-based intervention on a household level but rather focuses on recycling food waste instead of lowering it. The 16-week experiment was about the use of stickers placed on the lids of the trash bins that should help to decide more quickly where to throw trash. People not only started to recycle more, but they also recycled their trash correctly. The effect didn't decrease after removing the stickers and the realisation of this nudge is cheap and uncomplicated (Shearer, et al., 2017, p. 170f.). The most insightful study about the prevention of household food waste through nudging explores more the consumer perceptions of how food waste can be reduced on an individual level. The impact of personal behaviour and pre-planning gets analysed. Through a questionnaire, the researchers tried to better understand consumers' preferences and interest in changing

their behaviour towards food waste. The results showed that respondents were open to behavioural change and increased interest in the topic. The authors therefore emphasise that nudges have an extremely high potential to reduce food waste at home. However, the study does not include any tangible concepts or ideas about what these nudges might look like (von Kameke & Fischer, 2018, p. 32ff.).

5.2.4 Smart Nudges

Nudges can also apply to technology, as researchers point out in a study about smart nudges: "People make decisions and take actions to improve their viability every day, and they increasingly turn to artificial intelligence (AI) to assist with their decision making. Such trends suggest the need to determine how AI and other cognitive technologies affect value co-creation. An integrative framework, based on the service-dominant logic and nudge theory, conceptualises smart nudging as uses of cognitive technologies to affect people's behaviour predictably, without limiting their options or altering their economic incentives." (Mele, et al., 2021, p. 949).

Within a study of the combination of technology and nudges, the concept of smart nudges is understood as nudging, which refers to the use of cognitive technologies to influence people's predictable behaviour in a controlled manner without restricting it or changing economic incentives. Cognitive technologies enable and scale cognitive abilities such as language learning and thus promote human intelligence. In this sense, nudges are decision architects who make resources more accessible, increase engagement and make people more capable of acting.

The study focuses on how technologies and cognitive systems combined with nudges can support these shared value creations. Digital nudges refer to the user interface in the digital area and in places where the user has to make significant decisions. This is not necessarily about smart nudges (Mele, et al., 2021, p. 949f.).

It is claimed that user interface and user experience designers are decision architects who consciously or unconsciously influence and guide people's decisions when using digital devices (Mele, et al., 2021, p. 952). In return, results of digital nudges serve to optimise the design and the user experience. Examples of technology involving smart nudges are the concept of "HAPIfork" - An electronic fork that helps users monitor and track eating habits. The smart fork also alerts users through indicator lights and soft vibrations when eating too fast (Mele, et al., 2021, p. 953).
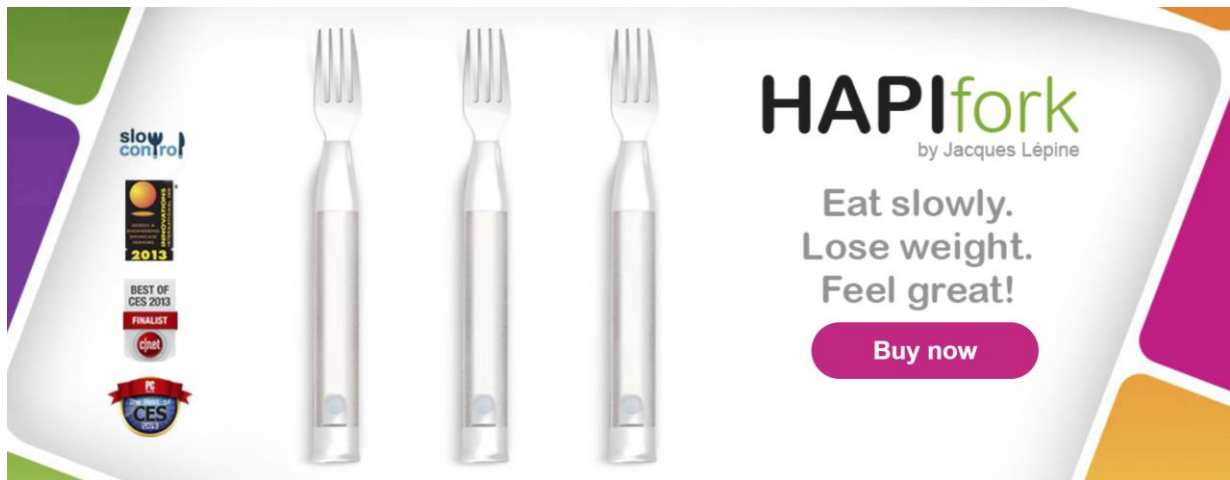
Figure 38 Smart fork as an example of a technology-based product containing smart nudges, (www.hapilabs.com)

5.3 Conclusion about Using Nudges to Ease Food Saving

The design research's insights about the potential of nudging as a tool to reduce food waste are summarised as follows:

Nudges can be applied in various ways to reduce waste or support a more conscious consumption of food. Nevertheless, nudges for reducing food waste on a household level seem to be not that much explored yet, even though the need is there. Previous research showed that education about food waste is not enough since it only motivates people to act correctly but doesn't make them act according to it. But people are willing to be more engaged through social (inter)action to reduce food waste. Therefore, supporting or praising good behaviours is more effective than judging and forbidding bad habits. As such, nudges should simplify free food distribution and lower barriers. They could make use of social norms and increase the ease and convenience of taking or giving free food (von Kameke & Fischer, 2018, p. 33). Further, nudges could serve as reminders to share or save food before it gets inedible or thrown away. Nudges might be more effective if the goal of food waste reduction is combined with another goal. Since there is no research going on about the use of nudges to overcome stigmatisation of accessing free food, using nudges as a design tool to reduce food waste through the reduction of stigmatisation seems to be promising.

6. Design Process

6.1 Design Approach

The design research showed that more food from private households could be saved if the access to free food was more convenient and less stigmatised. Therefore, the author proposed the hypothesis that a food sharing system for private households could motivate to save food by making free food – or in the context of food sharing: shareable food - more accessible. But certain aspects must be taken into account that currently make the distribution of shareable food challenging. Even if the vision is to give everyone equal and fair access to free food at any time, it is almost impossible to make this vision come true without losing control, reliability or functionality. By accepting this fact, the next logical thought is to focus on communities that give enough room and flexibility to make access and redistribution of free food dynamic. At the same time, s local limitation keeps up a safe space that allows to manage and facilitate the food saving activities within the community.

Why Using a Design Approach

Today's life and values are constantly changing due to the rapid development of technology, global change and unexpected crises of natural or political nature. This also means that behaviours, desires and needs change. Past solutions might not work as well as they did before. Therefore, design is needed to either redesign the existing or invent new solutions that can be adapted and reshaped for the future. While food loss and food waste are long-existing global problems, the trend of food sharing and food saving is comparably new and the request for a sustainable food distribution is remarkably high. Thanks to digitalisation, a lot of innovative technology is available that can help redesign the existing. Due to the research results, the author approaches to develop a design that makes food sharing convenient so that it can be easily implemented in society. For the design development process, various tools have been used to generate, analyse and evaluate ideas, such as the affinity diagram or comparison matrix. More detailed information about the outcome of those tools can be found in appendix E.

Figure 39 Photo of affinity diagram and brainstorming results (made by author)

Orientation for Developing a Design Concept that Makes Free food Accessible

For better orientation and more inspiration, the author considered the following points during the design development process:

Create personas that represent the target group
A target group is not only defined by geo-demographic aspects but also by socio-demographic aspects. Therefore, it is important to divide the target group into sub-groups representing a certain millieu. There are a lot of different opinions and lifestyles among sub-groups.

Keep up a human-centered approach and zoom into people's networks and things
While putting the human in the center of the design process, a concept might work better when applied to a network . A design concept doesn't have to be only one product or one technology. It can be a combination of interplaying elements.

Look at the detail and the bigger picture
The focus lies on households but you can look at them from different perspectives since households can be interpreted in various ways.

Imagine different use scenarios
Personas and use scenarios are an inspiration during the process. It is important to think about possible emotions, reaction, worries and actions of users.

Create a design based on the way people usually do in their daily life
People love habits and routines and they avoid extra effort. Design solutions should fit into the daily routine without disturbing it too much. Little changes can be more likely to turned into new habits and create new mindsets.

Make the familiar unfamiliar and the unfamiliar familiar
New ideas can come up, when ideas are turned upside down or when thinking out of context.

Figure 40 Design development orientation (made by author)

Food waste is a problem that affects everyone in society. Therefore, the food-saving approach should be addressed to everyone but especially to those who never actively thought about food saving. Those people might be still unbiased and have a high potential to be sensitised to the topic. Another interesting focus group are people that are already highly sensitised toward food saving. It is important to have this group in the scope because they might help to raise awareness among the society and motivate others to actively fight against food waste. The third focus group are people who get or feel stigmatised for their need for free food. This group is willing to save more food if psychological burdens would be lower but still, the mindset needs to be changed from "I am the one who needs free food." into "I am the one who saves food from being wasted.". The three target groups are shortly described in the following and represented by three persona profiles:

1. Individuals that never confronted themselves with the topic of food saving, food waste or free food but might be potential food savers
2. Individuals that have a very sustainable mindset and consider themselves to be experts in the field of food waste reduction and food saving
3. Individuals that are experts in the field of food waste reduction and food saving due to economic reasons

Figure 41 The three created personas (made by author)

The three persona profiles can be also found in appendix E.

Four components ("ingredients") have been formulated that could – ideally all combined within one concept – ease the access to free food and smoothen food distribution within a community. Those ingredients are "Human-centred system", "Product", "Technology" and "Nudges". The terms are described on the following graph:

Human-centred system

A community of people that that share a certain space, follow the same rules and have overlapping habits and responsibilities. Members of the community can be different types of households such as families with children, couples, singles, single parents, etc.

Product

Products are divided into physical products (physical and fixed products that are used only on spot) and hybrid products (hybrid tools that help to act, communicate and maintain a system)

Technology

Technolopgy that connects humans within a community, products within a system and users with the product. Technology supports the performance of all entities within a system and increases the efficiency of processes.

Nudges

Nudges can encourage and guide individuals to use systems in a right way in order to benefit from it. Nudges can minimise frictions that technology and products can't cover.

Figure 42 Components for the idea development (made by author)

Selection of the Concept

Four different food sharing ideas have been compared according to their strength and responsiveness to the research results. The following picture shows according to which criteria the ideas have been compared. More detailed matrices can be found in appendix D.

scala 0-10 (0= worst, 10=strong)	The wishing table	Little eating corners around food pantries	Food saving basket on bins	Local community food sharing system
hygiene	2	7	5	7
control	5	6	4	7
accessibility	7	6	8	8
demarcation from waste ?	6	7	3	7
distribution?	5	6	7	7
independence	4	3	8	7
against stigmatisation	3	7	3	6
total (of 70)	31	42	38	49

Figure 43 Comparison table of four different ideas (made by author)

As a result, the idea of a food sharing system within a community has the highest potential among the others. It can make it possible to reduce food waste, make free food accessible and create a sustainable mindset about food consumption and food sharing at the same time. The focus lies on household communities such as apartment buildings because this enables more equality among individuals regarding access to free food. The redistribution chain is reduced to a minimum and doesn't require extra effort, such as walking to a particular food sharing spot. A community-based concept can raise

trust in free food because the food is not coming from total strangers. Furthermore, a system within a community can be more controlled and could run independently by the community itself. Being part of a community of households means a balance between privacy and publicity connected to specific regulations, benefits and duties. This provides more security against vandalism and environmental influences.

The following graph shows how the four components will be approached and how they could be helpful within the design process:

A system that
- eases access
- organises distribution
- makes free food visible but is not disturbing
- keeps anonymity optional
- includes people without technology

A product to store food
- could have (natural) cooling features
- has to take minimal space
- should be expandible
- should be independend

A product to distribute food
- bags, containers, boxes
- could have cooling features
- should be sustainable (reusable or biodegradable)
- easy to clean
- has to protect the content

Technology that
- manages the sharing ecosystem
- updates the community about the content
- alerts the community to share
- makes the system transparent & reliable (see who gave food, how much others saved already etc.)
- allows flexibility in communication & interaction among the community

Nudges that
- rely on social norms and group dynamics
- remind the community to make use the system
- create new behaviour patterns
- encourage people without connection to food sharing to try it out
- spotlight effect
- bumerang effect

Figure 44 Development of the components within the selected idea (made by author)

6.2 The Design Challenges

The research has brought out so far that private households have a high potential to save food by sharing it with those who want and need access to free food. Concepts for sharing free food in public already exist on two different levels. On a product level, the idea of spreading food pantries and fridges around a city runs successfully in Tartu and is just getting started in Tallinn. On a digital level, there are a lot of online food sharing communities communicating on social media such as Facebook to give and take free food. Both systems are extremely popular among users. But the two sharing options face the same problems, which make it difficult to provide free food access for everyone:

- Even if people are willing to share food, they don't find the time to reach a distribution spot.
- People forget about the food that they want to share.
- People don't feel responsible for the distribution spots and the food that has been left inside, which makes distribution spots dirty and messy.

- While for some, it is exciting to contact new people while sharing food, others prefer to keep the communication to a minimum and avoid interaction to maintain privacy and anonymity.
- No matter the reason for accessing free food, the majority don't feel comfortable when accessing free food in public areas.
- Some people are very sceptical about offered free food. They don't feel encouraged to take free food because they perceive it as something abnormal.

Hence, the challenges for a designed solution are as follows:

- Easing the distribution of free food and the access to distribution spots
- Reminding and encouraging people to share food
- Raise responsibility among users of food sharing spots to keep them maintained
- Find a balance between human interaction and anonymity
- Making the act of giving and taking free food more normal and making it feel more comfortable

6.3 The Design Brief

With the help of the Moscow model, features of the design concept can get prioritised. It gives an overview of what the design concept will have or will do and what it won't have or won't be:

Mo	**S**	**Co**	**W**
Must have / be	Should have / be	Could have / be	Won't have / be
• inside • usable at any time • connected to an app • counting or measurement mechanism • transparent for food givers • make users responsible • simple	• Products are divided into • uniform box/bag system • usable without app as well • optional feedback system • anonymous for food takers (optional) • food is foreseeable • alert system • independend from electricity	• Cooling system for the storage system • boxes with sustainable cooling feature • module & extendable • food cams for every space • encouraging to share more than just food	• a fridge • outside • a care-taking person

Figure 45 MoSCoW model (made by author)

Based on the Moscow model, the following design brief formulates the goals of the design concept and shows how to reach them:

The goal is to design a reliable food sharing system for a household community that eases and encourages food distribution and makes users feel more comfortable and responsible for or while saving food. Included nudging mechanisms keep the system stable and should change the household's perception of food to turn food caring and sharing into a habit. The system is designed for any kind of household in an apartment building in- and outside of Estonia and is meant to share food with neighbours. The system should work without mid-man for distribution or maintenance. Instead, distribution and maintenance should entirely rely on the participating households of the community. Instead of focusing on how much food has been wasted by a household, the system should encourage individuals to reduce food waste and share food by empathising how much food has been already saved individually but also in comparison to other households and together. This nudging method is called spotlight effect. The system will be a combination of a physical product – a fixed storage shelf inside an apartment building, a hybrid product – uniform food containers, and a digital management and communication system – an app. This makes the system more flexible for users since not everyone feels confident with technology. Ideally, energy supply is not necessarily needed. The system is designed in a way that it allows households to also use the food sharing system, even if one of the components is missing. The design system should be a better way to share food besides local public food pantries as they are currently spreading in Estonia and digital food sharing groups such as the food sharing Tallinn Facebook group. Even though the aim is to give everyone access to free food, the design will focus on communities because it can manage certain friction points such as food distribution and maintenance better than the already existing alternatives. The desired vision is an independent and self-sustaining food sharing system that attracts every household to participate. Not only food will be saved, but people can also share experiences of information, for example recipes or "food saving hacks". Households might feel more connected through the goodwill of sharing food. The following graph shows the design brief:

accessible at any time	comfortable & convenient	self-sustaining & independend	adaptable
The design solution makes free food accessible at any time for every member inside a household community	The design solution makes the act of giving, taking and exploring free food within a household community comfortable, convenient and simple	Once in use, the design solution encourages the community to share food. No midman is needed to maintain and control the system. The Community controlls and maintains it themself. In case of technical issues, the system is designed in a way that it also works without technology.	Since every community is different, the design solution has to be adaptable regarding size and grade of digitalisation. In case the demand of the system is rising, the physical elements can be extended and increased but also the app provides a lot of extension opportunities.

Figure 46 Design brief (made by author)

6.4 The Idea of Designing a Food Sharing System

The idea is to reduce food waste by making access to shareable food convenient for everyone in the community. The author tried to combine various concepts that help households share food within the process. The idea of food planning, public food pantries and reusable food packaging served as an inspiration for redesigning a food sharing system. During the design process, it was decided to keep the idea of having a fixed food pantry for shareable food but to change the setting of it and connect it to technology. Therefore, apartment buildings will be equipped with an intelligent storage system in the entrance area connected to an app. Through the app, users can see which spaces are filled with what before deciding to walk to the storage system. The ability to check the available food in advance in real-time avoids disappointment and unnecessary walks. The app should make food sharing more attractive because shareable food can be presented there more gracefully. Users can upload shared food and provide detailed information. Food boxes make it easier to share cooked food or food that needs to be stored closed. Therefore, households don't have to use their own packages and wait to get them back.

The Situation of Food Sharing with the Currently Existing System

Right now, food sharing is inconvenient and unreliable. Food savers have to take long distances and insecurities into account and it is challenging to share prepared food. Let's suppose two persons from different households want to share food. In that case, either one of them must go to the home location of the other person - this usually requires the arrangement of a meeting time - or both persons must go to a food-sharing place (for example a food pantry) - one for leaving the food, the other one for picking it up. In this case, meeting in person is unnecessary, but the food taker also doesn't know if someone else will take the food before. In case of a direct hand-over, anonymity and privacy get lost. Stigmatisation could come up on both sides. Due to the high effort, people hesitate to give or take food. If there is a way to communicate, then only via social media or personal contact.

two or three locations
more effort
less convenience
less reliability

Direct distribution:
Either food giver or food taker has to leave the home location in order to share food. A certain time and place has to be pre-arranged.

Indirect distribution:
Both food giver and food taker has to leave the home location in order to share food at a third fixed location. The food distribution is based on "first come first serve".

Figure 47 The current food sharing system (made by author)

The Situation of Food Sharing with the Suggested System Design

With the suggested system, food sharing becomes more convenient and reliable. Food will be only shared between immediate neighbours. This limits the number of potential sharing partners but therefore reduces the physical effort to a minimum. A face-to-face meeting is not required to share food but optional. An app eases communication and management. Through the app, food takers get constantly updated about the available food in their apartment building. Provided food boxes make it easier to also share prepared food. By bringing the food sharing system into direct proximity to its users, households get constantly reminded and encouraged to save food by sharing. This turns food sharing into a normal activity and lowers stigmatisation.

one location
less effort
more convenience
more reliability

Direct distribution:
Either food giver or food taker in the same location has to leave the home in order to share food.

Indirect distribution:
Both food giver and food taker in the same location has to leave the home in order to share food at a fixed food sharing spot. The food distribution is based on "first come first serve" but the availability can be pre-checked.

Figure 48 The suggested food sharing system (made by author)

This innovative way of food sharing is considered to be a solution for food waste reduction inside an apartment building by easing access and lowering stigmatisation burdens of free food. First sketches have been made to visualise the idea of a new food

sharing system that combines a product with technology. Furthermore, app mock-ups have been prepared. Pictures can be found in appendix E. To evaluate the idea, a design experiment has been conducted and will be presented in the next chapter.

6.5 Design Experiment to Assess the Concept

The design experiment has been conducted from 1.4.2022 to 14.4.2022 and divided into two sub-experiments that run parallel. In the first design experiment, ten households were invited to join, of which seven participated actively. In the second design experiment, 16 individual persons participated, of which eight were born in Estonia. All participants in total are Estonian citizens and do not have a special connection with food waste reduction. The first experiment has been conducted entirely digitally due to restrictions and privacy concerns. The second experiment has been conducted face to face and usually spontaneously out of context. All participants are living in apartment buildings. In the following, the two experiments and their results will be described in detail.

6.5.1 Design Experiment 1

The Description of Test 1

Within this experiment, the food sharing concept has been imitated digitally through a digital co-working space where participants can access and work simultaneously.

