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A practice-oriented design for sustainability approach

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Doctoral Thesis

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Thesis for the degree of Philosophiae Doctor

Trondheim, June 2020

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PREFACE

This dissertation is submitted in partial fulfilment of the requirements for the degree of Philosophia Doctor (PhD) at the Norwegian University of Science and Technology (NTNU). The author declares that this dissertation and the work presented in it are her own and have been generated by her as a result of original research while in candidature for the degree of Philosophia Doctor at NTNU. The dissertation contains no material that was previously submitted for a degree at NTNU or any other institution. The research has been carried out at Consumption Research Norway (SIFO) at the Oslo Metropolitan University, and the Department of Design at NTNU. The main supervisor of the dissertation work has been Professor Casper Boks (NTNU), and co-supervisors have been Dr. Ida Nilstad Pettersen (NTNU) and Dr. Harald Throne-Holst (SIFO).

The PhD has been financed by the project CYCLE, 'an interdisciplinary project with a bio-economic perspective, focusing on several value chains from both agriculture and marine sectors. The main objective of CYCLE is to improve resource utilisation in the food chain in Norway by developing sustainable eco-friendly bio-processes and novel technology, with research and innovation at its core.' (http://cycleweb.no/). CYCLE was funded by the Research Council of Norway and the project was led by SINTEF. Additionally, the research presented in this dissertation has been informed by three parallel projects funded by the Norwegian Ministry of Children and Families and led by the author, which have studied food waste drivers in Norwegian households with a focus on policy implications.

ACKNOWLEDGEMENTS

This dissertation is the product of a six-year long process of exploring the ways in which food becomes waste and the design opportunities arising from new insights. The time span has included the birth of my two daughters, Hanna and Sofia, who have contributed with much joy along the way – not to mention a lot of food waste. Being part of the consumer group wasting the most food in Western countries (families with children) has perhaps increased my sensitivity towards the mechanisms that influence this rather counterintuitive phenomenon. It certainly has brought the issue under investigation quite close to home.

Of course, the empirical research this dissertation is based on has been conducted with unassociated participants, and I would like to express my gratitude to everyone who has participated in my research; to all the members of the 26 Norwegian households that welcomed me into their homes to ask them about their everyday dealings with food and rummage through their kitchens, to all the design students who contributed their creativity and ideas in the design workshops in Trondheim and Oslo, and to the senior designers who participated in imagining future practices and worlds during the design fiction workshop.

In the formal line of acknowledgements, I would first like to thank my supervisors Professor Casper Boks (main supervisor), Dr. Ida Nilstad Pettersen and Dr. Harald Throne-Holst for their advice along the way, and for providing continuous feedback to all my questions, ideas and challenges. Further, I would like to thank the Department of Design at NTNU for the administrative support. I also thank my employer, Consumption Research Norway (SIFO) at Oslo Metropolitan University for the financial, professional and administrative support.

Furthermore, I thank my colleagues in the research group of Technology & Sustainability at SIFO for providing support and useful comments on articles along the way. A special thank you needs to be given to my dear colleague Nina Heidenstrøm, who has provided invaluable support and input on both the professional and personal level from start to finish of my PhD project. Thanks also to my co-author Henry Mainsah, who has contributed with his expertise and workshop leading experience, and inspirational collaboration, to Gunnar Vittersø, the internal project leader of SIFO's contribution to CYCLE, and Torvald Tangeland, Head of Research for Technology and Sustainability.

I would also like to thank the project CYCLE, led by SINTEF, the Research Council of Norway for funding, and the Norwegian Ministry of Children and Families, which commissioned three parallel projects that could contribute to informing my PhD project.

Finally, I would like to thank my family for cheering me on and showing support and interest in my project. To Sverre, who has patiently engaged in endless discussions on food waste and design, whilst every now and then grinning smugly when catching me waste leftovers 'too unattractive to eat'; to my two daughters, Hanna and Sofia, who have been so patient with my long working hours towards the end, asking: 'Mummy, when will your book finally be finished?'; and to my mother Eva and father Karl-Heinz for their love, support and encouragement.

Marie Hebrok
Oslo, January 2020

SUMMARY

This dissertation develops a practice-oriented design for sustainability (PODS) approach, incorporating the use of design fiction, to explore opportunities for reducing household food waste by design. Through this approach it has produced narratives of current and possible future food-related practices that have been co-created with participants in order to elicit opportunities for design interventions. The narratives provide insights into how food waste occurs within the flow and rhythm of everyday life, how it is entangled in a web of interrelated practices and conflicting ideals, and into how practices could be reconfigured in the future by design, imagining not only incremental innovations but also new ways of food consumption. Moreover, in light of the food waste case, it reflects on what the theoretical underpinnings of PODS mean for current and future ways of addressing sustainable consumption issues by design. The dissertation is based on a total of four articles: three peer-reviewed and published journal articles, and one submitted journal article. The research has been conducted in Norway.

In Article 1 I show that there are currently two dominant strategies being promoted by national authorities and industry to enable consumers to reduce household food waste: 1) information and education strategies, and 2) technological innovations (such as digital tools, refrigeration, containers, and packaging). These strategies seem to implicate a belief that food waste is the direct effect of a lack of knowledge, skills and tools. In spite of current strategies to reduce household food waste, levels have not been reduced sufficiently, neither in a European nor in a Norwegian context. In order to contribute with useful insights on which to build future strategies and interventions on household food waste, I explored current and possible future food-related practices.

In Articles 2 and 3 I illustrate how household food waste in Norwegian households is caused by the complex interplay between everyday practices, and how it is often a result of idealised practices – or put more simply: good intentions. Moreover, I discuss the large number of decisive moments pertaining to the ways in which we plan for and acquire our food, store it, assess its edibility, value it and prepare and find occasions to eat it, that cause food to become superfluous and decay before we have a chance to consume it. I argue that the current strategy of increasing awareness and skills through campaigns and products does not take into account the complexity of the problem, and propose ways to look at it through the lens of practice-oriented design. Furthermore, I propose development of more contextual measures against food waste that target food handling practices when and where they are enacted.

In Article 4 I seek to broaden the temporal scale and expand the way we perceive the solution space and the imaginable pathways towards sustainable food consumption in general by embedding the issue in a design fiction. By inscribing current technological, social, cultural and political trends and trajectories into a fiction of how our food system might be in a not so distant future, we as researchers can make possible futures more tangible to ourselves and potential audiences. In this way, it enables us to see critical issues on both a micro and macro level, and discuss ideas of preferable and non-preferable food futures. I see this method as a vehicle for democratising future visions and discourses on sustainability that could be applied in interdisciplinary projects of research and innovation that include all relevant stakeholders from industry, policy, research, innovation and civil society. I also see it as a way to expand how we as researchers and participants see the issues under investigation beyond the narrow space of incremental improvements of the status quo. Knowing that future visions influence the trajectories of current developments and decision making, it is relevant to explore ways of making these visions more accessible for the public to create, reflect on and criticise.

I identify two routes towards reducing food waste by design which are not mutually exclusive. The first route consists of product-level and product-service-level innovations, such as the ones that can already be seen in packaging, labelling, fridge/freezer technology, apps, box scheme services and online grocery shopping services. The practice-oriented insights provided in this dissertation can contribute to further improvements of products and services on these levels; for instance, by developing more contextual measures and addressing the unintended results of idealised practices through design. The second route entails reimagining and reconfiguring food-related practices more profoundly. This route involves rethinking how we go about provisioning for food, when and where we eat, how and where food is stored, etc.

The research presented in this dissertation has implications for actors working on issues related to sustainable consumption in general and on household food waste and food consumption in particular. It should be of interest to policymakers, non-governmental organisations, various actors in the food industry, and to commercial and public innovators of products and services seeking to contribute to sustainable consumption. Furthermore, implications can be derived from the theoretical underpinning of practice-oriented design for sustainability for current and future ways of addressing sustainable consumption issues by design. By making explicit the elements which practices entail and how they cause inertia and represent opportunities for change, I argue that social practice theory provides a framework for increasing understanding and unpacking the complexity inherent in the role of practices in wicked design problems. I

further argue that providing these insights enables us to approach the design problem in both incremental and radical ways, moving from ideas of product/service-user interactions to ideas of new ways of living.

SAMMENDRAG (SUMMARY IN NORWEGIAN)

Denne avhandlingen utvikler en praksisorientert design for bærekraft (Practice-oriented design for sustainability - PODS) -tilnærming for å utforske potensialet for å redusere matsvinn fra husholdningene gjennom design. Tilnærmingen har produsert narrativer om matrelaterte praksiser slik de er i dag og slik de kan bli i fremtiden. Fortellingene som har blitt skapt sammen med informanter og medforskere, har bidratt til å identifisere muligheter for å redusere matsvinn gjennom design. De gir innsikt i hvordan matsvinn oppstår i hverdagen, og hvordan matsvinn er et resultat av mange ulike praksiser og ofte av motstridende idealer. På bakgrunn av innsiktene fra forskningen presentert i denne avhandlingen, foreslår jeg ulike måter designfaget kan bidra til å redusere matsvinn, ikke kun gjennom inkrementelle innovasjoner på produkt- og tjenestesiden, men også gjennom systemorientert tenkning der det utvikles idéer til nye måter å produsere, anskaffe og spise mat på. Avhandlingen er basert på totalt fire vitenskapelige artikler: tre fagfellevurderte og publiserte artikler, og en innsendt artikkel. Forskningen er utført i Norge.

I artikkel 1, viser jeg at det per i dag er to dominerende strategier for å påvirke forbrukerne til å redusere matsvinn fremmet av myndigheter og kommersielle aktører: 1) kunnskaps- og holdningsstrategier, og 2) teknologisk innovasjon (for eksempel digitale verktøy, kjøle- og oppbevaringsteknologi, emballasje og merking). Disse strategiene ser ut til å forutsette at matsvinn er en direkte effekt av mangel på kunnskap, ferdigheter og verktøy. Til tross for dagens strategier for å redusere forbrukernes matsvinn, har det ikke blitt redusert tilstrekkelig, verken i europeisk eller norsk sammenheng. For å bidra med nyttig kunnskap om hvordan fremtidige strategier og intervensjoner bør utvikles, har jeg utforsket matpraksiser både i et nåtids- og fremtidsperspektiv.

I artiklene 2 og 3 illustrerer jeg hvordan matsvinn i norske husholdninger forårsakes av det komplekse samspillet mellom ulike hverdagspraksiser, og hvordan matsvinn ofte er et resultat av det jeg kaller idealpraksiser - eller forenklet: gode intensjoner. Videre illustrerer jeg de avgjørende øyeblikkene som finner sted når vi planlegger og skaffer oss maten, lagrer den, vurderer dens spiselighet, verdsetter den og tilbereder og finner anledninger til å spise den, og som avgjør om maten blir spist. Jeg argumenterer for at den nåværende strategien for å øke kunnskap, bevissthet og ferdigheter hos forbrukerne gjennom kampanjer og produkter ikke tar hensyn til kompleksiteten i problemet, og foreslår en praksisorientert designtilnærming til matsvinn i husholdningene. Oppsummert foreslår jeg at det bør utvikles mer kontekstuelle tiltak mot matsvinn, som retter seg mot mathåndteringspraksiser der de faktisk skjer.

I artikkel 4 søker jeg å utvide tidsperspektivet vårt for endring, samt måten vi tenker rundt løsningsrommet og mulige veier mot et bærekraftig matforbruk generelt ved å bruke metoden designfiksjon. Ved å skape en fiksjon der teknologiske, sosiale, kulturelle og politiske trender vi ser i dag ekstrapoleres inn i en ikke så fjern fremtid, kan vi forestille oss hvordan matsystemet vårt kan endre seg mer radikalt. Slik kan vi som forskere gjøre mulige fremtider mer håndgripelige for oss selv og potensielle publikum, og skape et rom for å diskutere utfordringer og muligheter knyttet til dagens utvikling og idéer om en bedre og mer bærekraftig fremtid. Jeg argumenterer for at metoden kan brukes som et redskap til å demokratisere fremtidsvisjoner og diskurser om bærekraft. Den gjør det mulig å samle relevante aktører fra industri, politikk, forskning, innovasjon og sivilsamfunn i diskusjoner om bærekraftige fremtidsscenarier i tverrfaglige prosjekter for forskning og innovasjon. Jeg ser den også som en metode for å utvide det som oppfattes som mulighetsrommet for å gjøre matforbruket mer bærekraftig fra det individ- og produktfokuserte (f.eks. holdningskampanjer og kjøleskapsteknologi) til mer systemorienterte (f.eks. vertikalt urbant landbruk, nye systemer for matdistribusjon og nye former og steder for matkonsumpsjon). Når vi vet at fremtidsvisjoner påvirker nåtidens beslutninger og dermed den videre utviklingen, er det relevant å utforske måter å gjøre disse visjonene mer tilgjengelige for publikum, slik at de kan være med på å skape dem, reflektere over dem og kritisere dem.