The board deals as a virtual "experiment field" containing an apartment house with various households and a virtual food sharing shelf where participants were asked to share food with their neighbours (other participants). It is important to stress that participants neither shared real food nor communicated with other participants during this experiment.
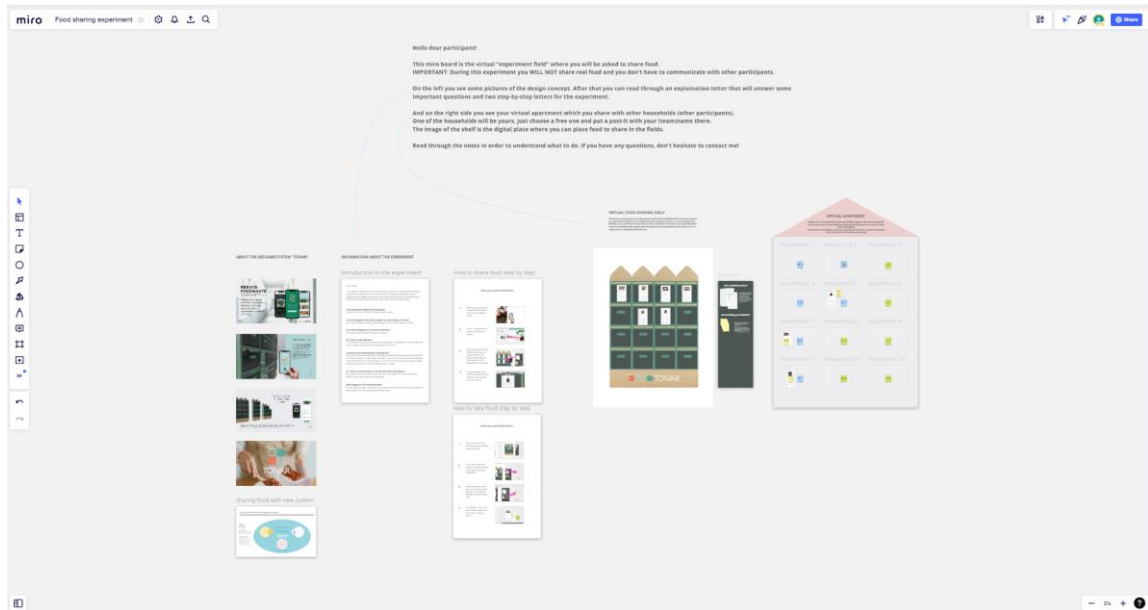
Figure 49 Screenshot of the virtual experiment field (made by author)

Participants have to fill out a food sharing letter that provides information about the shared food item and a photo to share food. This letter had to be dragged into one of the empty spaces on the food shelf. If a participant sees a food item that they would like to take, they have to drag the item into their household space together with a post-it that explains the decision.

The Purpose of Test 1

First, the purpose of this experiment was to find out what kind of food participants are willing to give and take. Further, information could be recorded about why people are sharing or taking food. Finally, this experiment format allowed getting an impression of how participants take photos of the food that they share. This impression was significant because the picture seemed to have a considerable impact on the decision-making during the experiment. The visual effect will be explored more in detail through the second test.

The Result of Test 1

In total, fifteen food items have been shared, of which eight items have been taken. The following table lists all the shared food items together with the condition and the reason to share:

Food Item	Condition	Reason of Sharing
Sour cream 10% fat	closed	bought too much
2 packages potato-salad	closed	bought too much
1 paprika	raw	person goes on holiday
1 package cherry tomatoes	raw	person goes on holiday
½ package toast	open	person goes on holiday
1 jar cabbage	closed	not used after long time
1 cup yogurt	closed	bough too much
1 cup Greek yogurt	closed	bought too much
1 package donuts	ordered	ordered too much
1 jar of jam	home-made, closed	needs more space
2 pieces of pizza	home-made, open	prepared too much
1 portion of pasta with sauce	home-made, open	prepared too much
1 salami	open	diet
1 portion chicken with potatoes	home-made, open	prepared too much
1 salad	open	no use

Figure 50 Shared food within the experiment (made by author)

The next table lists all the taken food items together with the reason why it has been taken:

Food Item	Reason of Taking
1 cup Greek yogurt	basic food
1 package donuts	looks good
1 jar of jam	just ran out of jam
2 pieces of pizza	loves this food item, no matter what
1 portion of pasta with sauce	looks good, hungry
1 salami	spontaneously needed for a certain dish
1 salad	loves this food item, no matter what
1 portion chicken with potatoes	Arrived home late and has no food

Figure 51 Taken food within the experiment (made by author)

The quality of the photos varies a lot. Some people seemed to care about a bright and neutral background of the food, especially with closed or packed food items. But many pictures have been taken spontaneously with divergent backgrounds or with a visible hand. Homemade open food has been photographed right from the plate or even from the pot. The following pictures show examples of how different photos have been taken.

Figure 52 three examples of taken photographs (made by author)

But against all expectations, the quality of the photos didn't seem to keep households from taking the food item. The following picture shows the selection of one participating household:
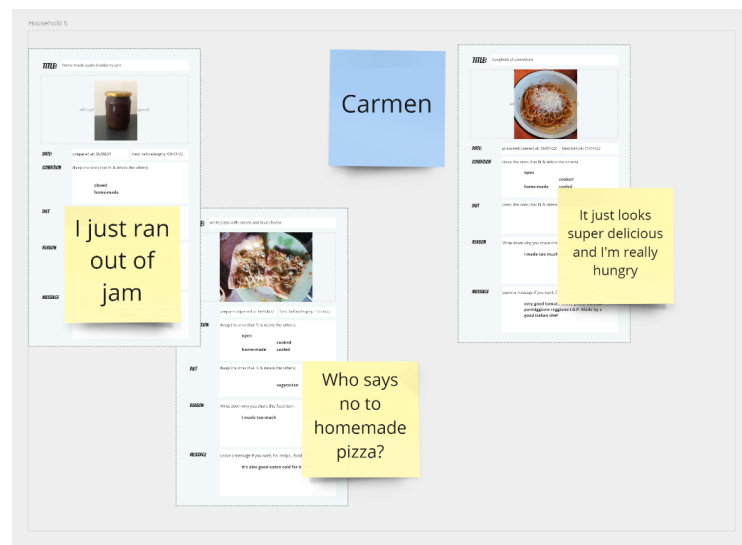
Figure 53 Food item selection of one household (made by author)

6.5.2 Design Experiment 2

The Description of Test 2

Participants were introduced to the project and asked to imagine having the new food sharing system in their apartment building. The imagined date for picking food items has been the 22nd of March 2022. This was important because the food offers have been uploaded on different days and daytimes and thus can influence someone's decision. Two sets, each with 15 food item layouts from the app, have been printed out and presented to the participants. The first set showed various kinds of food uploaded in the

app with very beautiful pictures. The second set showed similar food items, but the pictures did not look that appealing anymore. In some cases, the information has changed. For example, some food items were already opened or expired.

For each round, the participants were asked to go through the offers carefully and mark food items with a green sticker if they could imagine taking them or mark food items with a red sticker if they would definitely not take them. While marking the items, the participants were asked to share their thoughts and explain their decisions. It was stressed that personal preference should not be the main reason for choosing food. For example, if there is one card with a certain kind of cake, the participant should ask him- or herself: "Would I take this piece of cake?" instead of "Do I like this certain type of cake?". Pictures from the conduction can be found in appendix E.
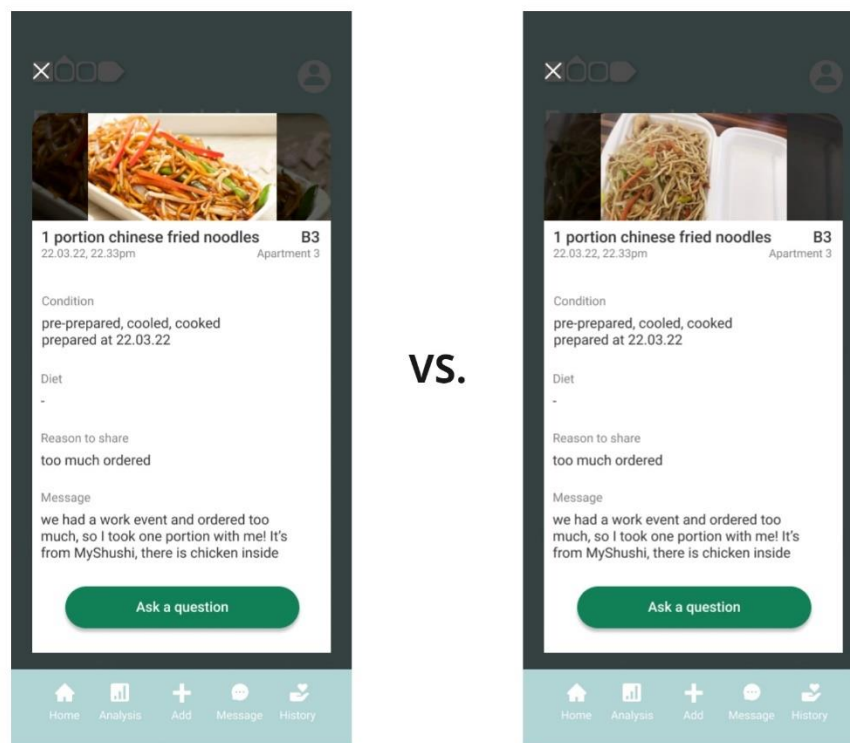
Figure 54 Example of two comparable food item layouts (made by author)

The Purpose of Test 2

The intention of this experiment was to find out which aspects are crucial or decisive when taking free food within the community food sharing system. Further, the goal was to see how much the visual appearance of food influences the decision about taking free food.

The Result of Test 2

In the first round, the majority was euphoric and open-minded towards taking food offers. But still, three main groups can be identified: people with high trust, people with medium trust and people with low trust in the community. Many participants chose food because they got attracted by the picture or just because they appreciated homemade food. One participant said: *"I would take in general everything homemade because it is exciting. And if it is not good, I won't die!"*. The participants were constantly asked during the test if they are aware of the fact that the food comes from strangers. Still, the picture had a more significant influence than the condition of the food or the fact that the food was homemade by a stranger. But at the same time, some participants were more critical towards the offered food. Some mentioned concerns about the quality and the hygiene of the food but balanced their decision by also considering their favours and the aspect of saving money or time. One participant expressed her concerns as follows: *"I would not take the left ordered food because who knows how many people touched it!".* Finally, some people only took closed and packed food items due to a lack of trust. One participant pointed out straight: *"I would only take closed food from the supermarket because I don't trust strangers."*. To summarise the first round results: the picture influenced people more than other factors, but still, the decision mainly based on the personal attitude. The most common reasons for choosing food items are listed below.

Main Reasons for Taking:
- the food item looks good and is home-made
- the food item is home-made
- the food item is closed
- the food item is pre-prepared and looks good
- the food item is highly desired

Main Reasons for Refusing:
- the food might be touched or contaminated
- the food item is home-made and thus not trustful
- the food item might have a lower quality due to the date

In the second round, almost every food item has been taken less than in the first round. Many participants changed their decision due to the picture or due to the condition of the food. A good example is a portion of sushi, which is an overly sensitive food item anyway. In the first round, eleven people took the left-over portion of sushi ordered from a restaurant. The picture showed three nicely arranged packages of sushi just as if

it had been ordered. In the second row, seven people changed their minds and refused to take the sushi because the offer changed to homemade sushi and the picture showed a big plate with sushi that didn't look as professional as if it was ordered or served in a restaurant. One participant argued the changing decision: *"Homemade sushi? No, definitely not. It is too risky with the raw fish and the quality."*. Six out of fifteen food items have been refused just because of the changed picture. After just glancing over the new selection of food items, some people commented right away: "I would not take it now because it doesn't look appealing to me anymore.". Three items have been refused because the product is already open and people were concerned about the quality and hygiene. But in general, more aspects together with the personal preference towards food were the reason for refusing certain items. People who had generally high trust towards food mostly stuck on their selection:" I *would still take everything homemade. I don't care how the picture looks like. And if I go down, I can see how it looks like anyway.".* People who had generally low trust towards food didn't change their decisions or took fewer food items. The full table with the detailed results can be found in appendix E.
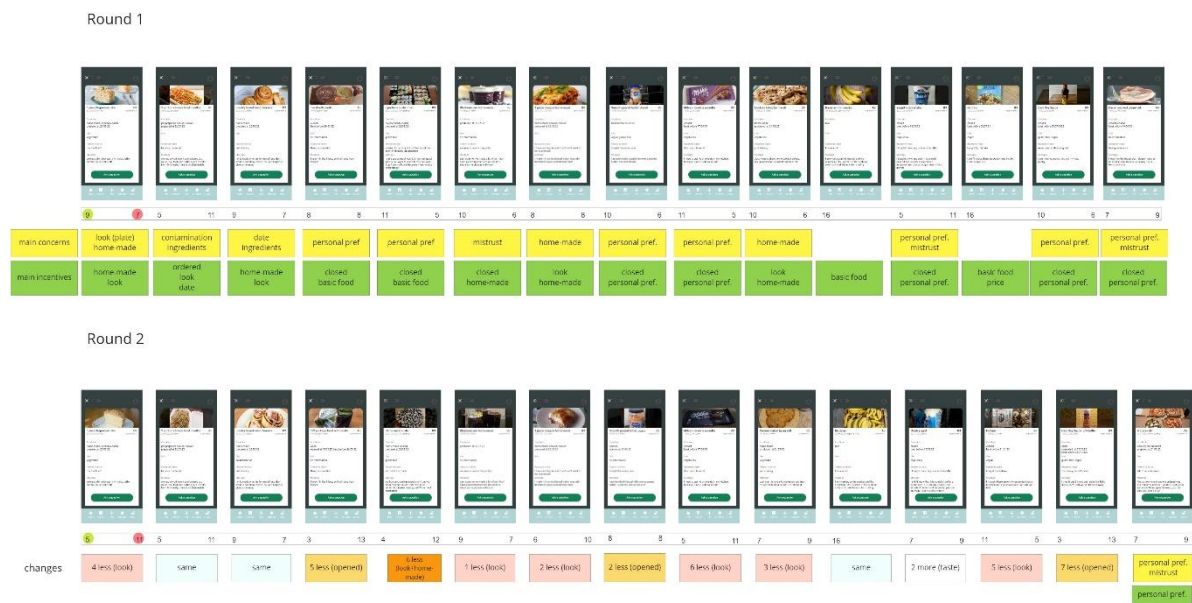
Figure 55 Results of experiment 2 (made by author)

The most often appearing reasons for choosing food items in the second row are listed below.

Main Reasons for Taking:

      - if the food item is not good, it can be still thrown away

      - the food item is still closed

      - the food item is still highly desired

      - the food is pre-prepared

Main Reasons for Refusing:

      - the food item might be touched or contaminated

      - the food item is home-made and thus not trustful

      - the food item is already open

      - the food item might have a lower quality due to the date

      - the food item doesn't look good anymore in the picture

6.5.3 Conclusion about the Design Experiment

The first experiment required more commitment from the participants and unfortunately, not all invited households could be motivated to actively participate in the experiment. Originally it was planned to experiment more physically. But to get reliable results, at least three interacting households within an apartment building would have been required and the fact that most of the asked people don't know their neighbours, made it impossible to find participants for this format. Furthermore, some invited households claimed they would never waste food or felt that the experiment format might be too intimate. Due to those reasons, the project has been turned digital. Nevertheless, within the digital experiment format, participants could have been found and food exchange took place. Although not all food items have been advantageously photographed and labelled, some households have not shied away from claiming food for themselves. In this experiment, food items were selected primarily based on personal preference or acute need. Most often, food was shared due to abundance or lack of consumption time.

For the second experiment, it was very easy to find participants. Some of them never really thought about food sharing and were overly excited to share their thoughts. In general, participants experienced this experiment format as playful and fun. The experiment has been conducted mainly at events or parties, where various kinds of people were gathered. A positive side effect was that the experiment gained a lot of curiosity and created discussions about food sharing and food waste even after the experiment. As the results show, the visual influence of photos is still undeniable. However, a specific factor determining whether a food item is accepted or rejected

cannot be identified as mainly decisive. Several factors play a role, such as personal preferences and attitudes towards food and groceries do. In addition, subjective trust plays an especially significant role when sharing food, especially when it comes to self-prepared food.

In both experiments, the fact that one does not know the previous owner of the shared food was not necessarily a problem. It also became clear that the participants have a high interest in free second-hand food and the majority are very tolerant of the condition of food. Because each food item from the second experiment could have been shared at least four times, it can be argued that a community food sharing system would have a high potential to actively counteract food waste in private households and simplify access to free food.

Unfortunately, the influence of a permanently installed food sharing spot could not be assessed within the design experiments. However, in the first experiment, it became clear that a steady reminder to share food is crucial. Thus, it is assumed that a physical sharing space encourages users even more to share food and to be open-minded towards this food saving method. Likewise, it was not possible to directly test the extent to which the design concept actively counteracts stigmatisation. As a result, it can be assumed that the fact that the previous owner of shared food is traceable but not the food's new owner, helps to reduce stigmatisation. Also, simplified access to free food in a familiar environment can help to make food sharing more enjoyable and standard.

6.6 Conclusion of the Design Process

A detailed concept for a food sharing system that eases access to shareable food and lowers stigmatisation burdens has been elaborated through the design process. Before working out the final design, the concept of food sharing within a community has been tested. The results strengthen the idea but also indicate how to improve it. After the evaluation of the design experiment, it has been decided to extend the app with a guide that explains to users how to take a good picture of the shared food, because some participants have expressed uncertainties about this. Furthermore, an instruction manual should be attached to the food sharing shelf. This explains residents the use of the system on spot, even if someone wants to share food without the associated app. The experiment helped to make crucial decisions regarding the system. For example, it became clear during the experiment that a cooling system is not necessary for many participants if there is the option to pick up food directly from the provider. More detailed information about allergens and ingredients was also not considered to be

necessary if there is an opportunity to communicate via a chat function. The elaborated system serves as a fundament for the final design solution. The challenge of the final design solution is to embed all components of the system into a convenient and appealing design that is easy to use and implement. The following chapter presents the suggested design solution. The components of the food sharing system and their functions will be explained in detail.

7. Final Design Solution

7.1 The System Design „Toivar"

Toivar is a food saving system that makes the use and management of food sharing within a community of households more convenient with the help of technology. The system is an interplay of a physical food sharing shelf equipped with recognition sensors, an app with smart camera recognition and food boxes suitable for long-term circulation within the sharing system.

Figure 56 The three elements of Toivar (made by author)

All kinds of food and drinks can be shared. Toivar is addressed to Estonian apartment buildings and encourages households to reduce food waste by sharing food with their neighbours. Furthermore, Toivar increases the feeling of comfort and responsibility while using the system through a balance between discreteness and transparency among users.

To offer food to the community, a user has to download the Toivar app and upload an offer for the food that will be shared. After storing the food on the Toivar shelf, the food item is visible to all users within the app and can be taken by anyone living inside the apartment building. The system doesn't require any mid-man for distribution or maintenance. Instead, distribution and maintenance entirely rely on the participating households of the community. Therefore, nudging mechanisms help to keep the system under control and change the household's perception of food to turn food sharing into a habit. Involved nudging mechanisms will be further explained in chapter 7.5.

The Toivar food shelf will be installed in the entrance area inside an apartment building so that users get constantly reminded of the option to share food whenever leaving or entering the building. The Toivar shelf is accessible at any time and gets by without any locking system since the prior intention is to make free food easily accessible.

The following image shows the dimensions of the shelf and the box compared to the size of a human and can also be viewed in appendix E.

UNIT: MM
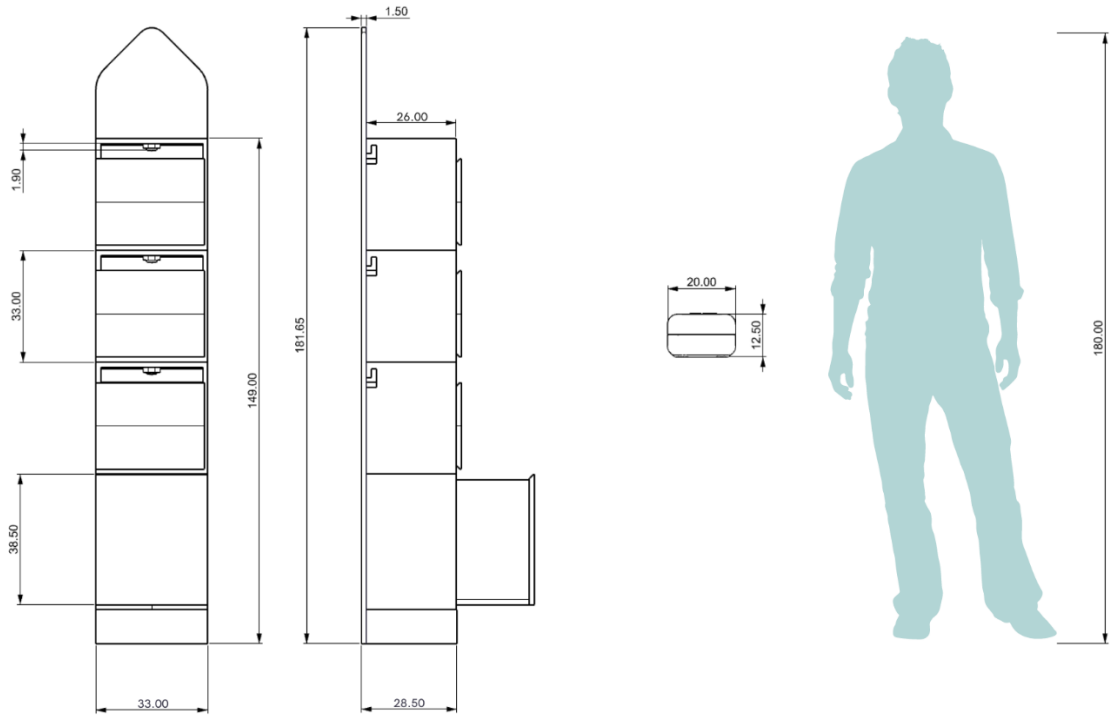
Figure 57 Dimensions of Toivar (made by author)

About the Corporate Design

The word "Toivar" is composed of the Estonian words "Toidu" and " Varjupaik", which can be translated as "food protection place".