Oppsummert identifiserer jeg to veier som kan lede mot å redusere matsvinn gjennom design, som ikke er gjensidig utelukkende. Det første sporet leder mot innovasjoner på produktnivå og produkt-tjenestenivå, for eksempel de som allerede kan sees i emballasje, merking, kjøleskap- / fryseteknologi, apper, matkassetjenester og netthandel av dagligvarer. Den praksisorienterte innsikten som formidles i denne avhandlingen kan bidra til ytterligere forbedringer av produkter og tjenester på disse nivåene. Den andre veien jeg identifiserer leder mot å forestille seg hvordan matrelaterte praksiser kan endre seg mer radikalt. Denne veien innebærer å tenke nytt rundt hvordan vi produserer, distribuerer og anskaffer mat, når og hvor vi spiser, hvordan og hvor mat blir lagret, osv.

Forskningen som presenteres i denne avhandlingen har implikasjoner for aktører som arbeider med spørsmål knyttet til bærekraftig forbruk generelt og med matsvinn og matforbruk spesielt. Den bør være av interesse for politiske beslutningstakere, frivillige organisasjoner, ulike aktører i næringsmiddelindustrien og for kommersielle og offentlige innovatører av produkter og tjenester som søker å bidra til et bærekraftig forbruk. Videre demonstrerer den en teoretisk og metodisk tilnærming til problemstillinger knyttet til bærekraftig forbruk gjennom design, som har implikasjoner for bærekrafts-orientert designforskning. Ved å gjøre eksplisitt de elementene som

praksiser består av og hvordan de skaper stabilitet, men samtidig representerer muligheter for endring, argumenterer jeg for at praksisteori gir et rammeverk for å øke forståelsen av kompleksiteten som ligger i rollen praksiser spiller i «wicked (design) problems». Jeg argumenterer videre for at det å frembringe denne innsikten gjør at vi kan tilnærme oss designproblemer på både inkrementelle og radikale måter, ved å gå fra ideer om produkt / tjeneste-brukerinteraksjoner til ideer om nye måter å leve på.

ZUSAMMENFASSUNG (SUMMARY IN GERMAN)

In dieser Dissertation wird ein praxisorientierter Design für Nachhaltigkeit Ansatz (PODS - Practice-oriented design for sustainability) dargestellt, der die Verwendung von Design Fiktion einbezieht, um Möglichkeiten zur Reduzierung von Lebensmittelverschwendung durch Design zu untersuchen. Durch diesen Ansatz wurden Narrative aktueller und möglicher zukünftiger lebensmittelbezogener Praktiken gemeinsam mit den Teilnehmern erstellt, um Möglichkeiten für Designinterventionen zu ermitteln. Die Forschungsergebnisse geben Einblicke, wie Lebensmittelverschwendung im Alltag auftritt, wie sie in ein Netz von miteinander verbundenen Praktiken und widersprüchlichen Idealen verwickelt ist und wie Praktiken künftig durch Design neu konfiguriert werden können. Dadurch können nicht nur inkrementelle Innovationen vorgestellt werden, sondern auch neue Arten des Lebensmittelkonsums. Darüber hinaus wird im Hinblick auf die Verschwendung von Lebensmitteln erläutert was die theoretischen Grundlagen der PODS für aktuelle und zukünftige Methoden bedeuten, um Fragen des nachhaltigen Konsums gezielt anzugehen. Die Dissertation basiert auf insgesamt vier Wissenschaftlichen Artikeln: Drei begutachteten und veröffentlichten Artikeln und einem eingereichten Artikel. Die Forschung wurde in Norwegen durchgeführt.

In Artikel 1 stelle ich dar, dass derzeit zwei vorherrschende Strategien von nationalen Behörden und Industrie gefördert werden, um den Verbrauchern die Reduzierung von Lebensmittelverschwendung im Haushalt zu ermöglichen: 1) Informations- und Aufklärungsstrategien und 2) technologische Innovationen (wie digitale Apps, Kühlung, Behälter, Etiketten und Verpackung). Diese Strategien scheinen die Annahme zu implizieren, dass Lebensmittelverschwendung die direkte Folge eines Mangels an Wissen, Fähigkeiten und Produkte ist. Trotz der derzeitigen Strategien zur Verringerung der Lebensmittelverschwendung in Haushalten wurden die Mengen an verschwendeten Lebensmitteln weder im europäischen noch im norwegischen Kontext ausreichend reduziert. Um nützliche Erkenntnisse für die Entwicklung zukünftiger Strategien und Maßnahmen zur Beseitigung von Lebensmittelverschwendung im Haushalt zu gewinnen, habe ich aktuelle und mögliche zukünftige Praktiken im Zusammenhang mit Lebensmitteln untersucht.

In den Artikeln 2 und 3 werde ich veranschaulichen, wie die Lebensmittelverschwendung in norwegischen Haushalten durch das komplexe Zusammenspiel alltäglicher Praktiken verursacht wird und wie sie oft das Ergebnis idealisierter Praktiken ist - oder einfacher ausgedrückt: gute Absichten. Darüber hinaus diskutiere ich die Vielzahl entscheidender Momente, die damit zusammenhängen, wie wir unsere Lebensmittel erwerben, lagern, ihre Essbarkeit beurteilen, bewerten, zubereiten und Anlässe zum Essen finden, die dazu führen,

dass Lebensmittel überflüssig werden und verderben, bevor wir eine Chance haben, sie zu konsumieren. Ich behaupte, dass die derzeitige Strategie zur Steigerung des Bewusstseins und der Fähigkeiten durch Kampagnen und Produkte die Komplexität des Problems nicht berücksichtigt und schlage vor, es durch die Linse von Design und Soziologische Praxistheorien zu betrachten. Darüber hinaus stelle ich die Entwicklung kontextbezogenerer Maßnahmen gegen Lebensmittelabfälle vor, die auf Praktiken im Umgang mit Lebensmitteln abzielen, und demonstriere wenn und wo sie umgesetzt werden können.