Figure 58 Logo of Toivar (made by author)

The four primary colours of the logo are used in the user interface of the Toivar app, as well as for the design of the food storage shelf and the food box.

The logo consists of four rounded squares in the style of the app interface of the food shelves that differ slightly from each other. The top left square abstracts a house with a roof and refers to the shelf's design and the food boxes. The top right square symbolises an arrow that stands for the circulation of food within a community. The bottom left element visualises a storage space filled with a food item that can be interpreted as a smiley. The bottom right part abstracts an empty storage space.

7.2 Use Case Scenario

Before explaining the food sharing system and its components in detail, two use case scenarios explain in a simplified way how Toivar makes food sharing easier and lowers stigmatisation burdens. The first picture shows how food can be shared and the second picture shows how food can be taken through the Toivar sharing system.

SCENARIO OF SHARING FOOD

It is 10pm, Ana gave a party and the last guests have left her apartment. Her guests enjoyed the food a lot but still there is a big piece of home-made quiche left. Due to her sensitive stomach, Ana doesn't want to eat it anymore at the next day but she hates to throw away food. So far, she brought left-over food to a public food pantry which is far away and at not even on her way to work. But she doesn't have a suitable food container anyway to leave the food there, because she avoids single-use packaging.
But last week the property management installed the food sharing shelf Toivar in the entrance hall of the building.
Ana already installed the Toivar app on her phone. Now she has an opportunity to try out the new food sharing system.

Because she has no suitable food container at home, Ana goes down to the Toivar shelf and takes out a Toivar box from the drawer. Back in her apartment, she places the piece of quiche inside the box and opens the Toivar app.

She starts to create a new food item. She takes a new picture of the food inside the box after reading the photo guide that explains how to take a good picture of food. She is surprised: The smart image recognition already recognised that her item is prepared and vegetarian! She adds more information, such as the reason for sharing and the ingredients. Then she selects the free shelf space A1 in the app and confirms the upload.

Ana goes down to the Toivar shelf with the filled box. Which space did she select again? She looks again at her phone to check and places the box in A1. After one minute she sees that her food item "One piece of home-made quiche" appears in the shared food list. She is very curious if someone will take it. It is home-made, but the food looks delicious on the picture!

In the late evening Ana receives a notification that her food has been taken - That was fast! She checks her personal and community food saving score - both increased but now she is on the top in the ranking!

Figure 59 Use case scenario of giving food (made by author)

SCENARIO OF TAKING FOOD
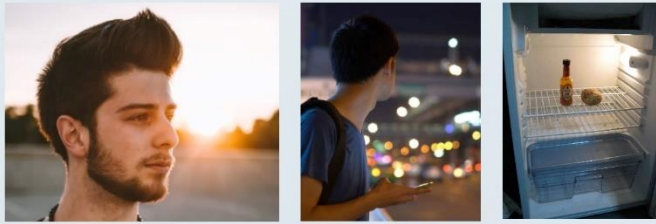
It is 11.30pm. Jaan is returning home late from a one-week trip that turned out to be more expensive as expected. Because also utility bills are hard to calculate at the moment, he probably needs to save money in the next weeks. After 7 hours bus ride, Jaan is very tired but also hungry. He knows that his fridge is empty because he stayed away from home for and all shops are already closed.

But he remembers that the property management installed the food sharing shelf Toivar in the entrance hall of his apartment builidng last week. Actually, Jaan is a bit sceptical. He once went to one of those public food pantries but it was very messy and he didn't feel comfortable. But right now Jaan would be happy to get something to eat and if the experience is good, maybe he can save some money through that for the next weeks!

Jaan decides to give Toivar a try and downloads the Toivar app on his phone.
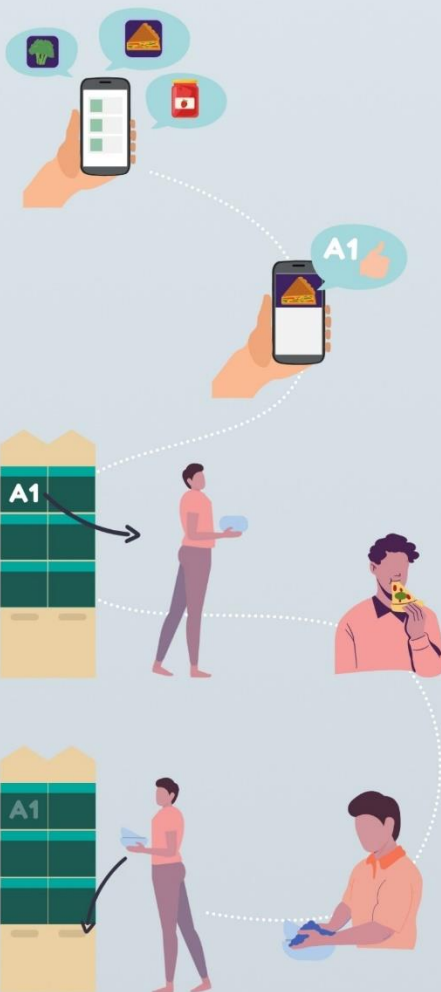
While walking home, he opens the app and creates an account. After the login, he immediatly sees all the food that is currently stored in the shelf. He starts to check out the food offers while walking home.

He sees that the people from apartment 1 uploaded a huge piece of quiche just 1 hour ago. He clicks on the offer to see more detailed information. Should he take food that is home-made by a stranger? But the picture looks good, so why not give it a try! Jaan decides to take this food item when he arrives. Hopefully nobody else takes it before him because he can't reserve the item. But the offer would disappear if someone takes it before him! He sees in the offer that it is stored in space A1.

Jaan arrives at the building and goes straight to the food shelf. He remembers the quiche was stored in space A1. He takes out the food box, goes straight to his apartment and opens the box. The food looks as on the picture. He starts to eat. He will clean and return the box on the next day - no need to hurry!

In the next morning, he cleans the food box after breakfast with the other dishes and drops the box at the food shelf before leaving the house for university. For Jaan this was a great experience. He doesn't know who is living in apartment 1 but they seem to be good cooks! He plans to check out the app more often. He saw that the total food saving score is high - it seems that Toivar is popular among his neighbours!

Figure 60 Use case scenario of taking food (made by author)

7.3 The Components of the System Design

The Toivar Shelf

Figure 61 Toivar shelf with poster (made by the author)

The Toivar shelf is designed to store the food items or drinks shared among households. The shelf itself is made of fibreboard with flame-retarding coating, which is suitable for indoor areas, robust and easy to clean. The shelf spaces are covered with dark transparent PET plastic doors. This allows to recognise the content from outside and protects the content from environmental influences such as direct sun or insects. Furthermore, it holds back food odours. On the bottom is an integrated drawer, where unused and clean food boxes are stored.

The shelf is in the entrance hall inside an apartment building and serves as a reminder to save food since residents are constantly entering and leaving the building and thus also passing the food shelf. A further reason for this specific placement is to keep the distribution distance as short as possible and make the access to free food fair for everyone living inside the building. The shelf system is modular and can be adapted to the size of the entrance area and the number of households in a building. A laser sensor is integrated into the bottom part of every space and connected to the app. This IoT ("Internet of Things") technology immediately measures whether a space is filled or empty. This technology is already standard in retail business or logistics to detect if a

shelf with goods is out of stock and needs to be refilled. The laser sensor is battery-driven (the battery lasts for two years), wireless and about the size of an ice hockey puck (Thingsquare, 2022). It can be easily fixed on the top inside the shelf spaces. The sensor measures the fixed distance between the bottom and the top inside of the shelf space. The sensor notices that the shelf space is filled whenever the distance changes due to a placed food item. The following image visualises how the laser sensor works:

Empty shelf space: Filled shelf space:

Laser sensor measurement=26,5mm   Laser sensor measurement<26,5mm
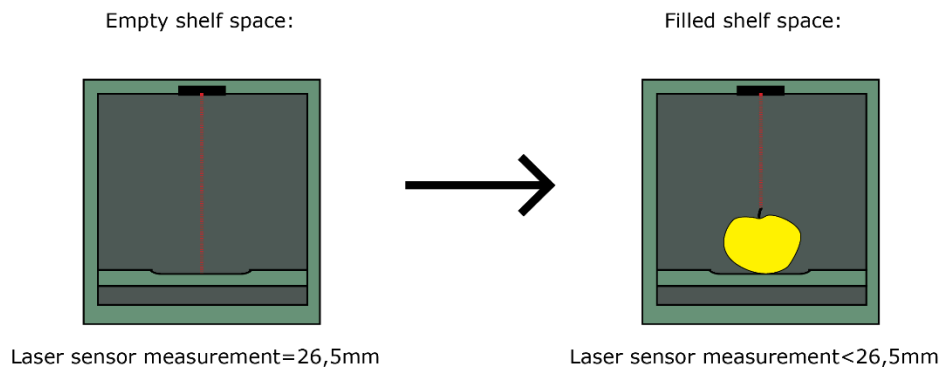
Figure 62 System of laser sensor (made by author)

The food shelf does not include a cooling mechanism. Instead, the food boxes serve as a temperature holder. For food that needs to be constantly cooled, the app leaves food givers the option to mark food that must be picked up from home. Every space is connected to a code, for example A1, B4 or D2. It helps users to leave and take food out from the right spot. A slight hollow inside the bottom of the shelf space enables to place food in the right area underneath the laser. Two posters will be attached to the shelf. One explains how to share food within Toivar and the other answers frequently asked questions. Both can be found in appendix E. The following graph shows a simplified schematic user flow of sharing food within the Toivar system in four steps:

Figure 63 Schematic user flow (made by author)

The Toivar Food Box

Households whose apartment building is equipped with Toivar should use the Toivar food boxes for sharing food. When sharing food, the food should be presented inside the box, whether the food is packed, homemade or pre-prepared. When taking boxed food out of the food shelf, the food taker must clean the container before returning it to the system. The box is made of stainless steel because it is easy to clean, it can keep food warm or cool for a while, it is resistant and food-safe. The bottom part of the box has a little plateau, which is the opposite of the hollow inside the shelf spaces. This helps to place the box in the right position inside the shelf.

Figure 64 Toivar food boxes (made by author)

The advantage for food givers is that they don't need to use their own food boxes or containers. The benefit for food takers is that the food box deals as an orientation and gives a better feeling for the size of the content. If someone wants to share overly sensitive food such as raw fish or meat, there is still the option "Food can be picked up from home" within the app.

The Toivar App

The Toivar app is the core component of the food sharing system. A detailed app flow chart is shown in appendix E and a QR code for clicking through the mock-up can be requested from the author. The app has the following functions:

- information exchange about shared food
- food saving analysis of the individual and community
- communication between users
- food sharing management
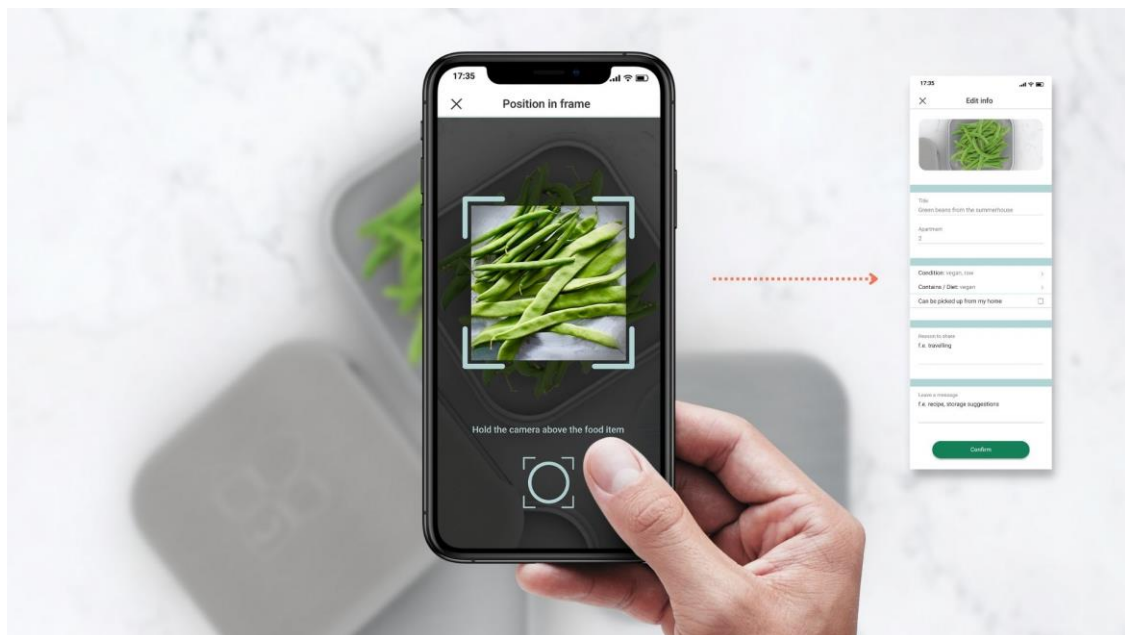
Figure 65 Smart food recognition of Toivar app (made by author)

Households have to create an account and indicate their apartment number to use the app. When opening the app, the user can scroll through currently available food items, check the food saving score, add a food item to the system and check messages or food that he or she has shared in the past. In addition, the user can switch the list view of the food offers to a plan view that shows in which space of the shelf the food is located. The following flowchart shows the app layouts of the main menu bar:
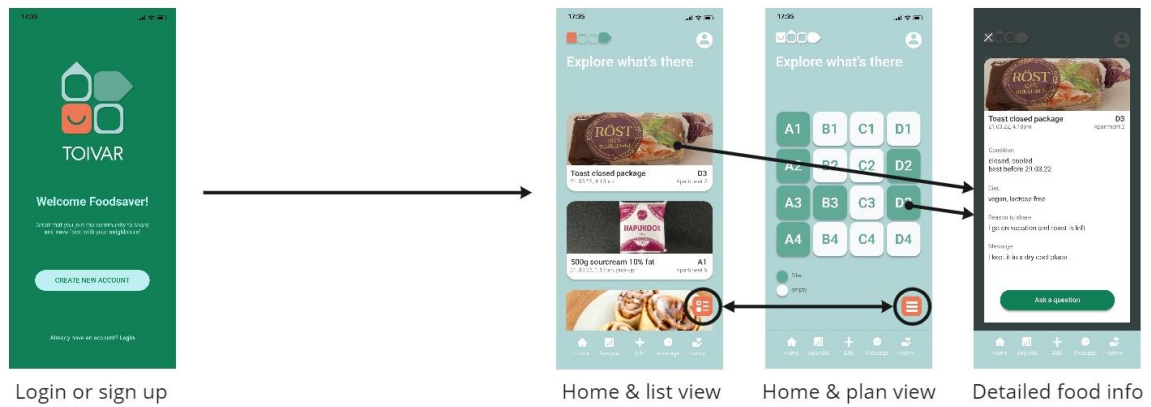
| Login or sign up | | Home & list view | Home & plan view | Detailed food info |

| Food saving score | Add food item | Message box | Sharing history |
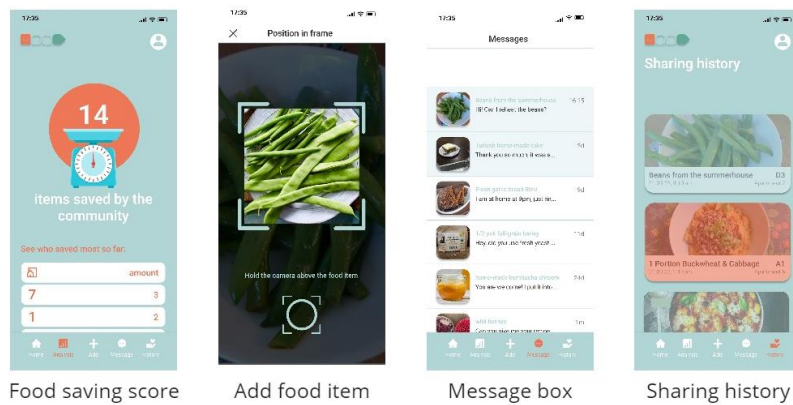
Figure 66 App layouts of the menu bar (made by author)

Thanks to smart technology features, the app can:

- recognise food from pictures
- estimate expiry dates based on the condition and preparation date of the food
- communicate with the sensors of the shelf and update the status of the spaces

The App for Food Givers

When sharing food with the community, the apartment number of the offering household will be visible to everyone. This should create more trust among all users because food can be traced back. Further, it should nudge food givers to take responsibility for untaken food and clear the space in time. When uploading a new food item, the user has to take a photo of the food item – preferably inside the Toivar box. Since the quality of the pictures is very important, the app includes a guide that explains how photos have to be taken and how not. The following image shows the uploading flow chart:
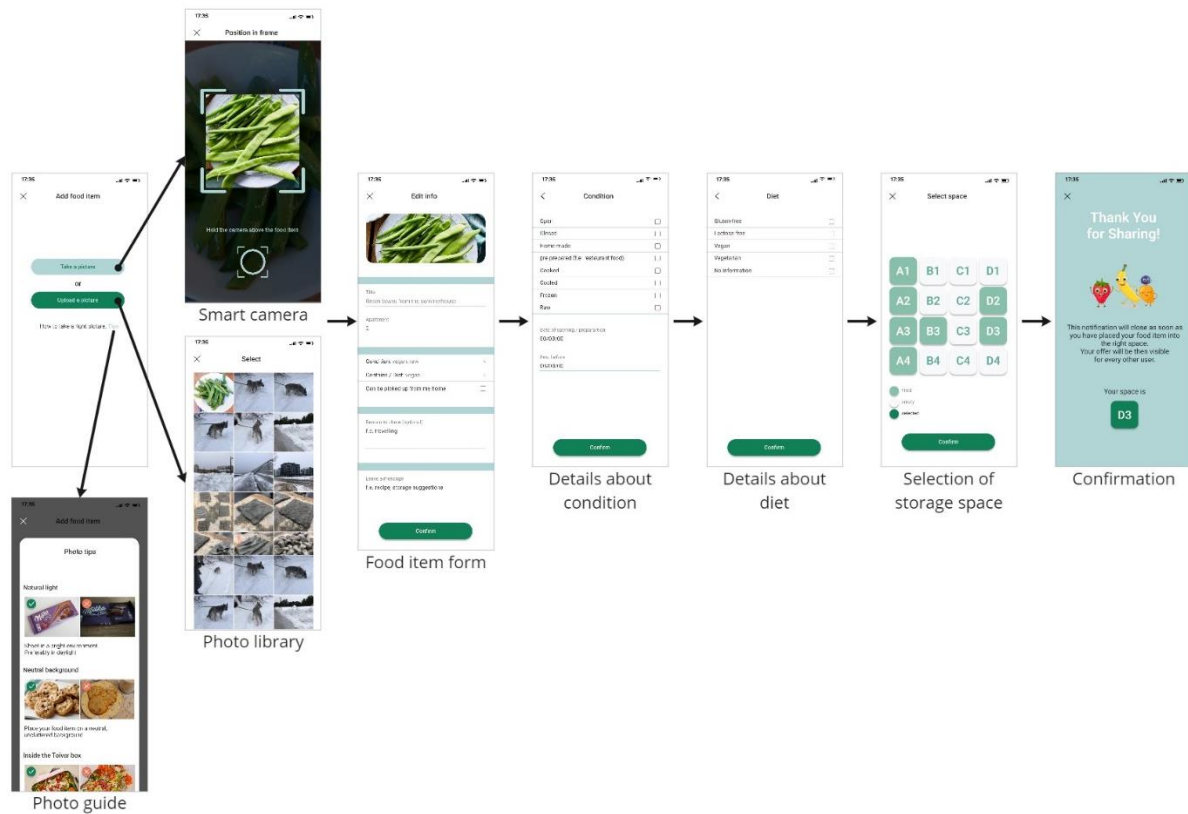
Figure 67 Food upload flow (made by author)

The integrated smart camera system can recognise the food from the picture and already fills out basic information in the next layout that the user can edit. The detailed information includes the food title, the apartment number of the provider, the food's condition, diet and the option of home pickup. Further, the offering person can give some additional information about the sharing reason and add some personal notes or comments. After selecting a free space on the shelf and confirming the upload, the user gets a notification that the food item will be published after placing it in the right shelf space. Only after that does the notification close. The offer gets published and the household can use the app as usual. This mechanism should nudge the user to place the food item right after creating the offer. The same logic is used when the system sends an alert about spoiled food. The provider whose food item has been spoiled can only continue using the app after removing the item from the food shelf. When someone takes the food, the provider will also get a notification and his or her food saving score will increase simultaneously with the community score – the total amount of rescued food inside a community. The following pictures show the layouts of the three described notifications:
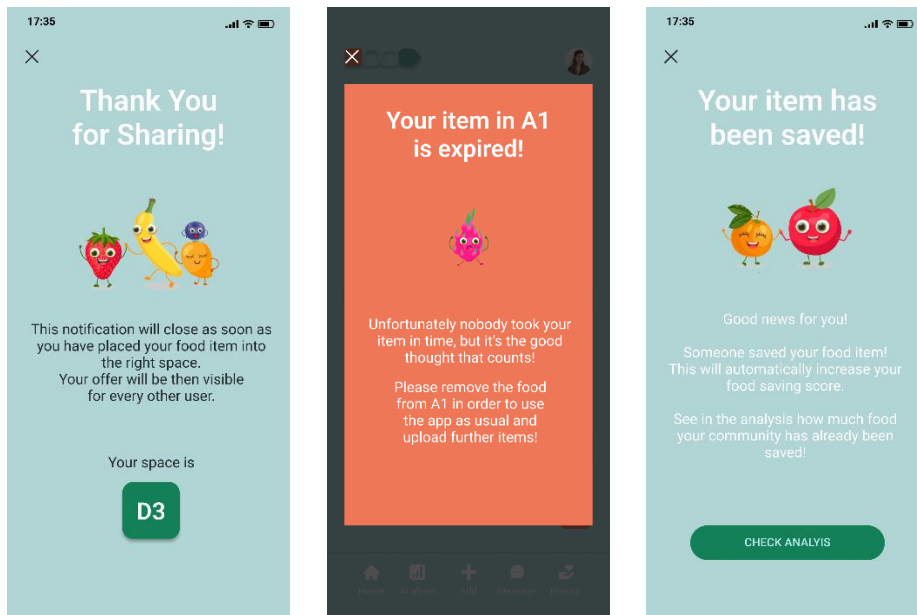
Figure 68 Notification after upload, detection of spoiled food and successful saving (made by author)

Food givers can also receive messages from other users regarding their uploaded food, for example questions about the food preparation, recipes or ingredients.