In Artikel 4 erweitere ich die zeitliche Ebene und die Art und Weise, wie wir den Lösungsraum und die vorstellbaren Wege zu einem nachhaltigen Lebensmittelkonsum im Allgemeinen wahrnehmen, zu erweitern, indem ich das Thema in eine Design-Fiktion einbette. Wenn wir aktuelle technologische, soziale, kulturelle und politische Trends und Entwicklungen in eine Fiktion einschreiben, können wir uns vorzustellen wie unser Lebensmittelsystem in nicht allzu ferner Zukunft aussehen könnte. Die Methode mach es möglich für uns als Forscher und dem potenziellen Publikum der Öffentlichkeit eine greifbarere Zukunft zu erstellen. Auf diese Weise können wir kritische Themen sowohl auf Mikro- als auch auf Makroebene erkennen und Ideen für vorzuziehende und nicht vorzuziehende Zukunfte der Lebensmittelproduktion, Distribution und Konsum diskutieren. Ich sehe diese Methode als Instrument zur Demokratisierung von Zukunftsvisionen und Nachhaltigkeitsdiskursen, die in interdisziplinären Forschungs- und Innovationsprojekten eingesetzt werden können, an denen alle relevanten Akteure aus Industrie, Politik, Forschung, Innovation und Zivilgesellschaft beteiligt sind. Ich betrachte es auch als einen Weg, um zu erweitern, wie wir als Forscher und Teilnehmer die untersuchten Themen über den engen Raum der schrittweisen Verbesserung des Status quo hinaus verstehen. Da wir wissen, dass zukünftige Visionen die Entwicklung und Entscheidungsfindung beeinflussen, ist es wichtig, Wege zu erkunden, wie diese Visionen für die Öffentlichkeit zugänglicher gemacht werden können, um öffentliche Reflektion und Kritik zu ermöglichen.

Ich stelle in dieser Dissertation zwei Wege zur Reduzierung von Lebensmittelverschwendung vor, die sich nicht gegenseitig ausschließen. Der erste Weg besteht aus Innovationen der Produktebene und auf der Produkt-Service-Ebene, wie sie bereits in den Bereichen Verpackung, Etikettierung, Kühl- / Gefrierkombinationstechnologie, Apps, Kochboxen und Online-Einkauf von Lebensmitteln zu finden sind. Die praxisorientierten Erkenntnisse dieser Dissertation können dazu beitragen, Produkte und Dienstleistungen auf diesen Ebenen weiter zu verbessern. Dies könnte zum Bespiel durch die Entwicklung kontextbezogenerer Maßnahmen und die Bekämpfung der unbeabsichtigten Ergebnisse idealisierter Praktiken durch Design erfolgen. Die zweite Möglichkeit besteht darin, die Ernährungspraktiken gründlicher neu zu definieren und zu

gestalten. Dieser Weg betrifft wie wir für Lebensmittel sorgen, wann und wo wir essen, wie und wo Lebensmittel gelagert werden usw.

Die in dieser Dissertation vorgestellte Forschung hat Auswirkungen auf Akteure, die sich mit Fragen des nachhaltigen Konsums im Allgemeinen und mit Haushaltsnahrungsmittelabfällen und dem Lebensmittelkonsum im Besonderen befassen. Sie sollte für politische Entscheidungsträger, Nichtregierungsorganisationen, verschiedene Akteure der Lebensmittelindustrie sowie für kommerzielle und öffentliche Innovatoren von Produkten und Dienstleistungen von Interesse sein, die zu einem nachhaltigen Konsum beitragen möchten. Darüber hinaus lassen sich Implikationen aus der theoretischen Untermauerung des praxisorientierten Design für Nachhaltigkeit -Ansatzes für aktuelle und zukünftige Wege ableiten, um Fragen des nachhaltigen Verbrauchs gezielt anzugehen. Indem ich die Elemente, die Praktiken mit sich bringen, explizit mache und darstelle, wie sie gleichzeitig Trägheit verursachen und Möglichkeiten für Veränderungen darstellen, argumentiere ich, dass die Praxistheorie einen Rahmen für ein besseres Verständnis und ein besseres Auspacken der Komplexität bietet, die der Rolle von Praktiken bei „wicked design problems“ innewohnt. Ich behaupte weiter, dass es uns durch die Bereitstellung dieser Erkenntnisse möglich ist, das Designproblem sowohl inkrementell als auch radikal anzugehen und von den Ideen der Interaktionen zwischen Produkt und Service-Benutzer zu den Ideen neuer Lebensweisen überzugehen.

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1 INTRODUCTION

Much of what we perceive as mundane everyday activities, routines and goals is increasingly connected to the growing environmental challenges we face today. Our everyday lives are in fact intertwined with these challenges in ways that are difficult to untangle and that contribute to what has been termed ′wicked problems′ (Buchanan, 1992; Rittel & Webber, 1973). Food waste is one such wicked problem. About one third of the food produced in the world is never eaten. In Western countries, about half of this waste comes from households. This dissertation approaches the issue of household food waste by framing it as a practice-oriented design problem, with the aim of unpacking not only the practices that lead to food waste, but also ways in which they might be modified by design. In this way, I seek to explore new ways of thinking about interventions and more sustainable food futures.

More specifically, the dissertation demonstrates a practice-oriented design for sustainability (PODS) approach to the problem of household food waste aimed at bringing to light new ways of seeing possible future pathways for food waste reduction. Furthermore, in light of the food waste case, it reflects on what the theoretical underpinnings of PODS mean for current and future ways of addressing sustainable consumption issues by design. The concept of PODS represents an approach to design for sustainability that draws on sociological theories of practices; that is, seeing practices rather than individuals as the smallest unit of analysis. Including design fiction contributes to expanding the solution space, the temporal scale and the way we think about sustainable food futures by making possible futures tangible and open to debate and criticism. This dissertation demonstrates how the approach can help identify barriers to and opportunities for sustainability by design, imagining not only incremental innovations but also new ways of living. By deep diving into the case of food waste in Norwegian households, I explore food-related practices, their impact on food waste levels, and possible future pathways for food waste reduction. Based on an extensive review of existing literature and on fieldwork in Norwegian households, I find that Norway is a representative case for household food waste in Europe, as both quantitative and qualitative research findings here align with findings in other European countries. I also find a need to expand the solution space for food waste reduction.

Household food waste in Europe is a young research area dominated by two strands of research that differ significantly in terms of methodological and theoretical approach and focus: 1) quantitative studies of self-reported accounts of food waste amounts and drivers analysed through theories of behaviour (i.e.