The App for Food Takers

Food takers stay fully anonymous. Only when picking up food directly from another household, the food taker will interact directly with the food provider. Food takers can check out food offers through the app and contact the offering households, but food items cannot be reserved – first comes, first serves. Even if taking food means saving food, taking food doesn't increase the food sharing score. The food saving score serves as an incentive to offer food since this is the part of food sharing connected with more personal effort.

7.4 User Journey Map and Service Blueprint

A service blueprint visualises the relations between different components, including the use scenario of the Toivar food sharing system (Gibbons, 2017). It gives a comprehensive understanding of how the system works with all its visible and invisible processes. The service blueprint is divided into two parts that are connected with each other. One part shows the blueprint of a food taker and the other one shows the blueprint of a food giver. Both blueprints are connected to a user journey map.
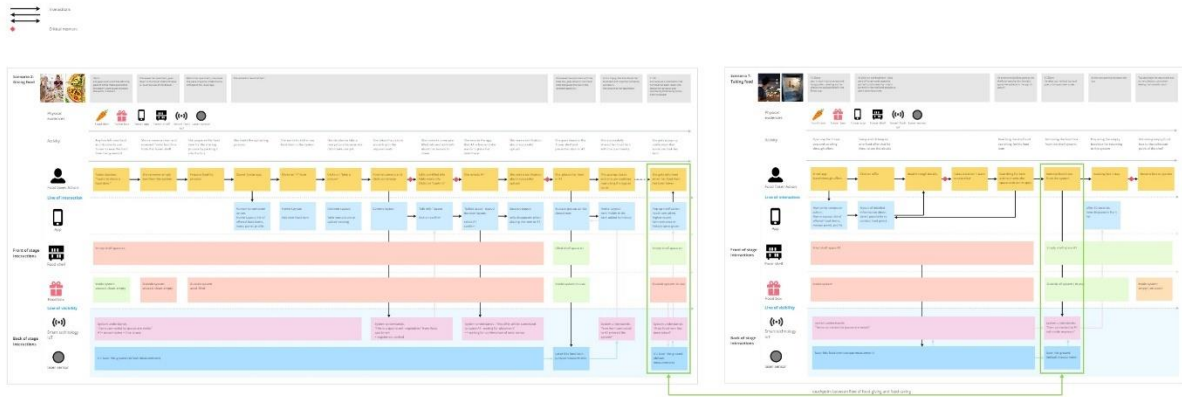
Figure 69 Blueprint of the Toivar food sharing system (made by author)

The full detailed blueprints are available in appendix E.

The following user journey maps describe the actions, experiences and feelings of a food giver and a food taker while sharing food with the help of the Toivar food saving system. The journey maps give a holistic view of the customer's experience. It is separated into three segments: The segment "Lens" frames the map by introducing the persona within an imagined scenario and her or her goals and expectations. The personas have been already introduced in chapter 6.1. The segment "Experience" shows different phases and actions of the journey. Possibly occurring thoughts and questions are formulated. A diagram shows the level of effort during the journey. The segment "Insights" looks at the possible risks which could cause a negative experience or a cancellation of the user journey. But opportunities are also described here, how users could make more benefits or extend their pleasant experience.
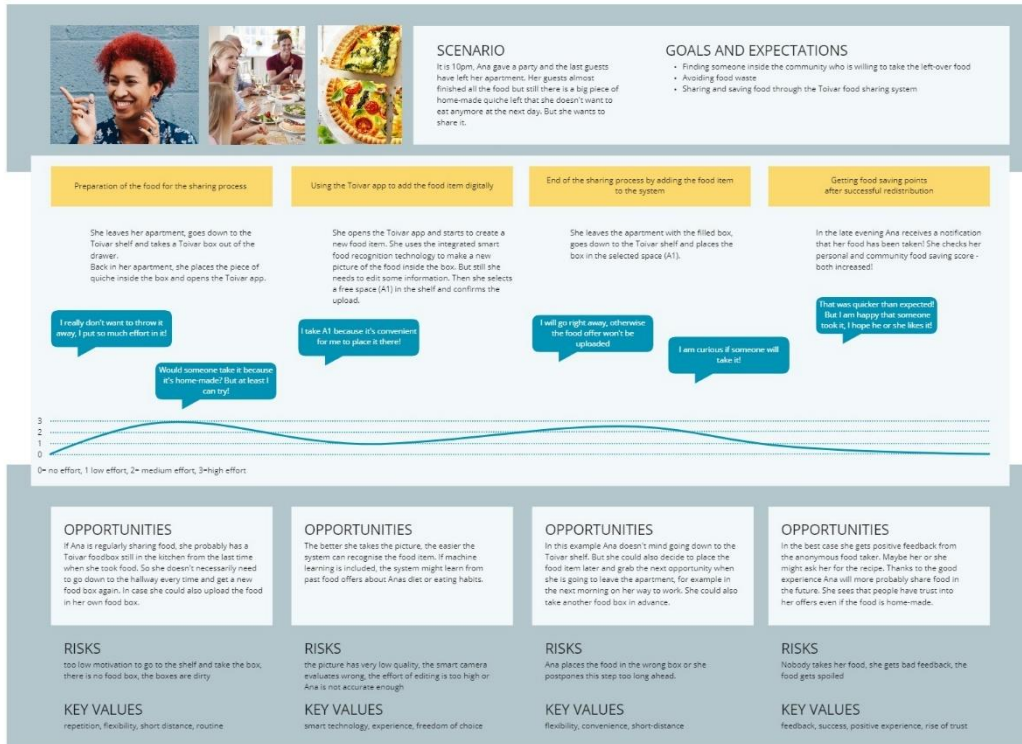
Figure 70 User journey map of a food giver (made by author)
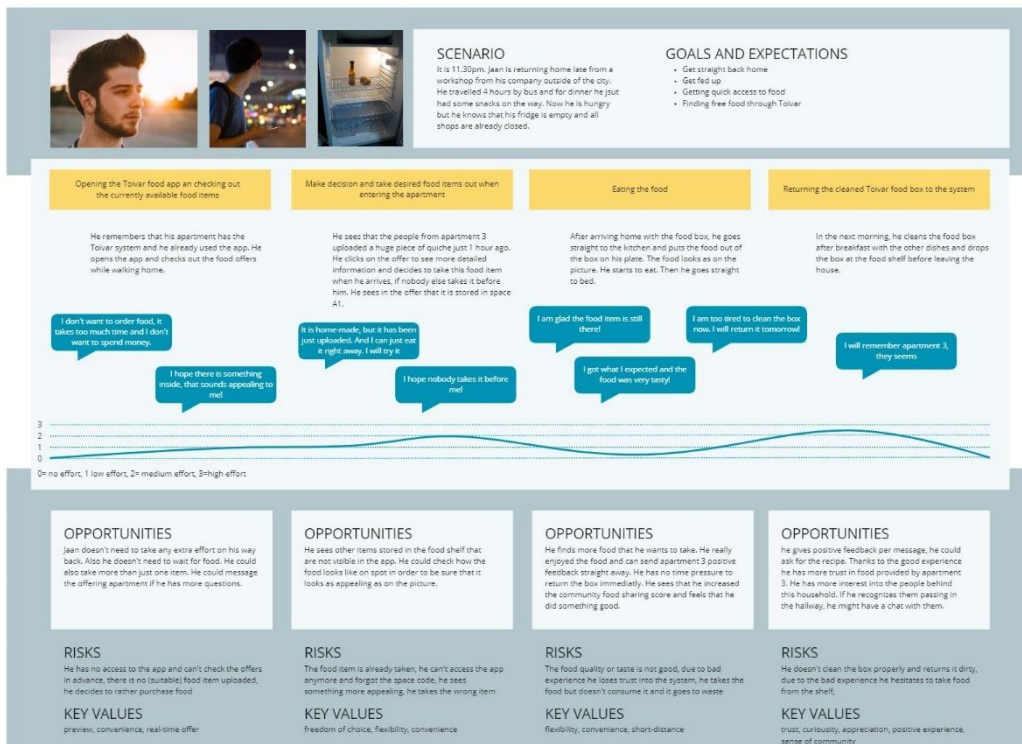
Figure 71 User journey map of a food taker (made by author)

7.5 Nudges

Several nudging mechanisms are integrated into the Toivar system to push users towards sharing food. Since the system fully relies on the trust and commitment of the community, nudges are essential to keep the system intact and self-sufficient. The following table gives an overview of scenarios during the food sharing journey with Toivar, where nudges drag attention to something to remind the user of something or warn him of her softly. The nudges get categorised according to chapter 5. All the below-listed nudges guide the users somehow towards a responsible behaviour that turns – in the best case – into a habit and guarantees the successful implementation of Toivar in Estonian community buildings.

Situation	Nudge	Category	Desired Effect
The Toivar food shelf is in the entrance area of an apartment building. People pass it when entering or leaving the building.	Routine, reflection, provide memories, change defaults, direct and indirect encouragement, modify environment and behaviour	Cognitive, affective, behavioural	Residents get constantly reminded during the day of saving food. The probability to forget offered food shrinks. The central location is easily accessible for everyone.
Food takers higher the food saving score of food givers but cannot increase their own score just by taking food.	Change composition of decision options, change decision consequences, direct and indirect encouragement	Affective	While the demand for free food is high anyway, through the scoring system people get encouraged to "join the game" and offer food since this side of food sharing requires more effort.
The apartment number of a giving household is visible for all users within the app.	Spotlight effect, Support self-obligation and responsibility, underline the right decision	Cognitive	Food takers feel more comfort and trust because they can track the food back. At the same time, food givers feel more obliged to take care of the shared food item.
Food takers stay anonymous.	Attach unconsciousness, modify behaviour	Behavioural	Food takers feel less stigmatised and should feel free to take as much shareable food as they want, no matter the reason for it.
The analysis in the app shows the amount of saved food from the entire apartment but also ranks all apartments according to their amount of saved food.	Social nudge, group pressure, support of obligation and Commitment	Cognitive	The ranking among households creates a soft competitive situation and should motivate households to share more food. Every saved food item also increases the total food saving score, which strengthens the sense of community.
Toivar focuses on how much food has been saved instead of how much has been wasted	Framing-effect: focus on success instead of on failure	Behavioural	By focusing on the food saving success, the community feels more motivated and influential. The relation to rescued food is more positive.

Figure 72 Table of nudges within the Toivar system (made by author)

7.6 Conclusion about the Final Design Solution

It is important to stress that due to the master thesis limitation, the design represents a concrete solution to the problem of food waste and stigmatisation in the context of household communities in Estonia. The design is modular because the size of apartment buildings and the number of households vary. The proposed system operates best when all components work together but can be used to a limited extent even if one component is missing. This is important when considering that not all potential users are tech-savvy. The proposed design is also flexible. Different materials, dimensions and shapes are possible, which also increases the financial scope for the realisation of this project. Especially when thinking about security measurements and regulations, flexibility regarding the design of the physical shelf is crucial. Fire regulations for buildings are stringent and materials have to be selected that both meet the requirements for fire safety and look coherent. More design experiments can be helpful to develop the design further. Nudges are crucial for the system. They not only lower stigmatisation and higher the food sharing awareness but also ensure that users will take care of the system. To evaluate the practical impact of nudges, Toivar must be tested in reality with prototypes and over a more extended period.

It is possible to extend Toivar to other forms of communities, such as office buildings or other building complexes where different parties are settled. The graph underneath visualises how the Toivar food sharing system could be extended in the future. The graph consists of a core (Toivar) surrounded by four shells. The first shell visualises the ecosystem in which Toivar is deployed as suggested within this thesis. In case of a realisation of the project, the second layer includes stakeholders necessary to plan, implement and finance the project. The author suggests that not residents should pay for the system but the apartment building owners. The government could subsidise the project to lower the costs. As soon as Toivar has been successfully tested in apartment buildings in Tallinn, the focus lies on expansion. Which other communities could benefit from Toivar? Is Toivar suitable for governmental institutions such as universities? Can the system be introduced to other Estonian cities? The outer shell includes stakeholders from various sectors that are necessary to develop and realise the project, for example city planners or programmers but also promoters.

The Toivar ecosystem

Scaling up deployments through a multi-layer community-driven approach
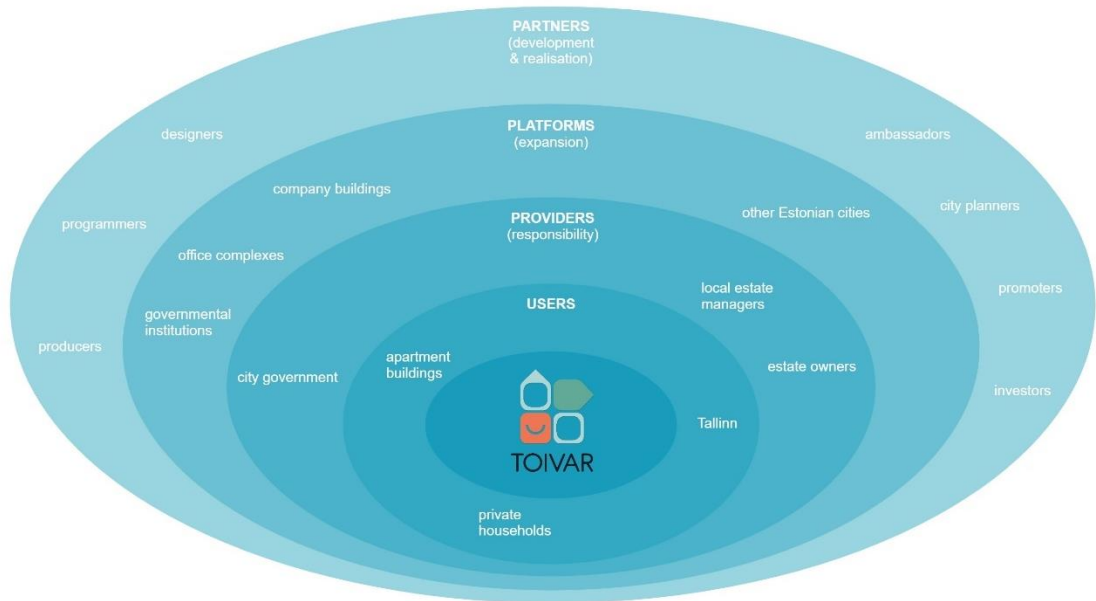
Figure 73 Future extends of Toivar ecosystem (made by author)

8. Summary

The thesis started with the exploration of food waste and the paradox of the co-existence of food waste and food insecurity regarding the stigmatisation of free food. The data collection showed that interest in access to free food is extremely high regardless of its motivation, while an abundance of food is more present than ever. Surveys have found that more people are willing to share any kind of food if exchanging food would be easier, more trustworthy and more enjoyable. The design experiments showed that the majority are eager to go beyond their comfort zone to save food, even though trust in second-hand food varies widely. With the help of design research, an answer to the following question should be found:

"How to reduce food waste on a household level
by easing the access and lowering the stigmatisation burdens
of free food?"

Thus, the goal of this master thesis was to design a reliable food sharing system for a household community that eases and encourages the distribution of shareable food and makes users feel more comfortable and responsible for or while saving food.

The Toivar food sharing system is a design solution that reduces food waste on a household level by physically and psychologically simplifying food saving through sharing. In addition, Toivar aims to increase trust in second-hand food from the local community and encourage users to share responsibly. The use of smart technologies in conjunction with product design and nudging mechanisms make it possible to reinvent the concept of food sharing. Instead of pushing people closer towards a food sharing system, the human-centred approach and the psychological interest of the individual well-being within a community brought out a concept that pulls the sharing system closer to the people in their home environment - where currently most of the food waste occurs.

The research results empathise the necessity for a more convenient and unconditional way to get access to shareable food, which serves as an antidote to social exclusion and categorisation and as a method to raise awareness of the environmental impact of surplus food. Furthermore, it is a way to recultivate the value of food in society.

The fact that Toivar relies on the trust and responsibility of its users may evoke doubts regarding its credibility and effectiveness and raises the question if the concept is a

utopia. Indeed, some assumptions about the functionality of the suggested food sharing system hypothesise that users trust, respect and take care of each other.

But the goal of a utopia is to convey an idea that enables the improvement of society. There is a demand for an optimised food sharing system. In addition, the technology used in the Toivar system is already accessible and configurable. Purely hypothetically, nothing stands in the way of the realisation of Toivar except the willingness and interest to try out the system and, if necessary, to develop it further. More comprehensive research could investigate the influence of visual and haptic design in more detail. Furthermore, assessing the system with a prototype in different households is recommended.

Finally, the author wants to stress that no matter how technologically advanced or systematically thought-through, a food sharing system is useless if humans do not trust each other. From a conceptual perspective, trust among people can minimise the cost of interactions, especially when the aim is to establish bonds, collaborations and joint ventures that require commitment from both sides. Without trust among a community, sharing food is much more difficult. But trust is crucial to get a feeling of how likely someone is to take opportunities, avoid risks, and enable or disable cooperation. Trust indicates to what extent someone is willing to accept and share rules, norms and values. The Toivar food sharing system requires trust in the community. The design testing could show that people theoretically trust each other. But still, the question remains if they keep up this trust in practice. In the future, the meaning and probable consequences of trust or distrust have to be more examined to ensure that Toivar can be fully evolved and expanded.

Acknowledgements

References

2Good2Go, 2021. *www.toogoodtogo.de.* [Online]
Available at: https://toogoodtogo.de/de/impressum
[Accessed 30 09 2021].

Anon., 2022. *www.boulderfoodrescue.org.* [Online]
Available at: https://www.boulderfoodrescue.org/about-bfr/
[Accessed 01 01 2022].

Anon., 2022. *www.hungerandhealth.feedingamerica.org.* [Online]
Available at: https://hungerandhealth.feedingamerica.org/explore-our-work/nutrition-education-initiatives/strategies/nudges/
[Accessed 03 01 2022].

Anon., 2022. *www.savingfood.eu.* [Online]
Available at: https://savingfood.eu/
[Accessed 01 01 2022].

Bang, A. L. e. a., 2012. *The Role f Hypothesis in Constructive Design Research.* Helsinki, s.n.

Blake, M., 2015. *Neoliberalism and the making of food as waste–or–The need to reframe the debate from food waste to food surplus,* s.l.: s.n.

Bruckner, H. K. et al., 2021. "Free" food with a side of shame? Combating stigma in emergency food assistance programs in the quest for food justice. *Geoforum*, 07, Issue Volume 123, pp. 99-106.

Bruckner, H. K. et al., 2021. "Free" food with a side of shame? Combating stigma in emergency food assistance programs in the quest for food justice. *Geoforum*, 07, Issue Volume 123, pp. 99-106.

Chandon, P., 2019. *Which Healthy Eating Nudges Work Best?,* France: INSEAD.

de Souza, R. T., 2019. *Feeding the Other: Whiteness, Privilege, and Neoliberal Stigma in Food Pantries.* s.l.:MIT Press.

de Souza, R. T., 2019. *Feeding the Other: Whiteness, Privilege, and Neoliberal Stigma in Food Pantries.* s.l.:MIT Press.

European Comission, 2020. *ec.europa.eu.* [Online]
Available at: https://ec.europa.eu/food/system/files/2020-05/f2f_action-plan_2020_strategy-info_en.pdf
[Accessed 11 01 2022].

European Comission, 2022. *ec.europa.eu.* [Online]
Available at: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-

deal_de

[Accessed 01 11 2022].

European Commission, 2021. *www.ec.europa.eu.* [Online]

Available at: https://ec.europa.eu/food/safety/food-waste_de

[Accessed 01 01 2022].

Feeding America, 2022. *www.hungerandhealth.feedingamerica.org.* [Online]

Available at: https://hungerandhealth.feedingamerica.org/explore-our-work/nutrition-education-initiatives/strategies/nudges/

[Accessed 11 01 2022].

Food and Agriculture Organisation of the United Nations, 2014. *Food wastage footprint, Full-cost accounting, Final Report,* s.l.: Food and Agriculture Organization of the United Nations.

Food and Agriculture Organisation of the United Nations, 2022. *www.fao.org.* [Online]

Available at: https://www.fao.org/hunger/en/

[Accessed 01 10 2022].

Food and Agriculture Organization of the United Nations, 2003. *www.fao.org.* [Online]

Available at: https://www.fao.org/3/y4671e/y4671e00.htm#Contents

[Accessed 01 10 2022].

Food and Agriculture Organization of the United Nations, 2003. *www.fao.org.* [Online]

Available at: https://www.fao.org/3/y4671e/y4671e00.htm#Contents

[Accessed 01 10 2022].

Food and Agriculture Organization of the United Nations, 2022. *www.fao.org.* [Online]

Available at: https://www.fao.org/hunger/en/

[Accessed 01 10 2022].

Foodsharing Estonia, 2021. *www.foodsharing.ee/.* [Online]

Available at: https://www.foodsharing.ee/tartu.html

[Accessed 28 08 2021].

Garfield, L., 2016. *www.businessinsider.com.* [Online]

Available at: https://www.businessinsider.com/mit-makes-a-food-cam-for-its-kitchen-2016-4

[Accessed 30 09 2021].

Gibbons, S., 2017. *www.nngroup.com.* [Online]

Available at: https://www.nngroup.com/articles/service-blueprints-definition/#:~:text=Definition%3A%20A%20service%20blueprint%20is,two%20to%20customer%20journey%20maps.

[Accessed 02 04 2022].

GRACE Communications Foundation, 2021. *www.foodprint.org.* [Online]

Available at: https://foodprint.org/issues/the-problem-of-food-waste/#easy-footnote-

bottom-5-1309

[Accessed 05 11 2021].

Harrik, A., 2021. *Eesti saaks vajadusel hakkama poole vähemate põldudega,* Estonia: ERR.

Ikea, 2021. *www.ikea.de.* [Online]
Available at: https://www.ikea.com/de/de/this-is-ikea/corporate-blog/lebensmittelverschwendung-reduzieren-pubf7e399e0
[Accessed 03 10 2021].

Kallbekken, S. & Sælen, H., 2013. *'Nudging' hotel guests to reduce food waste as a win–win environmental measure,* Oslo: Elsevier.

Krogh, P. G., Makussen, T. & Bang, A. L., 2015. Ways of Drifting—Five Methods of Experimentation in Research Through Design. In: *ICoRD 15 - Research into Design Across Boundaries Volume 1.* New Dehli: Springer India, pp. 39-50.

Malenica, D. & Bhat, R., 2020. *Review article: Current research trends in fruit and vegetables wastes and by-products management-Scope and opportunities in the Estonian context,* Tartu: Agronomy Research.

Marshall, A., 2015. *Finding Money in Copenhagen's Trash Cans.* [Online]
Available at: https://www.bloomberg.com/news/articles/2015-10-27/how-copenhagen-s-new-trash-cans-help-the-homeless
[Accessed 11 02 2022].

Martínez, F. (. N. & André, 2020. *Politics of Recuperation: Repair and Recovery in Post-Crisis Portugal.* 1st ed. ed. London: Routledge.

Martínez, F., 2017. *Waste is not the end. For an anthropology of care, maintenance and repair,* New Jersey: Wiley.

Martínez, F. & Beilmann, K., 2020. *Waste and postsocialism in Estonia: Becoming European through the management of rubbish,* Estonia: SAGE Publishing.

Mbow, C. C. R. L. B. T. B. M. H. M. K. E. L. P. P. M. R.-F. T. S. F. T. Y. X., 2019. *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems,* s.l.: in press.

Mele, C., Russo Spena, T., Kaartemo, V. & Marzullo, M. L., 2021. *Smart nudging: How cognitive technologies enable choice architectures for value co-creation,* Naples: Elsevier Ltd..

Nagatsu, M., 2015. *Social Nudges: Their Mechanisms and Justification,* Helsinki: Springer.

NoWaste, 2021. *www.nowasteapp.com.* [Online]
Available at: https://www.nowasteapp.com/
[Accessed 11 10 2021].

Pateman, R. M. e. a., 2020. *Citizen Science for Quantifying and Reducing Food Loss and Food Waste,* Switzerland: Frontiers Media.

Piirsalu, E., Moora, H. & Väli, K., 2021. *Toidujäätmete ja toidukao teke Eesti toidutarneahelas,* Estonia: Stockholm Environment Institute.

RingKarp, 2021. *www.ringkarp.ee.* [Online]
Available at: https://ringkarp.ee/en/about-us/
[Accessed 22 09 2021].

Samsung, 2022. *www.samsung.com.* [Online]
Available at: https://www.samsung.com/us/explore/family-hub-refrigerator/overview/#smarthome
[Accessed 06 10 2021].

Shearer, L. et al., 2017. *A problem unstuck? Evaluating the effectiveness of sticker prompts for encouraging household food waste recycling behaviour, Waste Management,* United Kingdom: Elsevier.

Sirplus, 2021. *www.sirplus.de.* [Online]
Available at: https://sirplus.de/
[Accessed 16 11 2021].

Stiftung Gesundheitswissen, 2018. *www.stiftung-gesundheitswissen.de.* [Online]
Available at: https://www.stiftung-gesundheitswissen.de/gesundes-leben/psyche-wohlbefinden/selbst-schuld-stigmatisierung-von-krankheiten
[Accessed 15 10 2021].

Thaler, R. H., 2009. *Nudge, Wie man kluge Entscheidungen anstößt.* United States of America: Econ.

Thingsquare, 2022. *www.thingsquare.com.* [Online]
Available at: https://www.thingsquare.com/blog/articles/retail-wireless-shelf-monitoring/
[Accessed 02 04 2022].

Toidupank, 2022. *www.toidupank.ee.* [Online]
Available at: https://www.toidupank.ee/
[Accessed 01 01 2022].

United Nations Environment Programme, 2020. *The little book of green nudges: 40 nudges to spark sustainable behaviour on campus.* Ardenal: United Nations Environment Programme.

United Nations Environment Programme, 2021. *Food Waste Index Report 2021,* Nairobi: s.n.

United Nations, Department of Economic and Social Affairs, 2021. *www.un.org.* [Online]
Available at: https://www.un.org/development/desa/disabilities/envision2030-

goal12.html

[Accessed 03 10 2021].

United Nations, 2022. *un.org.* [Online]

Available at: https://www.un.org/sustainabledevelopment/development-agenda/

[Accessed 11 01 2022].

United Nations, 2022. *un.org.* [Online]

Available at: https://www.un.org/sustainabledevelopment/development-agenda/

[Accessed 11 01 2022].

University of applied sciences Berlin, n.d. *ww.systemdesign.htw-berlin.de.* [Online]

Available at: https://systemdesign.htw-berlin.de/studium/

[Accessed 07 03 2022].

Voltri, J., 2021. *Eestis visatakse igal aastal ära ligi 164 miljoni euro eest toitu,* Estonia: ERR.

von Kameke, C. & Fischer, D., 2018. *Preventing household food waste via nudging: An exploration of consumer perceptions,* Lueneburg: Elsevier Ltd..

von Kameke, C. & Fischer, D., 2018. *Preventing household food waste via nudging: An exploration of consumer perceptions,* Germany: Elsevier.

Figure register

Figures might contain resources from freepik.com, canva.com and unsplash.com.

All resources are used under the creative commons license.

Appendices

All figures, charts and maps in the appendix are made by the author. For more detailed information or in case of missing material, please contact the author:
Larissa.pelke@gmx.de

A. Interviews

The following persons have been interviewed during the field research process:

Name	Relevance	Duration	Date of conduction	Keywords
Julian Kaljuvee	Founder of Food Angels	30min	15.09.2021	Restaurants food waste Awareness
Ulrike Plath	Professor of History and Culture at TLÜ	45min	05.10.2021	Food Waste Waste
Luka Pelke	Social project manager & coordinator	30min	28.10.2021	Poverty Stigmatisation Food Saving Vanity
Piet Boerefijn	Founder and CEO of Toidupank Estonia	40min	02.11.2021	Poverty Food Waste Volunteer Work
Karl Koha	Manager of Toidupank Estonia	30min	10.11.2021	Location Volunteer Work Food Distribution
Lucas	Volunteer at Toidupank Estonia	7h	15.11.2021	Stigmatisation Poverty Volunteer work Free Food
Annaliis	Manager and Coordinator of Foodsharing Tartu	45min	26.11.2021	Free Food Food Waste Food Saving Food Sharing

B. Observation Records

Note taking

Taking notes was sometimes a quick solution but rather superficial and as an emergency way to gather information in unexpected places and moments, for example when having unexpected conversations about the main topics. But therefore, the information often was outstanding and relevant. For more detailed material, please contact the author.

Audio Recordings

This record method was only used during interviews. The recording made it possible to fully focus on the interviewee and the interview itself without getting disrupted by taking notes. The recording made it possible to listen to the whole interview again and add valuable information that got lost during the chat with the interviewee. It is important to stress that all interviewees were fully aware of being recorded and agreed to that. For more detailed material, please contact the author.

Photography

Especially photography as a medium to record and analyse observations has been immensely helpful in the research process because it could capture important moments in time as well as document about the environment where the observations took place. Time lapses during the food-delivery of the Estonian Foodbank for example visualised roughly the circulation of surplus food between food retailers, the organisation and food food-receiving organisations within only a few hours. For more detailed material, please contact the author.

C. Surveys

	Target Group	Participation	Participation period	Keywords
Survey 1	Volunteers	6	15.11.2021 - 01.12.2021	access; free food; perception; food saving
Survey 2	Food Sharing Group	73	08.11.2021 - 22.11.2021	free food; food saving, giving, receiving, food shaming
Survey 3	Users of public Food Pantries	11	08.01.2022 - 22.01.2022	access, free food, food shaming

Survey results

Due to the length, individual answers to open questions of survey 1 to 3 can be requested from the author.

The following charts show the results of survey 1:

I do food-related volunteer work because (multiple answers possible)
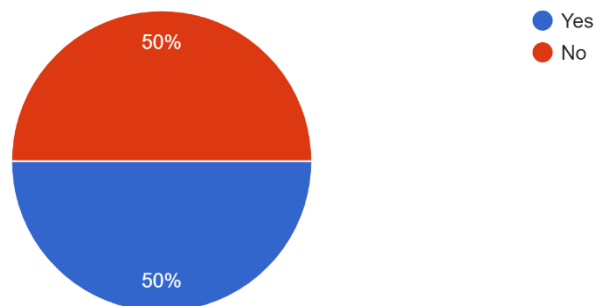6 responses
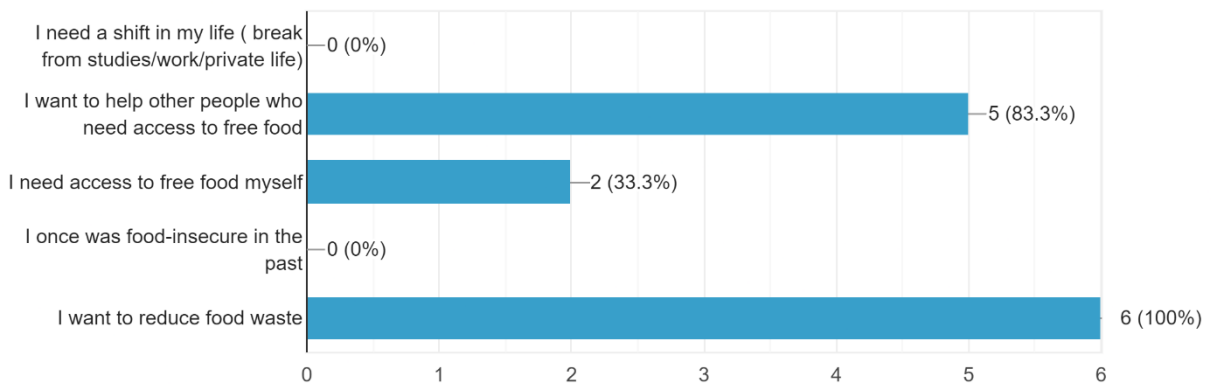
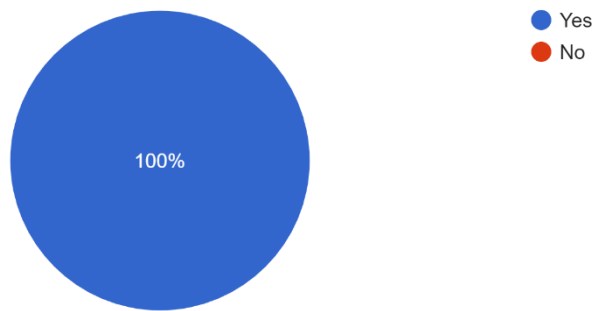### Please indicate below how much the statements apply to you.
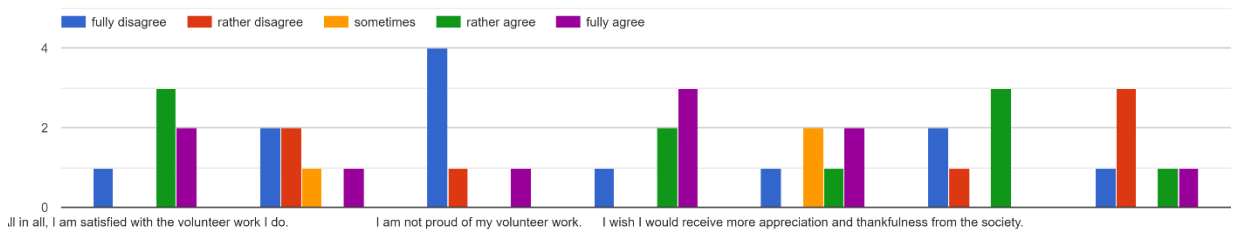
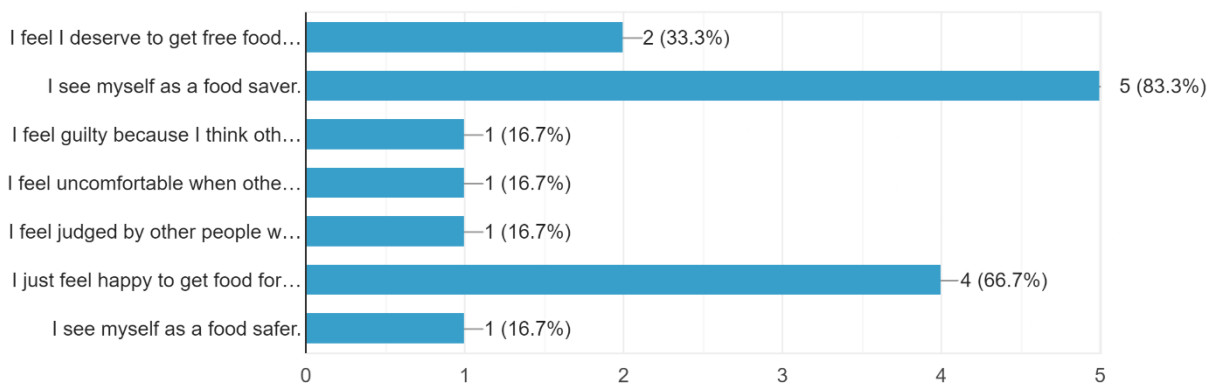### Have you ever thought about stopping with volunteer work?
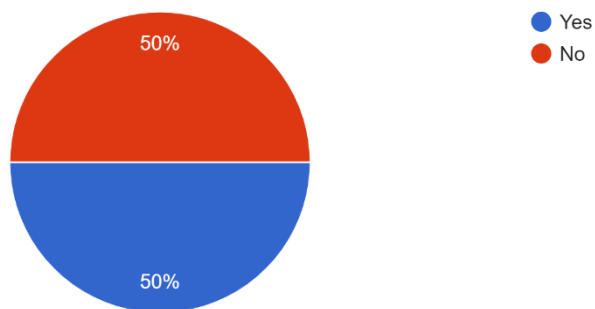6 responses

Do you also have access to free food?

6 responses

- Yes
- No

100%

How do you feel when taking free food for yourself? (multiple answers possible)

6 responses

I feel I deserve to get free food…	2 (33.3%)
I see myself as a food saver.	5 (83.3%)
I feel guilty because I think oth…	1 (16.7%)
I feel uncomfortable when othe…	1 (16.7%)
I feel judged by other people w…	1 (16.7%)
I just feel happy to get food for…	4 (66.7%)
I see myself as a food safer.	1 (16.7%)

Did your perception or the value of food change since you are volunteering?

6 responses

- Yes
- No

50%

50%

Did you ever had bad experience with people that you support through your work? (for example agression, harassment, insults, complaints)

6 responses

- Yes
- No

83.3%

16.7%
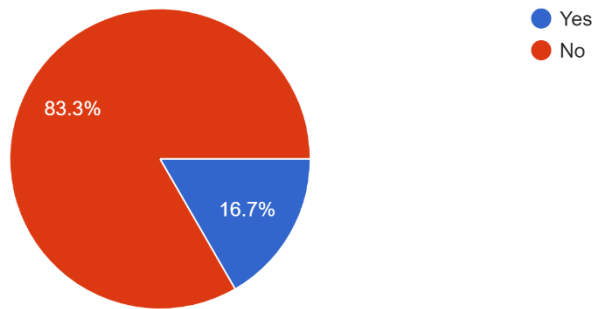
Please indicate below if the statements apply to you.

- yes
- sometimes
- no
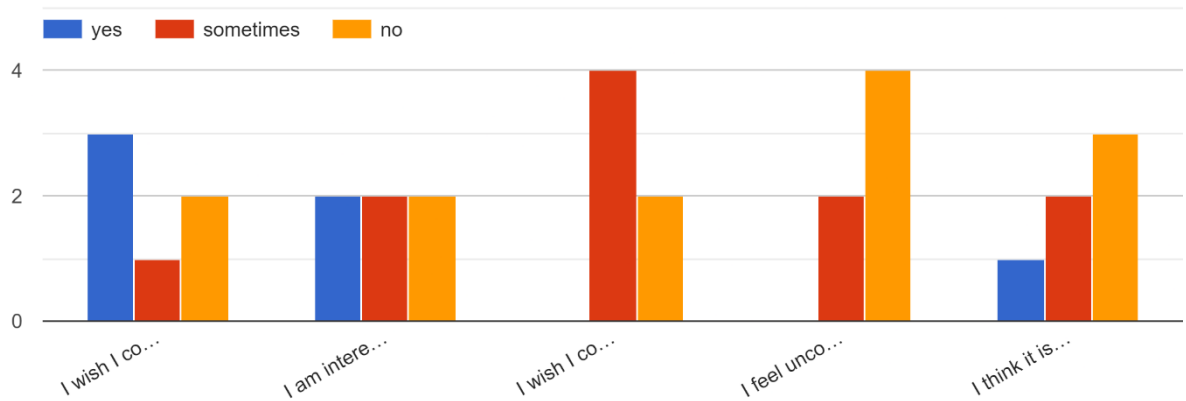
Please select your age group

6 responses

- under 18
- 19 to 30
- 31 to 45
- 46 to 60
- over 60

33.3%

66.7%
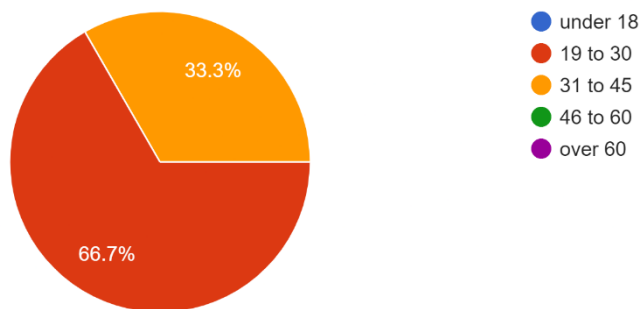
How many adults are currently living in your household?

6 responses

- 0
- 1
- 2
- 3
- 4
- more than 4

66.7%
16.7%
16.7%
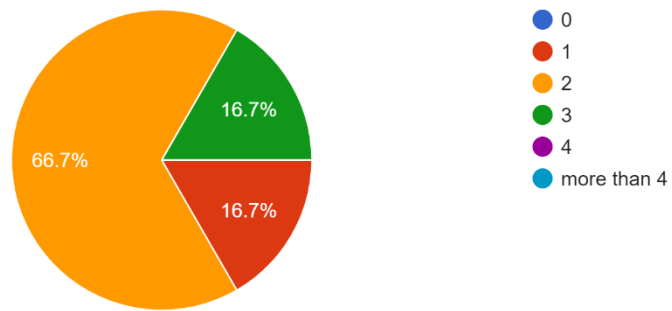
How many children are currently living in your household?