Aramyan et al., 2016; Canali et al., 2017; Vittuari et al., 2016) and 2) qualitative studies of food waste practices analysed through theories of practice (i.e. Evans, 2014; Mavrakis, 2014; Southerton & Yates, 2014; Watson & Meah, 2012). Both strands of research aim, to varying degrees, to make policy recommendations for measures that could reduce household food waste. However, the first strand of research seems to have the most impact on actual policies and initiatives. These are largely information-based campaigns seeking to increase awareness about the issue and to educate consumers in how to interpret date labelling, assess the edibility of food, and in how to store, portion and plan meals and purchases. No significant effect of these campaigns on food waste levels has been proven. While the first strand seems to focus on individuals and their capacity to improve their skills, performances and attitudes, the second strand seeks to unpack the complexity of how practices interrelate and incorporate material, meaning and competence, finding that they are not so easily modified to achieve food waste reduction. Thus, these insights seem not as easily translatable into concrete policy recommendations and design interventions, perhaps because looking at household food waste through the lens of social practice theory creates a complexity that can only be addressed through a multitude of measures and interventions and cannot be compiled into one approach. During the initial phase of the project, it thus became clear to me that no single design solution would be able to play a role significant enough to reduce household food waste in the context of current practices. Instead, I saw potential in unpacking a multitude of contexts and moments of reflection inherent in everyday life from a PODS perspective in order to illuminate promising intervention points for design and possible future pathways towards sustainable food consumption. Consequently, the research gap this dissertation aims to contribute to fill pertains to the lack of empirically informed suggestions for interventions that could induce food waste reduction by design.

1.1 Aims and research questions

The aim of this research is to explore the problem of household food waste through the lens of social practice theory and from a design perspective in order to illuminate future pathways for reducing this waste by design. The following four research questions were pursued in the form of one main research question (MRQ) with three sub research questions (SRQs):

MRQ: How can a practice-oriented design for sustainability approach contribute to new insights about how food waste can be reduced by design?

In order to answer the main research question, three sub research questions were defined:

- SRQ1: How do social practices influence household food waste?
- SRQ2: What current products, services and systems aim to reduce food waste in households?
- SRQ3: What future pathways towards reducing household food waste by design can be identified from a social practice perspective?

1.2 Scope

The aim of this research has been to explore practices causing food waste in households, and potential intervention points for design through the concept of PODS. A further aim has been to apply the method of design fiction to open up the solution space and temporal scope in order to explore possible preferable and non-preferable future trajectories of change extrapolated from current technological and socio-cultural trajectories. The fieldwork in households was conducted in Oslo, Norway, and the design workshops were conducted in Oslo, Kjeller and Trondheim in Norway. Thus, even though the results align with similar research in other European countries, they are limited to a Norwegian context. The dissertation has investigated food wasted in households only, not on food wasted in other parts of the value chain. Emphasis has been placed on the practices that lead to food waste and on potential intervention points for design, and not on quantifying or describing the content of the waste itself. The work aims to generate insights and ideas, not final design solutions. Furthermore, it takes a future-oriented perspective leaving historical accounts of food waste outside of the scope.

1.3 Dissertation outline

Chapter 1 introduces the research objectives and research questions. Chapter 2 presents the thematic, theoretical and methodological background for the project. Chapter 3 describes the research design, including the theoretical positioning and methods applied. Chapter 4 summarises the four scientific articles and their findings. Chapter 5 revisits the research questions, discusses the overall contribution and implications of the project, and makes recommendations for further research. The table below shows an overview of the four articles included in this dissertation.

Table 1: Overview of the four articles included in this dissertation

	Articles
1	*Household food waste: Drivers and potential intervention points for design – An extensive review*, Marie Hebrok & Casper Boks, 2017, *Journal of Cleaner Production*, vol. 151, pp. 380–392.
2	*Food waste in the shadow of ideals: A case for practice-oriented design*, Marie Hebrok, 2018, *Journal of Design Research*, Vol. 16, Nos. ¾.
3	*Contextualising food waste prevention: Decisive moments within everyday practices*, Marie Hebrok & Nina Heidenstrøm, 2019, *Journal of Cleaner Production*, Vol. 210. Pp. 1435-1448.
4	*Bird: Design fiction and the futures of food consumption*, Marie Hebrok & Henry Mainsah, submitted January 2020.

2 BACKGROUND

This chapter presents the thematic, theoretical and methodological background for this dissertation. Starting with an introduction to food waste as a major societal problem, moving on to the theoretical and methodological resources the work presented in this dissertation builds on.

2.1 Thematic background

Food waste is a significant environmental and ethical problem that has gained increasing attention across Europe during the past decade. Research has revealed that about one third of the food produced in the world is never eaten (FAO, 2011). The food sector is a major contributor to climate change, accounting for about 25–30 per cent of global emissions, and food waste represents as much as 8 per cent (FAO, 2015). IPCC's most recent report on climate change and land emphasises the importance of reducing food waste and over-consumption of food as food security is increasingly threatened (IPCC, 2019). In developing countries, most of the waste occurs during production, while in Western countries about half of the food waste comes from households (FAO, 2011). The revised EU Waste Framework Directive recently introduced new legislation that sets an EU-wide target of a 50-per-cent reduction in food waste, in line with the Sustainable Development Goals (SDGs) of the United Nations (European Commission, 2018). Considerable efforts are made throughout the food value chain to reduce household food waste in affluent countries. Nevertheless, influencing consumer practices remains a major challenge, and political measures directed at consumers are scarce and consist mostly of awareness campaigns. This measure seems insufficient for addressing the complex picture of how structural, material and socio-cultural aspects of food-related practices are resulting in a massive amount of food going to waste at the consumer level, as shown by research from a multitude of angles conducted by a number of different disciplines (Aschemann-Witzel, de Hooge, Amani, Bech-Larsen, & Oostindjer, 2015; Evans, 2014; Foden, Browne, Evans, Sharp, & Watson, 2017; Mavrakis, 2014; Southerton & Yates, 2014; Stensgård & Hanssen, 2016; Watson & Meah, 2012). In the following section I will provide a brief account of the food waste issue in Europe in general and in Norway in particular.

2.1.1 Food waste in Europe

In Europe, an estimated total of 88 million tons of food (including inedible parts) is wasted (Stenmarck, Jensen, Quested, & Moates, 2016). As shown on the figure on the right, about half of the food waste comes from households. However, all estimates carry a rather high degree of uncertainty due to the lack of uniformity in defining food waste and gathering data across European countries. Development of a coherent approach to defining food waste and collecting data across European countries has been the aim of the EU-funded research project FUSIONS (Food Use for Social Innovation by Optimising Waste Prevention Strategies, 2012–2016). The project has also explored the feasibility of social innovations to reduce food waste (Vittuari et al., 2016).

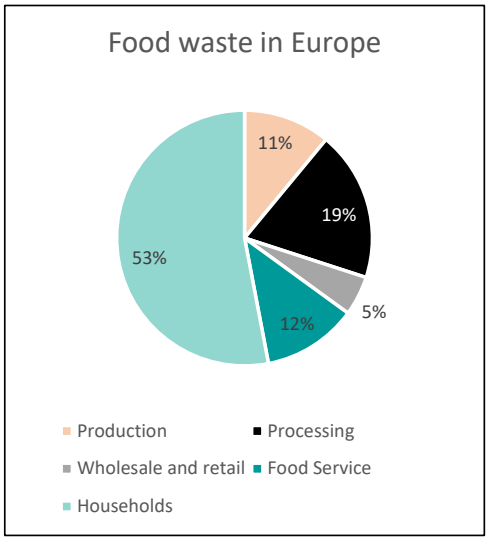

Figure 1: Food waste in Europe. Source: Stenmarck et al., 2016.

According to FUSIONS, *'Food waste is any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea)'* (Stenmarck et al., 2016).

The second major food waste project funded by the EU, Re:Fresh, builds on the results from FUSIONS. Re:Fresh 2015–2019 (EU Horizon 2020) is a solution and action-oriented project on food waste aimed at developing strategic agreements with governments, businesses and local stakeholders, formulating EU policy recommendations, and designing and developing technological innovations (eu-refresh.org, 2020). In response to the UN Sustainable Development Goal (SDG) of halving food waste by 2013, the European Commission has also established a multi-stakeholder platform on food losses and food waste (European Commission, 2019). Participants are currently working on collecting information on food waste initiatives and best practice in order to draft recommendations and proposals for action and implementation of food waste prevention measures. The food waste issue is also addressed in the revised EU waste legislation (EUR-Lex, 2018) and in the EU action plan for the circular economy (European Commission, 2015).

According to Welch et al. (2017), the action plan frames consumption within an individualised behaviour model of social action which largely ignores the role of the use phase of products, the domestic sphere, and social practices. This framing of consumption has direct impact on the kind of measures that are being recommended and applied to combat the food waste problem.

Whilst the food industry and food service sector can reduce food waste by improving logistics and other systems, and are financially motivated to do so, households represent a more complex challenge to policymakers. Regulating what people do in the privacy of their own homes is difficult without imposing radical restrictions on liberty. As a result, the recommendations and actions made in most research projects and other initiatives directed at household food waste are related to increasing awareness to induce behavioural change. Thus, the results from the two research projects FUSIONS and Re:Fresh and the documents produced by the bodies of the European Commission mentioned above both place emphasis on targeting consumers through awareness campaigns and date labelling as means to change consumer behaviour regarding food waste.

2.1.2 Food waste in Norway

Similar results and dynamics can be observed in Norway. Here, coordinated research on food waste quantities along the value chain commenced in 2010 with the ForMat project. Four sectors were mapped: industry, wholesale, retail and household. Remaining sectors include primary production, the service industry and public procurement, which are now targeted by Matvett AS. The service industry is currently developing a system to measure and reduce food waste, and central actors have signed an agreement drafted by Matvett AS. As estimated in other European countries and shown in figure 2, about half of the food waste comes from households (Stensgård, Prestrud, Hanssen, & Callewaert, 2018). The final ForMat report revealed that (leaving out the missing sectors) consumers contribute to 58 per cent of the food wasted in Norway. According to Stensgård and Hanssen (2016), food waste in Norway

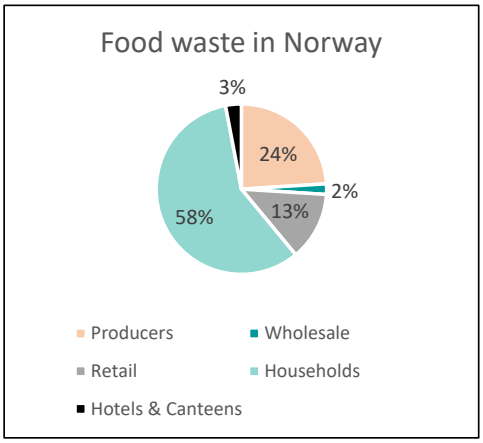

Figure 2: Food waste in Norway in percentage of tons. Source: Stensgård et al., 2018.

represents an economic loss of about NOK 20 billion annually and emissions of about 978,000 tons of CO_2 equivalents. This means that a Norwegian household could make a potential annual saving of approximately NOK 5,800 through not wasting food. However, the definition of food waste in the ForMat project deviates from the one proposed by the EU project FUSIONS. According to ForMat: *'Food waste includes all useful parts of food produced for humans, that are either wasted or removed from the food chain for purposes other than human consumption, at the time when animals and plants are slaughtered or harvested'* (Stenmarck et al., 2016). Unlike the FUSIONS definition, the Norwegian definition excludes food that is downgraded to animal feed and parts considered inedible (such as skin and bones). In this dissertation I define food waste according to the ForMat definition.

A number of campaigns to reduce food waste throughout the food system are running across Europe, such as WRAP in the United Kingdom, a registered charity and major player conducting research and communicating with the public, industry and policymakers, and *Stop Spild av Mad* in Denmark, which was founded by food waste activist Selina Juul to influence stakeholders throughout the food system to reduce waste. In Norway, Matvett AS serves as a campaign to reduce food waste, but is in fact a company funded by the food industry to fight food waste throughout the value chain. Matvett has launched a website for consumers providing information and tips on how to store various fresh foods, how to use leftovers in new dishes, and how to avoid food waste in general. In 2018 Matvett launched a video campaign on social media, showing add-like video clips of typical food-related activities where the actors threw away one third of the food they had bought or prepared, illustrating how one third of the food produced globally is wasted.

In the retail industry, food waste reduction is clearly in the retailer's own interest and need not be motivated by environmental concerns. Matvett AS has therefore proved highly successful in pushing retail efforts to reduce waste. In addition to reducing in-store waste, retailers have also been persuaded to contribute to reducing household food waste. Examples of such efforts are stopping the use of three-for-two deals after research showed that they led to food waste in households, and running food waste campaigns to encourage consumers to waste less food at home. For instance, the Norwegian retail chain Kiwi launched a campaign in which it provided its customers with recipes for using leftovers in new dishes. It also launched a series of small-size bread products. REMA 1000 launched a new delivery concept, delivering fresh bread twice daily instead of once to ensure maximum freshness for the consumer. However, the actual effect on food waste has not been measured, and no significant reduction in household food waste has been documented.

Norwegian NGOs are also joining the fight against food waste among many other sustainability issues, for instance by running their own research projects, such as the MatVinn project by the environmental organisation The Future in Our Hands, which recruited several families to participate by implementing food waste reduction strategies in their everyday lives and, more importantly, by communicating the results from the project. Oher research projects have focused on food waste in various ways in Norway, such as ReForRem and Breadpack (packaging), and COSUS (sustainable food consumption). In parallel and in collaboration with the ForMat project, a major project entitled Prevention of food waste in a value chain approach, financed by the Research Council of Norway, was conducted. The project included an anthropological study of food waste drivers in Norwegian households by SIFO-researcher at the time Tommy Ose (Ose, 2018), who concluded that food waste is caused by an array of different aspects related to both macro- and micro-level socio-technical and cultural developments.