6 responses

- 0
- 1
- 2
- 3
- 4
- more than 4

100%
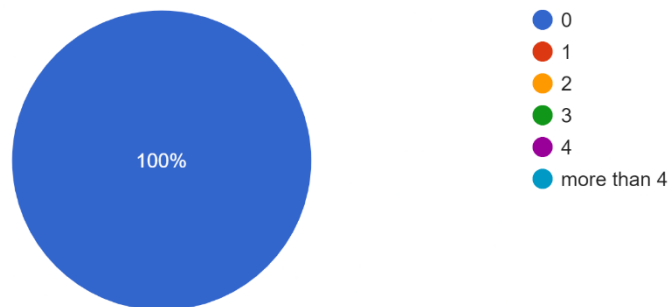
What describes your current situation most?

6 responses

unemployed/not working — 0 (0%)
student — 3 (50%)
employed/working — 4 (66.7%)
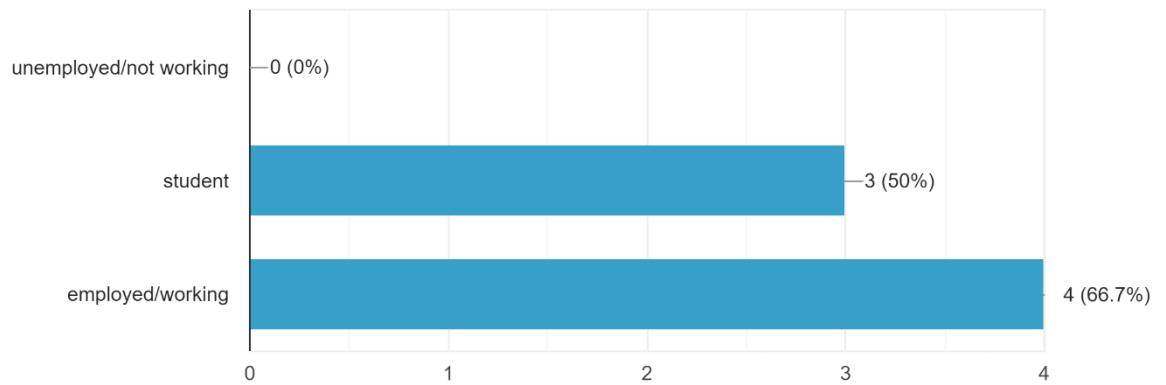
Apart from you how many adults in your household are currently working ?

6 responses

Pie chart legend:
- 0
- 1
- 2
- 3
- 4
- more than 4

66.7%

33.3%
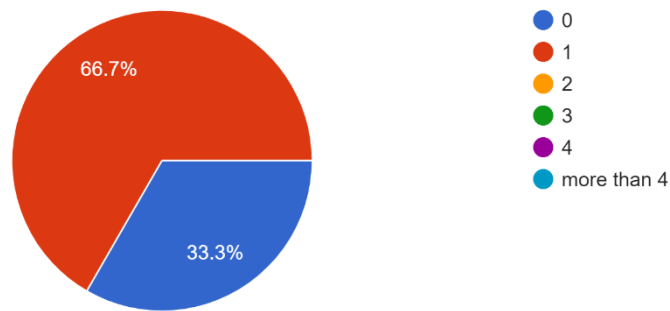
What is your net income per month or amount of money you can spend?

6 responses

Pie chart legend:
- under 300
- 300 to 500
- 500 to 1000
- 1000 to 2000
- over 2000

33.3%

16.7%

16.7%

33.3%
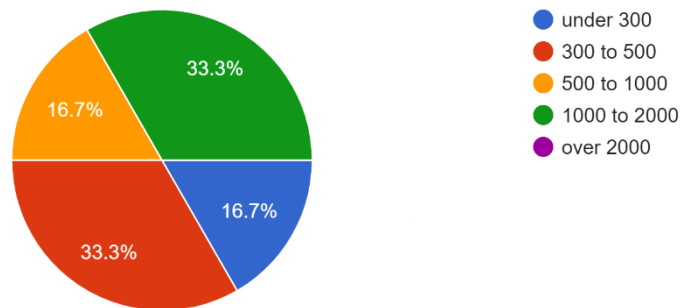
Please answer with "yes" or "no"

Bar chart legend: Yes | No

	I take advantage of governmental/social/ financial support?	I have experience with volunteer work related to food/ foodwaste/ food insecurity.	I am currently working as a volunteer and my work is related to food/ foodwaste/ food insecurity.
Yes	1	6	5
No	5		1
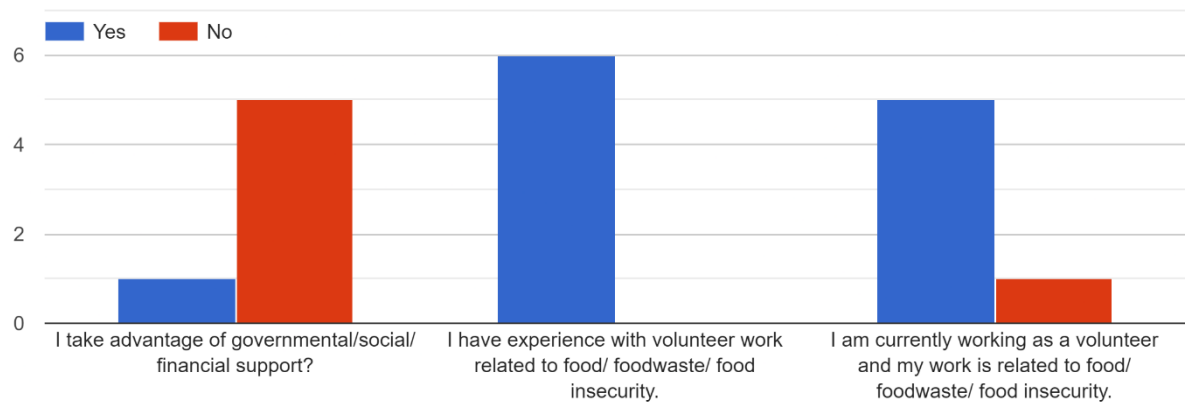
The following charts show the results of survey 2. Due to the length, only results of Estonian-speaking participants are presented. The English results can be requested from the author:

Olen seotud toidupuudusega, kuna

72 responses

Kategooria	Väärtus
ma tean vähemalt ühte inim…	23 (31.9%)
ma olen kannatanud toidupu…	30 (41.7%)
ma pean end praegu toidupu…	3 (4.2%)
toetan aktiivselt toidu puudu…	14 (19.4%)
ma ei oska selle teemaga ül…	10 (13.9%)
ma ei kannata toidupuuduse…	1 (1.4%)
ma tean, et see on suur prob…	1 (1.4%)
Jälgin teemat, aga ei osale v…	1 (1.4%)
Ei kannata puuduse käes, k…	1 (1.4%)
Olen varasemalt olnud vabat…	1 (1.4%)
Mind teeb toidu raiskamine v…	1 (1.4%)
teema on ühiskondlikult tähtis	1 (1.4%)
Olen tudeng, toit on alati vää…	1 (1.4%)
Ei taha osta pakendatud toit…	1 (1.4%)
seisan aktiivselt toiduraiska…	1 (1.4%)
Ei taha ülal pidada süsteemi,…	1 (1.4%)
Ülikooli ajal teadsin. Paljud ü…	1 (1.4%)
Hoian oma raha kokku ja po…	1 (1.4%)

Ressursipuuduse tõttu oli viimase 12 kuu jooksul aeg, mil (jah või ei)
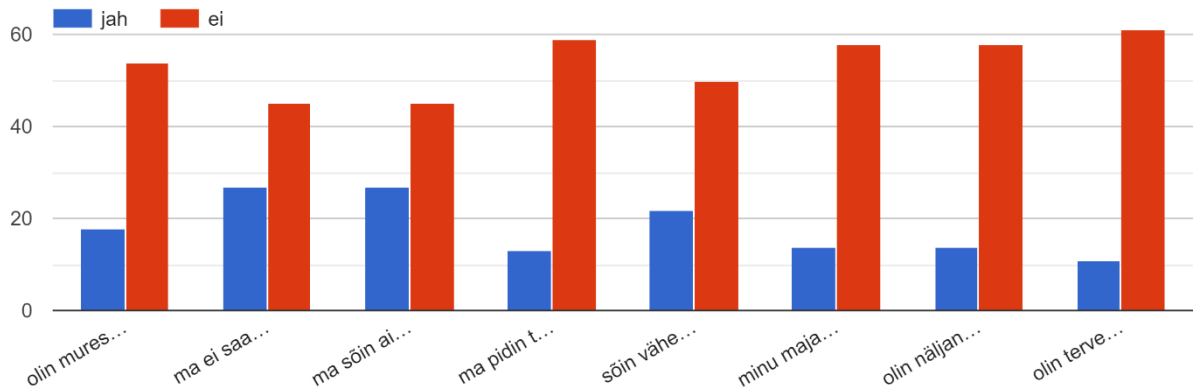
Kas kasutate tasuta toidu saamise võimalust/toiduabi?

72 responses

Jah 27.8%
Ei 72.2%
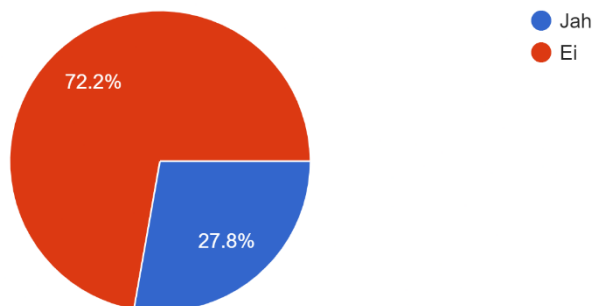
Kui ma võtan vastu toiduabi

52 responses

Vastus	Arv
tunnen end süüdi, sest arv…	21 (40.4%)
mul on häbi, sest ma vaja…	8 (15.4%)
muretsen ma, mida teised…	9 (17.3%)
minu jaoks ei ole tähtis toi…	7 (13.5%)
võtan vastu ka valmistoitu…	9 (17.3%)
ma tunnen, et inimesed, k…	6 (11.5%)
tunnen end alaväärsena,…	9 (17.3%)
ma võtan prügikastist toitu…	1 (1.9%)
ei võta toiduabi	1 (1.9%)
Tegu on päästetud toiduga…	1 (1.9%)
Olen õnnelik, kuna saan s…	1 (1.9%)
Mul ei ole toiduabi vaja läi…	1 (1.9%)
Ei oska kommenteerida, il…	1 (1.9%)
Kardan, et toit ei ole piisav…	1 (1.9%)
ma ei vaja toiduabi	1 (1.9%)
…või kui võtan sööki toidu…	1 (1.9%)
Olen tänulik	1 (1.9%)
ei ükski neist	1 (1.9%)
See oleks normaalne	1 (1.9%)
ei ole seda kunagi teinud	1 (1.9%)
Tekitan seda enda jaoks is…	1 (1.9%)
Ei vaja toiduabi	1 (1.9%)
Mul on pohhui. Inimesi pe…	1 (1.9%)
Ei vaja toiduabi, pigem toi…	1 (1.9%)
Ei kasuta	1 (1.9%)

Kui suure osa toidu ülejääke Te ära viskate/annetate?
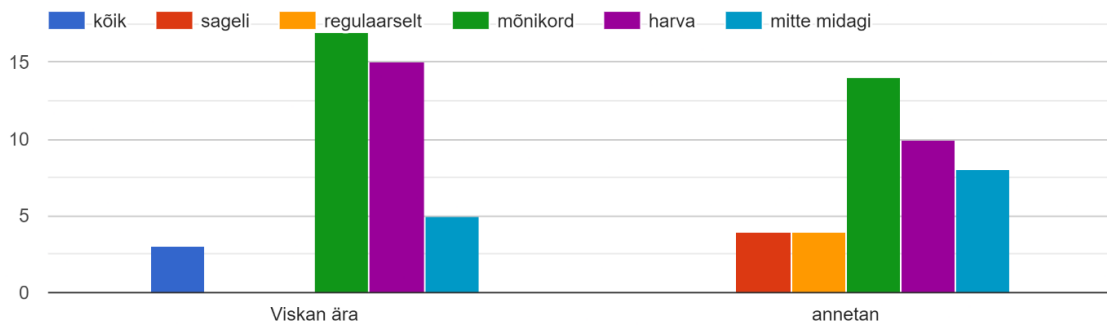
Kasutan toidujagamise Facebooki gruppi, tasuta toidu saamiseks/andmiseks.

129
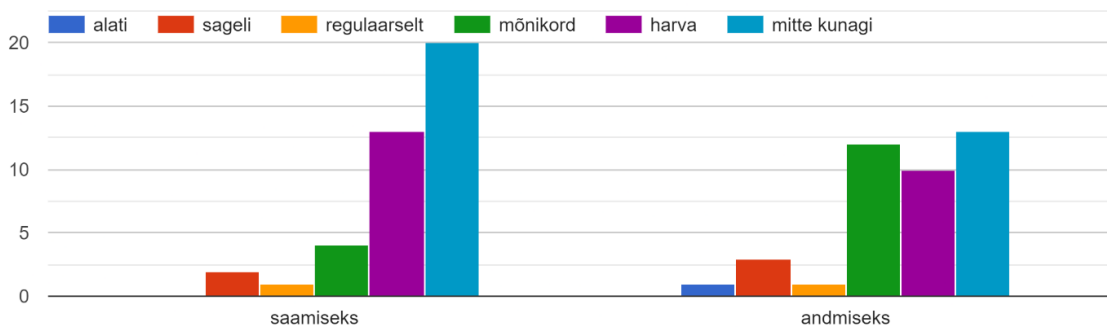
Kas teil on kunagi olnud halbu kogemusi tasuta toidu jagamisega?

65 responses

mitte kunagi	54 (83.1%)
inimene ei tulnud kohale	2 (3.1%)
tundsin end ebamugavalt inime…	3 (4.6%)
keelebarjäärid	2 (3.1%)
ei tundunud, et inimene seda tõ…	1 (1.5%)
Polegi kogemusi olnud veel	1 (1.5%)
Ainsal korral, kui pakkusin, tulig…	1 (1.5%)
Üsna keeruline on juriidiliste tõ…	1 (1.5%)
Üritasime Teha Tallinna toiduja…	1 (1.5%)
Olen kasutanud toidujagamise…	1 (1.5%)
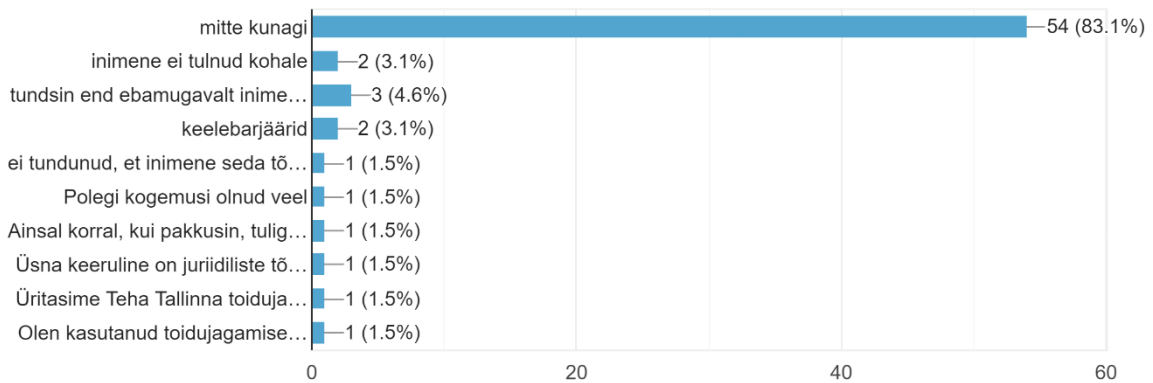
Küsimused üldse mitte/pigem mitte/pigem jah/jah:

üldse mitte | pigem mitte | pigem jah | jah

probleemidest ja püüan aktiivselt toidu raiskamist oma majapidamises vähendada.   Minu jaoks on oluline kodumajapidamistes toidu raiskamise vältimine.

Ma viskan ära toitu, sest

alati | sageli | mõnikord | harva | mitte kunagi

ostan rohkem toitu kui vaja   ostsin valed tooted ja mu perele/mulle ei meeldi nende maitse
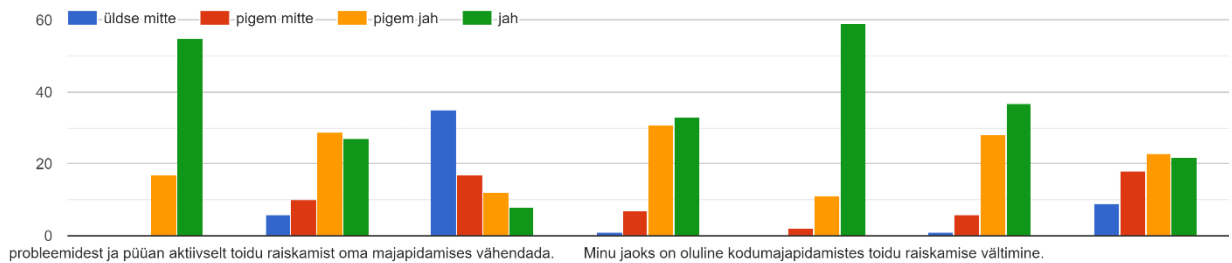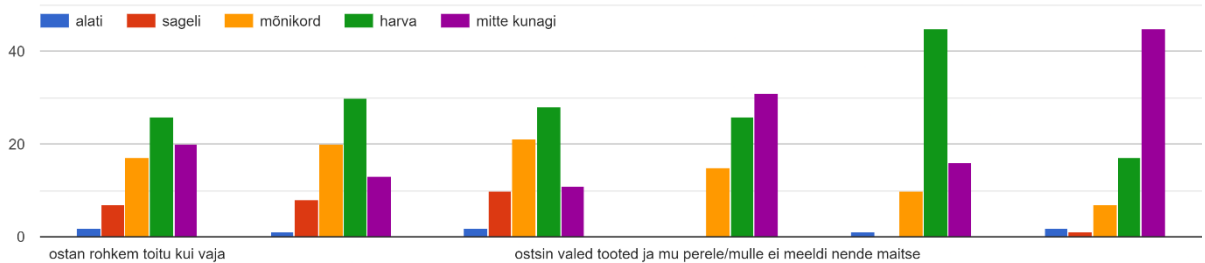
Mis muudaks tasuta toidule juurdepääsu lihtsamaks?