2.2 Theoretical and methodological background

This project is inspired by previous contributions drawing on social practice theories to explore how food becomes waste in households (see: Cappellini & Parsons, 2012; Evans, 2014; Ganglbauer, Fitzpatrick, & Comber, 2013; Mavrakis, 2014; Southerton & Yates, 2014; Watson & Meah, 2012) and by the work of scholars using practice theory to inform design for sustainability research projects (i.e. Hielscher, Fisher, & Cooper, 2009; Kuijer, 2014; Kuijer & Bakker, 2015; Kuijer & Jong, 2009; Kuijer & Jong, 2012; Matsuhashi, Kuijer, & Jong, 2009; Pettersen, 2013, 2015; Pettersen, Boks, & Tukker, 2013; Scott, Bakker, & Quist, 2012; Scott, Quist, & Bakker, 2009). More specifically, the theoretical and methodological background informing the work presented in this dissertation draws on the adaptation of practice theory as applied in sociology of consumption to design for sustainability purposes, in particular the concept of PODS (Pettersen, 2015). Furthermore, and in line with recent contribution by Clear and Comber (2017), I draw on a speculative design method, design fiction, to make possible futures tangible and to facilitate critical discussion and action.

The concept of design has become increasingly complex. Perhaps the most cited definition is that put forward by Herbert Simon, who claimed quite broadly that 'everyone designs who devises courses of action aimed at changing existing situations into preferred ones' (Simon, 1996:55). The performances and manifestations of consumption and design are very much intertwined, and of great significance to how our everyday lives are enacted. How a product, service or system is designed influences of course how it is consumed; and since consumption

can be seen as a moment in every practice (Warde, 2005), design also influences how we go about our everyday lives. Connected to the rise of the concept of design thinking as a methodological toolbox for designers, innovators and a growing number of disciplines, practising designers are increasingly seeking to 'empathise' more deeply with consumers in order to develop products and services that cater to their needs and desires (Brown, 2009). Moreover, both design researchers and practitioners are currently exploring ways to apply design methods to resolve larger societal problems, such as those related to sustainable consumption. Traditionally, design has been perceived as a problem-solving service activity, connected to the needs of consumers and industry. However, as a field of practice and a field of research, design has developed significantly in recent decades and is increasingly working to contribute to the analysis of contemporary societal challenges far beyond the single product or service. The role of design in distributing, mediating and reproducing culture (Balsamo, 2011), in creating insights through future visions (Lindley & Coulton, 2015), and in functioning as a vehicle for socio-technical change (Pettersen, 2013) is increasingly being explored and utilised in academia, business and policy. It seems that in a world of ever increasing complexity brought about by the pace of technological development and social and economic change, design is becoming increasingly relevant in its diverse forms, as illustrated by the expanding use of design thinking across sectors and particularly in connection with imagining and creating transitions towards sustainability.

2.2.1 Design for sustainability

As a discipline, design has branched out into numerous fields of specialisation, such as industrial design, graphic design, service design, interaction design, systems design, information design, process design, speculative design, human computer interaction, architecture and engineering. In recent decades, design scholars in various subdisciplines have engaged in the development of design theory and methodology to explore possible solutions to complex problems related to sustainability. Initially lacking in theoretical and methodological resources to approach the entangled aspects of large unsustainable systems, the inherently future-creating character of design is now making the field increasingly relevant as a vehicle for change. Thus, design scholars are increasingly looking to incorporate resources from sociology of consumption, behavioural psychology, science and technology studies, fiction and art in design processes and research in order to develop productive approaches to design for sustainability. This interest in other fields has spurred the development of new methods, techniques and strategies. Central relevant contributions include design for sustainable behaviour, drawing

on social psychology (see Laitala & C.Boks, 2012; Rodriguez & Boks, 2005; Wever, Kuijk, & Boks, 2008; Zachrisson & Boks, 2014); practice-oriented design, drawing on sociology (i.e. de Jong & Mazé, 2017; Kuijer, 2014; Pettersen, 2015; Scott et al., 2009); and transition design, drawing on multiple perspectives (Ceschin & Gaziulusoy, 2016; Irwin, 2015). One common denominator in these approaches to design for sustainability is that they are all occupied with designing interventions that should serve as triggers for sustainability. The proposition is that by intervening in strategic places of unsustainable systems, larger changes might be induced. A prerequisite for developing these strategic interventions is a deeper understanding of the relationships between socio-cultural aspects of the human condition and of its material infrastructure of products, architecture, technologies and systems.

According to Ceschin and Gaziulusoy (2016), the field of design for sustainability (DfS) emerged in the 1990s, and was initially considered to be an aspect of design pertaining to material, production methods, repairability and recycling, often referred to as green design. In the following decade, eco design, a nature-inspired approach to product development based on biomimicry approaches, life cycle assessment methods and cradle-to-cradle design (McDonough & Braungart, 2002) dominated practice and discourse on sustainable design, providing tools to accomplish more sustainable products. Green design and eco design represent a production-oriented approach to sustainability through design. Since then, attention has been increasingly directed at what has been called human-centred or user-centred design, and at the potential of social innovation and system innovation in creating a more sustainable society. Ceschin and Gaziulusoy (2016) define four levels of innovation that have emerged during this evolution: 1) the product level – design and redesign of products; 2) the product-service level – design and redesign of product-service systems and business models; 3) the spatio-social level – social innovation on the scale of neighbourhoods and cities; and 4) the socio-technical level – radical change and transition towards new socio-technical systems on a societal scale. They argue that sustainability gains increase with each level. However, they see the levels to be mutually inclusive, addressing different parts of a whole. For instance, although approaches on the product level, such as green design or eco design, cannot reduce environmental impact on a large enough scale alone, these approaches are important to achieving the objectives of the socio-technical systems level.

Human-focused methods such as user-centred design, participatory design and co-design (Sanders & Stappers, 2008) share an inclusive approach to design, where users participate in the design process to ensure that the result is adapted to user needs. This interest in the user has also increased the amount of inquiry into the use phase of products and into its environmental impact. For energy-

demanding products, such as washing machines, refrigerators and other household appliances, the largest environmental impact occurs during use, not during production or distribution. Thus, during the past decade design researchers have increasingly paid attention to the role of design in everyday life, and to the potential of design for supporting more sustainable lifestyles. Two strands of research have emerged that focus on sustainable behaviour and sustainable practices. The first strand is based on theories of behavioural psychology, whilst the second strand has emerged from applying sociological practice theory to design. Although, both strands aim at creating changes in how people go about their everyday lives, there are clear differences between the two approaches to design for sustainability.

Design for sustainable behaviour (DfSB) represents a product-user-oriented approach to behavioural change. The aim of the approach is to influence users to use a particular product in the most sustainable way or to use product design to influence people to behave in a certain way. For instance, by redesigning key features of a wood burning stove to enable correct use and reduce emissions (Daae, Goile, Seljeskog, & Boks, 2016), by redesigning the fridge to reduce energy use (Tang & Bhamra, 2012) or by making energy use visible by using cords that light up when used (de Jong & Mazé, 2017). DfSB strategies can be used along a spectrum of degrees of force (Lilley, 2009). At one end of the spectrum there is no force, the user is in complete control; at the other end of the spectrum the product is in total control, for instance through automation. Between these two extremes there are various persuasive strategies that can be applied.

Although the approach provides concrete tools for designers that are easy to implement in design processes and that may very well be effective in making product use more effective and sustainable, it largely ignores the wider socio-structural context in which products are used (Kuijer, 2014; Pettersen et al., 2013). According to Kuijer (2014), there are important risks of failure associated with strongly normative conceptualisations of right and wrong behaviours, and with the vulnerability to rebound effects. For example, when consumers use the savings provided by DfSB to increase consumption of other products. Thus, it seems to be more appropriate to try to achieve incremental rather than large-scale innovation and system changes. This is a limitation which the emerging strand of PODS seeks to compensate for by applying a more holistic contextual approach, examining the practices of everyday life and the meaning, competence and material they consist of. PODS draws on sociological practice theory, and is an approach that sees design as enabling and shaping practices, and as being shaped by practices in return, meaning that the relationship between design and practices is mutually

constitutive. Moreover, design is seen to play a decisive role in socio-cultural transitions towards a sustainable society.

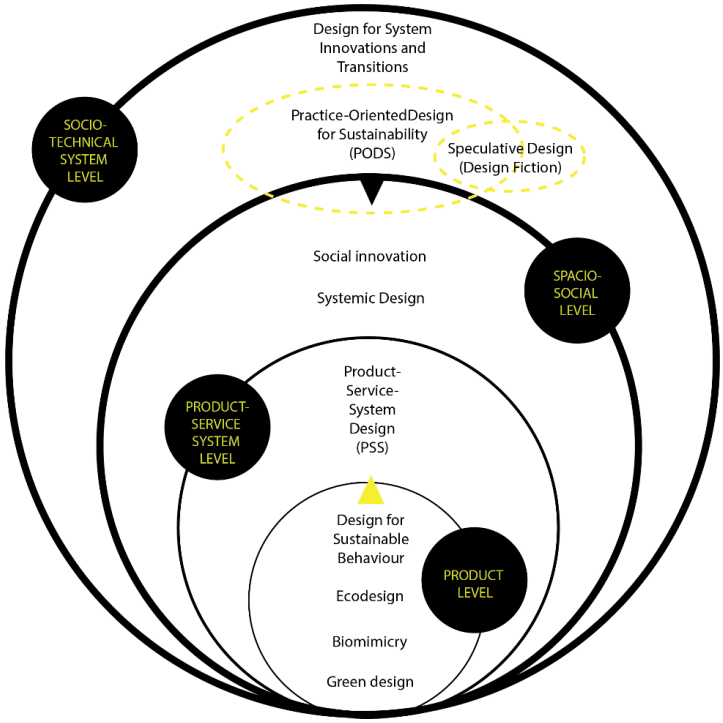

Figure 3: DfS approaches and innovation levels adapted from Ceschin & Gaziulusoy, 2016:144.

The above figure shows how the four levels of innovation introduced earlier incorporate each other, and how each level becomes increasingly system oriented. It also shows how some of the main approaches to design for sustainability can be seen to belong to different levels of innovation. I argue that PODS represents an approach that can incorporate all four levels of innovation by providing the necessary insights and framings to approach complex problems. Furthermore, I argue that incorporating speculative design as a means to explore future possible practices provides the approach with tools to democratise and make tangible the discussion and critique of preferable and non-preferable trajectories towards sustainable futures. The following sections will elaborate on the concept of PODS and speculative design.

2.2.2 Practice oriented design for sustainability

Practice-oriented design for sustainability (PODS) is a concept that has emerged from a cross-fertilisation of social practice theories applied to consumption studies and design for sustainability. A basic assumption in practice theory is that practices

are reconfigured if elements change, disappear and/or are replaced. This reconfiguration can entail a significant change in how certain ways of doing are enacted and in what material, meaning and skills are involved. In PODS, the designer takes the role of actively redesigning elements of a practice, creating new links between elements and breaking links between others, in order to actively induce change. The concept originates in the notion of practice-oriented product design (POPD), which was first suggested by sociologist Elizabeth Shove et al. in the book *The Design of Everyday Life* (Shove, Watson, Hand, & Ingram, 2007), which was a result of the research programme Designing and Consuming: Objects, Practices and Processes (2005–2006). The essence of the approach is enshrined in the POPD Manifesto (POPD, 2006) as eight tenets: 1) POPD holds that practices are the basic unit of society; 2) POPD knows we are all PODers (practice-oriented designers) ; 3) POPD goes beyond the verbal; 4) POPD realises that no object is an island; 5) POPD understands that history matters!; 6) POPD recognises that needs are made; 7) POPD assumes the relationality of value; and 8) POPD never ends!

Practice theory is not considered a unified theory, rather it is seen as loosely connected theories of practice that have evolved from the works of icons within sociology such as Pierre Bourdieu (1977) and Anthony Giddens (1984), and later applied and adapted in various ways by a number of central scholars such as Schatzki (1996), Reckwitz (2002), Warde (2005), Shove, Pantzar and Watson (2012) and Nicoloni (2013). What all contributors share is the dismissal of utilitarian theories explaining human action as a result of rational individual choices. Furthermore, they reject the dual relationship between structures and agents as developing separately, positing that these entities are mutually constitutive (Nicolini, 2013; Shove et al., 2012). The core of social practice theories is seeing practices as the smallest unit of analysis, consisting of a set of elements which, in the account of Shove et al. (2012), are: *competence, meaning* and *material*. Competence refers to 'forms of understanding and practical knowledgeability', meaning refers to 'the social and symbolic significance of participation at any one moment', and material refers to 'objects, infrastructures, tools, hardware and the body itself' (Shove et al., 2012:23). The links between the various elements are as important as the elements themselves.