72 responses

Rohkem kohti linnas, kuhu saa…	61 (84.7%)
Kogumissüsteem, mis korjaks…	30 (41.7%)
Parem suhtlus toidu vastuvõtjat…	36 (50%)
Positiivne ja kutsuv koht toidu j…	51 (70.8%)
oluline on pigem tegeleda põhj…	1 (1.4%)
sotsiaalne restoran, kuhu poed…	1 (1.4%)
Kauplused ja söögikohad võiksi…	1 (1.4%)
Parem koostöö kaubanduskesk…	1 (1.4%)
Liiga jõukad ja ülbed inimesed…	1 (1.4%)
Üleliigsete inimeste likvideerimi…	1 (1.4%)

Vanuserühm

72 responses
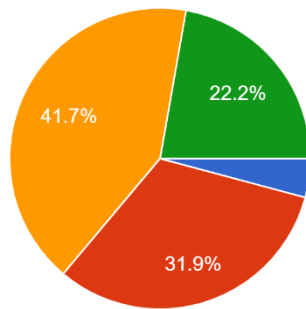
- ● alla 18-aastased
- ● 19-30-aastased
- ● 31-45-aastased
- ● 46-60-aastased
- ● üle 60-aastased

22.2%
41.7%
31.9%

Mitu täiskasvanut elab teie leibkonnas
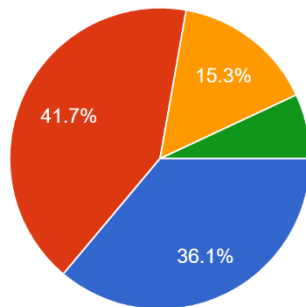
72 responses

- ● 1
- ● 2
- ● 3
- ● 4
- ● rohkem kui 4 täiskasvanut

15.3%
41.7%
36.1%

Mitu last elab teie leibkonnas
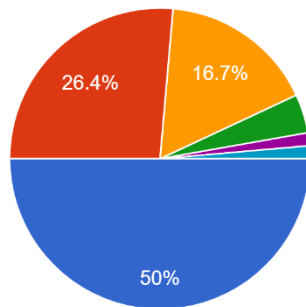
72 responses

- ● 0
- ● 1
- ● 2
- ● 3
- ● 4
- ● rohkem kui 4 last

26.4%
16.7%
50%

Hetkeseis

72 responses
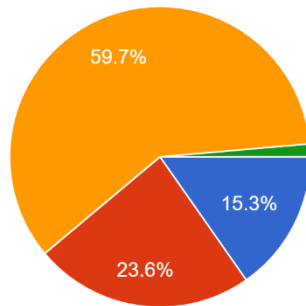
- töötu
- õpilane
- töötan
- üliõpilane

59.7%
23.6%
15.3%

Töötavate täiskasvanute osakaal leibkonnas

72 responses
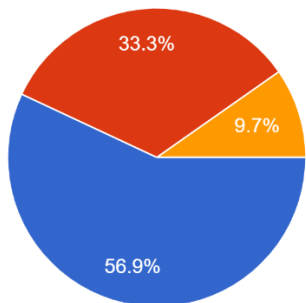
- kõik töötavad
- mõned töötavad
- mitte keegi ei tööta

33.3%
9.7%
56.9%

Kuu netosissetulek kogu leibkonnas

72 responses
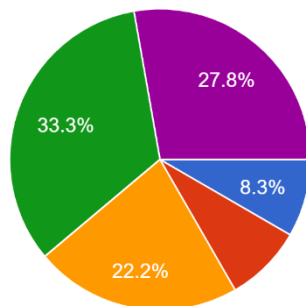
- alla 300
- 300-500
- 500-1000
- 1000-2000
- üle 2000

27.8%
33.3%
8.3%
22.2%

Riikliku/sotsiaalse toetuse kasutamine

72 responses

- jah
- ei

77.8%
22.2%
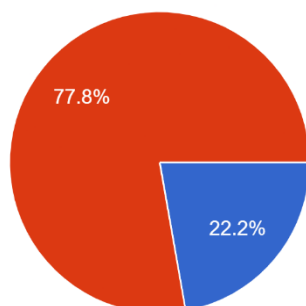
The following charts show the results of survey 3. Due to the length, only results of Estonian-speaking participants are presented. The English results as well as the poster connected to the survey can be requested from the author:

Kui tihti Te toidujagamispunktides käite?
11 responses

- Mitte kunagi
- 1-2 korda aastas
- 1-2 korda kuus
- 1-2 korda nädalas
- Mitu korda nädalas
- Iga päev
- Mitu korda päevas
- Esimest korda käisin .
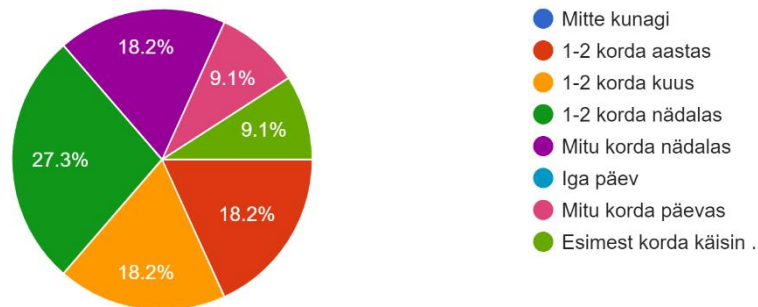
Mis oli Teie motivatsiooniks tulla?
11 responses

Nägin facebooki grupis, et uut toitu on toodud ja tulin sellele jä…	5 (45.5%)
Tulin spontaanselt vaatama, kas midagi on pakkuda	9 (81.8%)
Tõin toitu	5 (45.5%)
Ma olin näljane	4 (36.4%)
Muu	0 (0%)
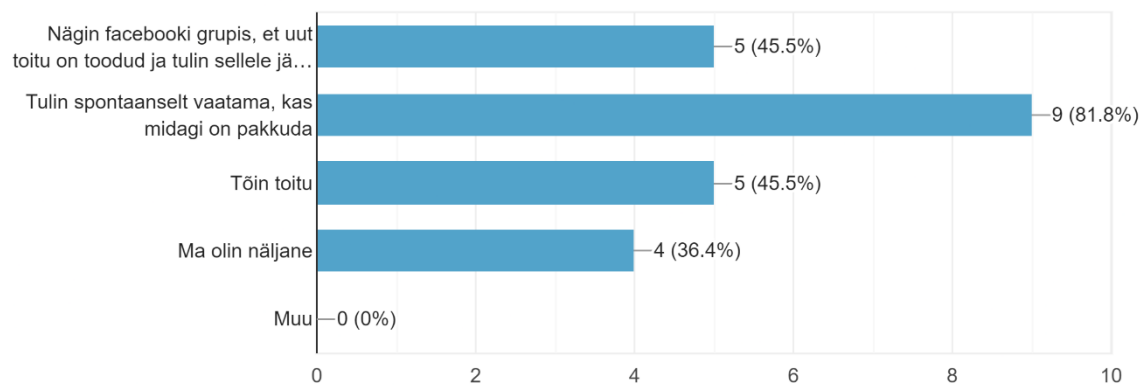
Millal Te külastasite toidujagamispunkti?
11 responses

- Varahommikul/hommikul
- Päeval
- Õhtul
- Öösel
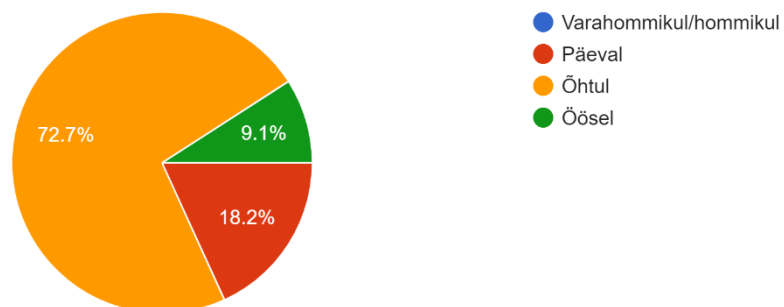
Kas saite toidujagamispunktist toitu?

11 responses

- ● Jah, ma sain täpselt seda, mida tahtsin
- ● Jah, ma sain midagi, mida ma ei oodanud
- ● Ei, midagi oli veel alles, aga mul polnud seda vaja
- ● Ei, toitu ei olnud järelejäänud
- ● Ainult tõin toitu

18.2%
9.1%
9.1%
63.6%
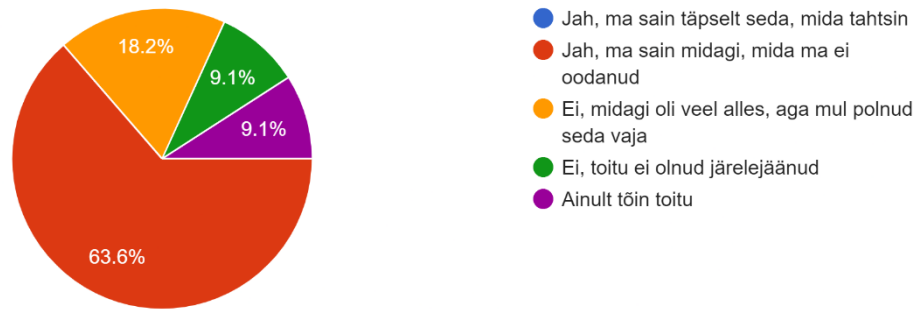
Milline väide kehtib Teie kohta?

legend: toidu võtmisel | toidu toomisel | toidujagamispunkti kontrollimisel
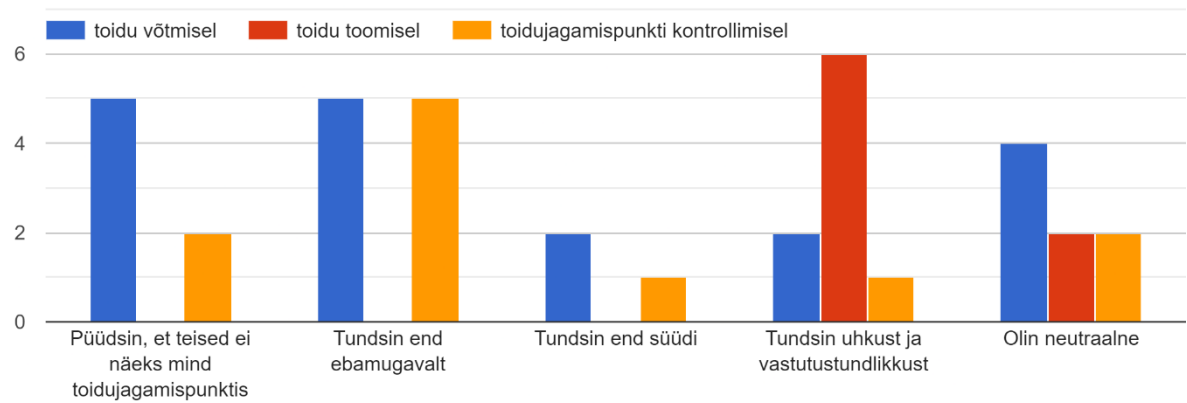
D. Research Maps and Visualisations

The development of the research question has been visualised on the following graph:

Development of the research question

"A food sharing system that reduces food waste inside a community of households by easing the access and lowering stigmatisation burdens of free food"

How to reduce food waste on a household level by easing the access and lowering the stigmatisation burdens of free food?

community of households

How can design help to reduce food waste by easing the access and distribution to free food?

"treasure food"

the food insecure

the food secure

How can design help to reduce food waste by overcoming neoliberal stigmatisation of public access to free food?

food insecurity

nudging

How can design help to reduce food waste by overcoming neoliberal stigmatisation of free food?

neoliberal stigmatisation

How to transform negative emotions connected to free food into positive emotions in the context of food sharing through design?

food insecurity

emotional discomfort

How to reduce food waste in private households through a combined design solution?

The following map shows how food waste and neoliberal stigmatisation of free food is connected:
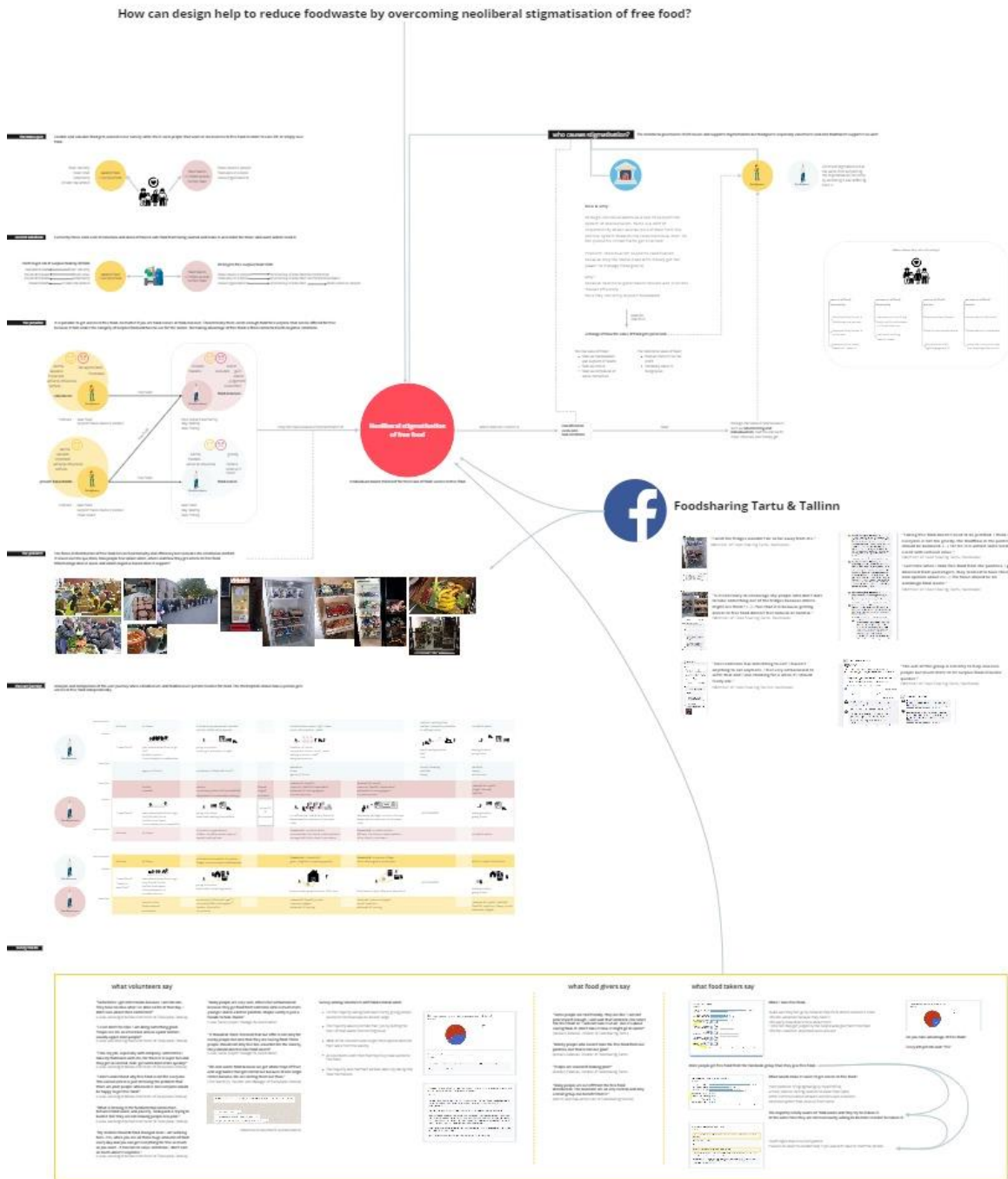
E. Design

The following picture shows the affinity diagram:
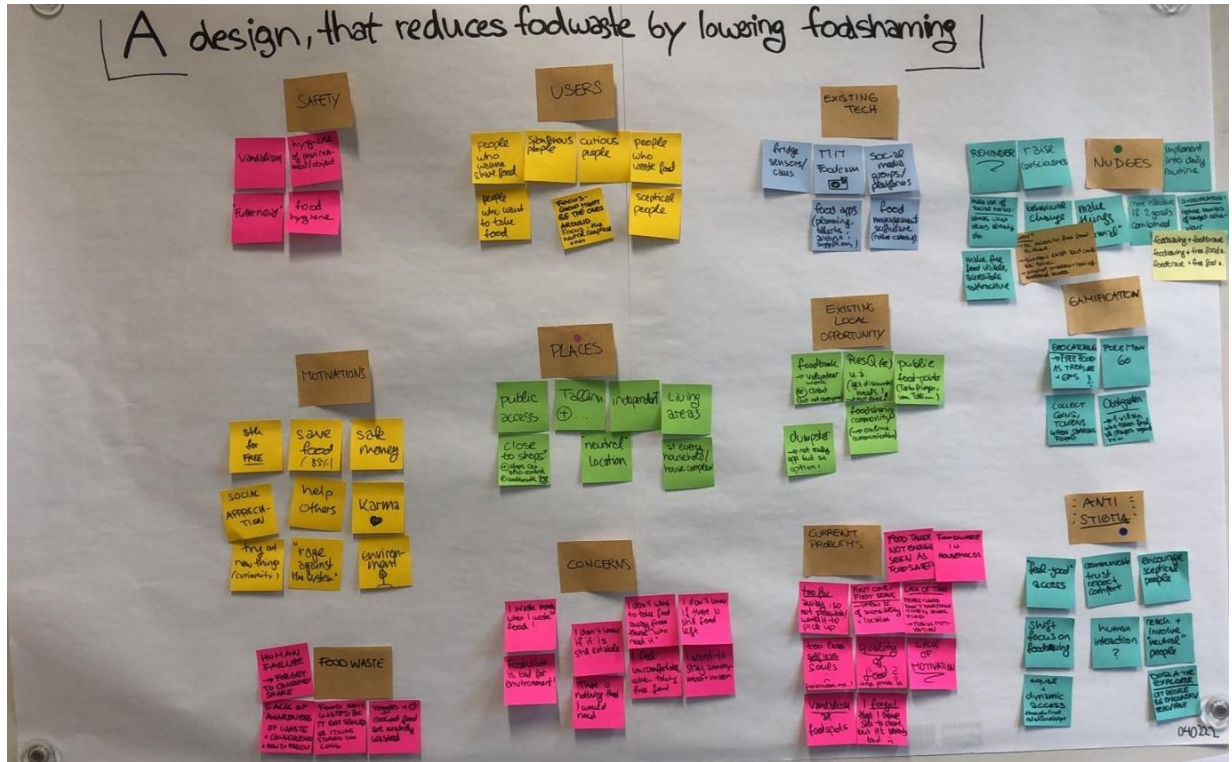
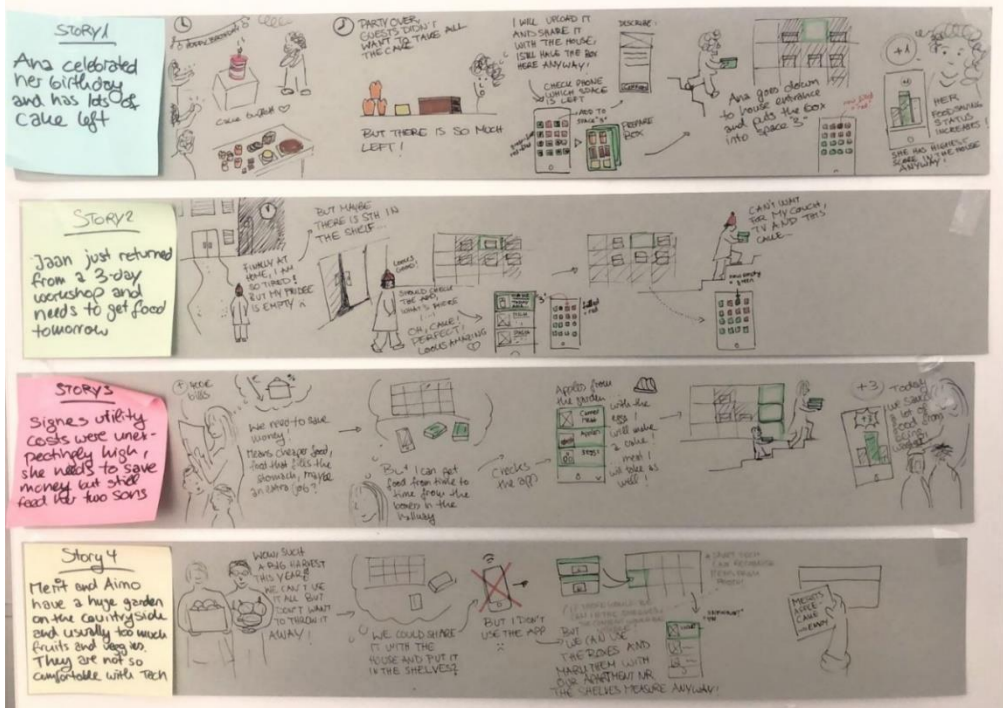The following map shows matrices comparing different food saving ideas:

The following picture shows the first sketch of the idea:
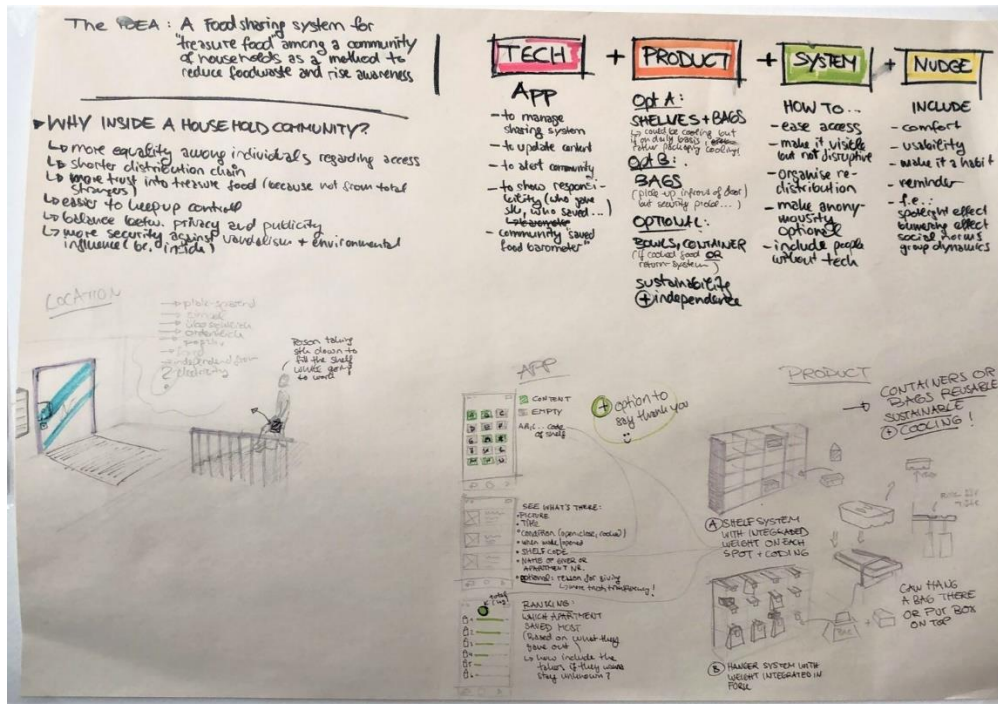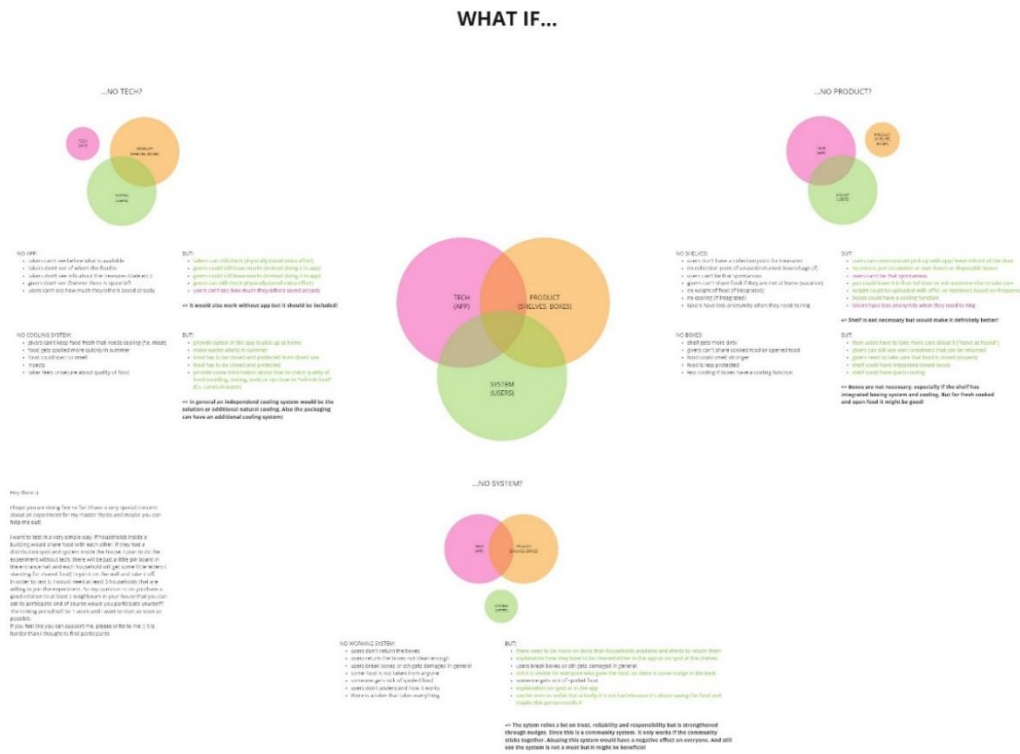

The following picture shows first lo-fi mock-ups for the app:
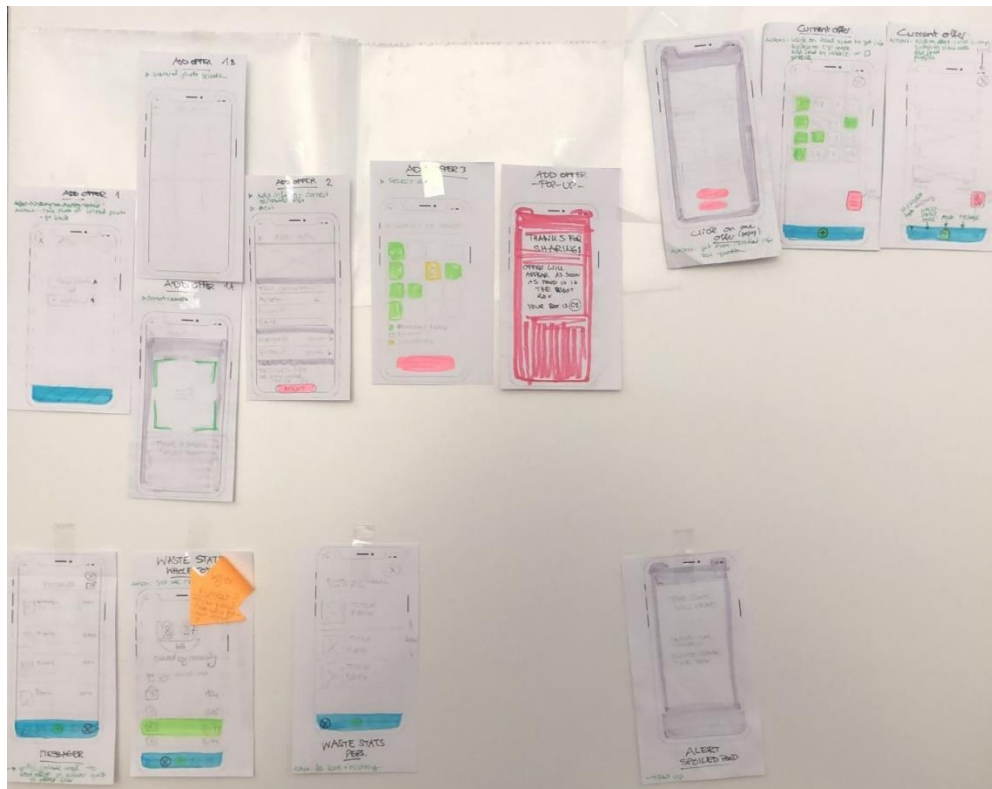
The following picture shows three different user experience stories:

The following graph shows how the system would work if one component would be missing:

The following three pictures show the profile of the three personas that form together the target group which is addressed through the design brief:

Jaan
Cybersecurity Master Student

ABOUT
- Age 18-25
- € 350-500
- Limers, Mods, Muppies, Yetties, Yuppiess

FOOD ATTITUDE
cooks and eats what he is used to know, orders food regularly, tries to save money, wastes food regularly, eats to get fed up, minimalistic cooker, lots of processed food

PERSONALITY PROFILE
Extrovertism
Green mindset
Stress
Adventure
Education
Digitalized

MOTIVATIONS
Motivated to try out new things and share the experience, image cultivation,

CORE NEEDS
Being able to join communities and connect with like-minded & new people, flexibility

PAIN POINTS
no time to cook, organisation, lack of food knowledge, forgets food, unregular week schedule

"...and the free food is really edible?"

Ana
Antrophologist, Volunteer worker

ABOUT
- Age 28-35
- € 1800-2600
- LOHAS, LOVOS, Hanks, GenX

FOOD ATTITUDE
Enjoys cooking, no food waste, big food knowledge, vegan, tries to only buy organic or local products, loves to cook and share food with others, meal prepping, low trust in food industry

PERSONALITY PROFILE
Extrovertism
Green mindset
Stress
Adventure
Education
Digitalized

MOTIVATIONS
Doing something that matters, bring people together & connect them, spread green mindset, sharing is caring, social justice, sustainability

CORE NEEDS
extend network with like-minded people, support from above, having more time to volunteer and share, research about food and food industry, keep herself educated

PAIN POINTS
Limited time, can't change and motivate everyone to act responsible, limitations of volunteer work, being aware and frustrated of what happens "behind the scenes" in the food and waste sector

"Making free food acessible reduces waste!"

The following map shows the app flow chart of taking and giving food through the app:

when someone gives food

when someone takes food

The following picture shows the dimensions of Toivar:

UNIT: MM

The following diagrams show the blueprint of giving food, taking food and how those two blueprints are connected:

Scenario 1: Taking food

Timeline notes (top):
- 11.30pm — Jaan is returning home late and hungry after travelling and he checks the available food in the Toivar app.
- He clicks on one food item - a big piece of home-made vegetable quiche from this evening - that is currently in the shelf and decides to take it when he arrives.
- He enters the building, goes to the shelf and searches for the right space. He rechecks in the app - it was A1
- 11.35pm — He takes out the food box and goes to his apartment to eat.
- At the next evening he cleans the box
- Two days later he returns the box to the collection point when leaving the house for work

Physical evidences: Food item · Toivar box · Toivar app · Toivar shelf · Smart Tech IoT · Laser sensor
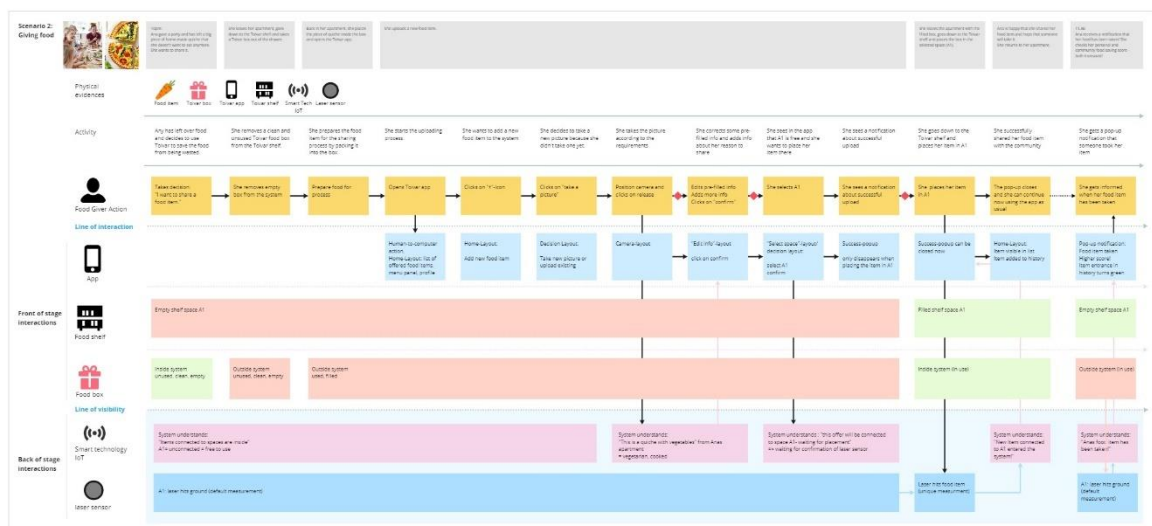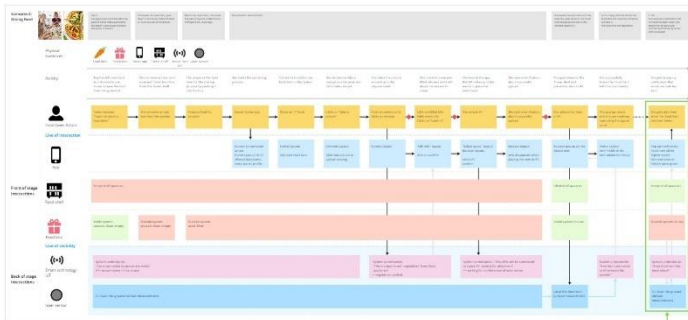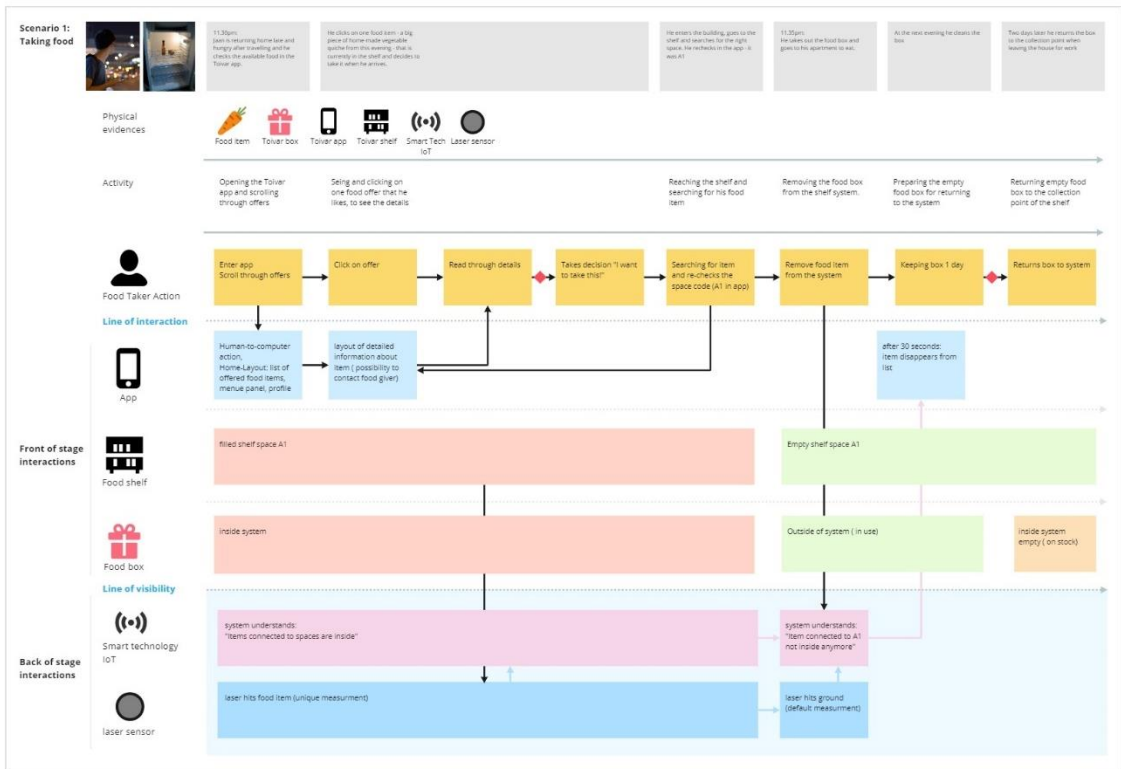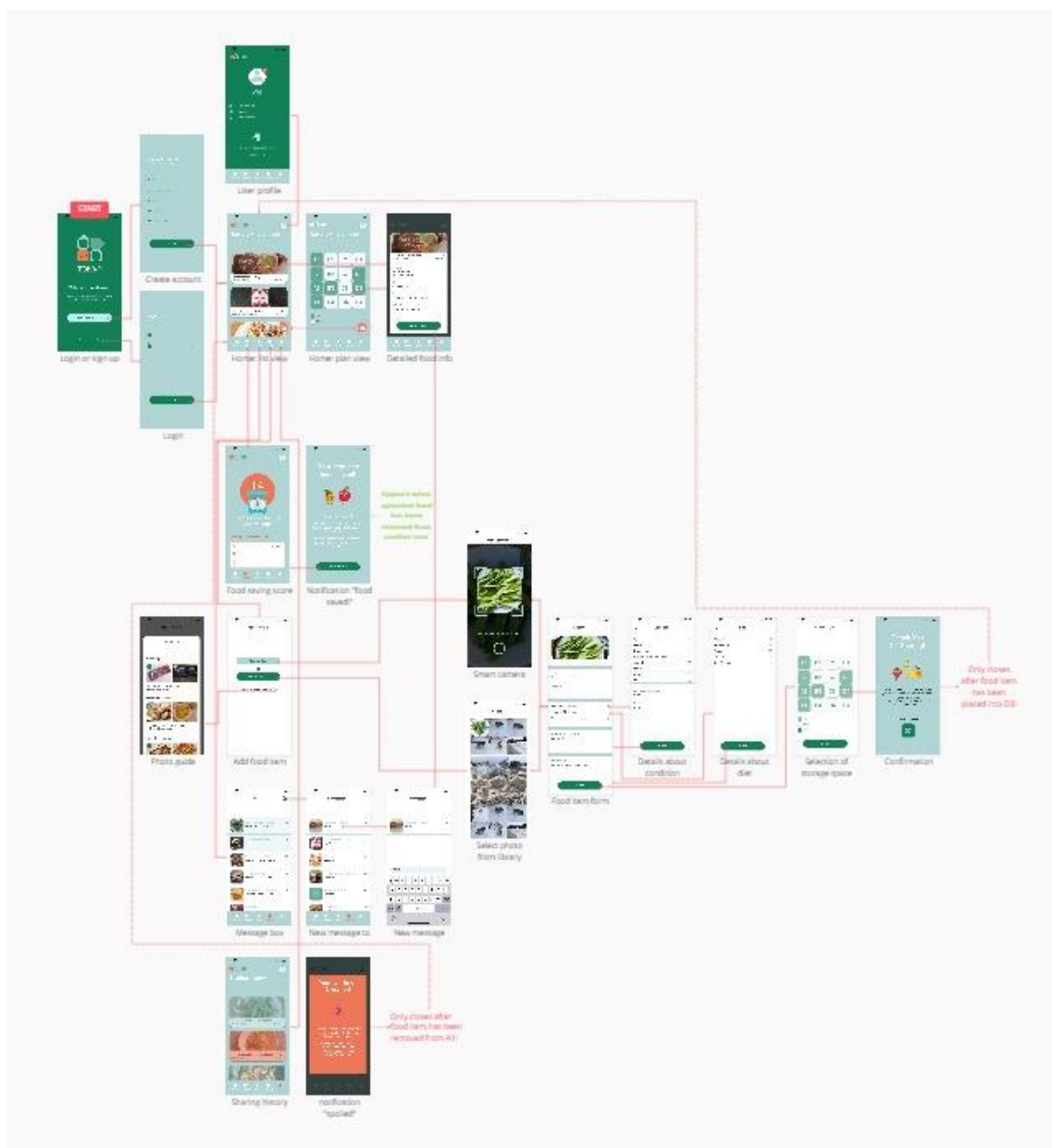
Activity:
- Opening the Toivar app and scrolling through offers
- Seing and clicking on one food offer that he likes, to see the details
- Reaching the shelf and searching for his food item
- Removing the food box from the shelf system.
- Preparing the empty food box for returning to the system
- Returning empty food box to the collection point of the shelf

Food Taker Action:
Enter app Scroll through offers → Click on offer → Read through details → Takes decision "I want to take this!" → Searching for item and re-checks the space code (A1 in app) → Remove food item from the system → Keeping box 1 day → Returns box to system

Line of interaction

App:
- Human-to-computer action, Home-Layout: list of offered food items, menue panel, profile
- layout of detailed information about item (possibility to contact food giver)
- after 30 seconds: item disappears from list

Front of stage interactions

Food shelf:
- filled shelf space A1
- Empty shelf space A1

Food box:
- inside system
- Outside of system (in use)
- inside system empty (on stock)

Line of visibility

Back of stage interactions

Smart technology IoT:
- system understands: "Items connected to spaces are inside"
- system understands: "item connected to A1 not inside anymore"

laser sensor:
- laser hits food item (unique measurment)
- laser hits ground (default measurment)
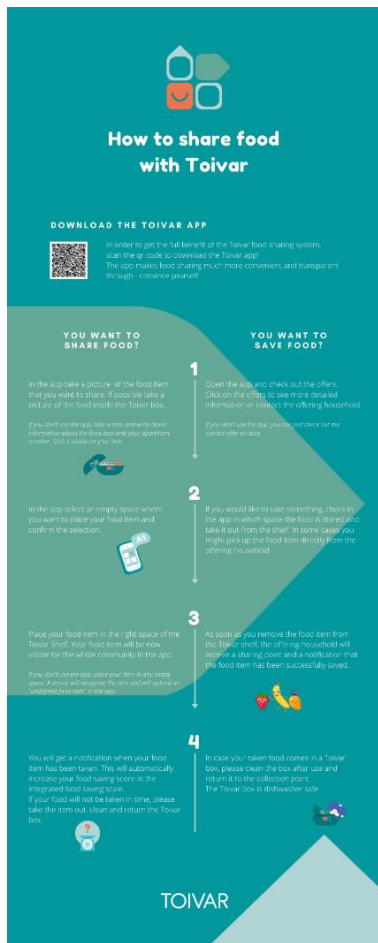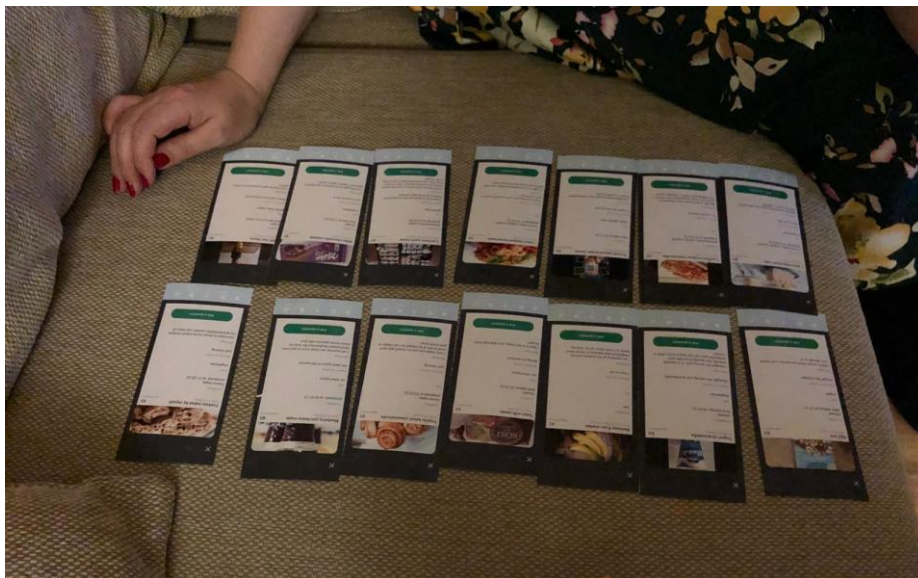
Interaction
Critical Interaction

The following diagram shows the flowchart of the Toivar app. Please contact the author to get access to the interactive mock-up:

The following two pictures show the posters which will help users to understand how Toivar works:

The following pictures have been taken while two persons did design experiment 2:

The following table shows the detailed results of experiment 2: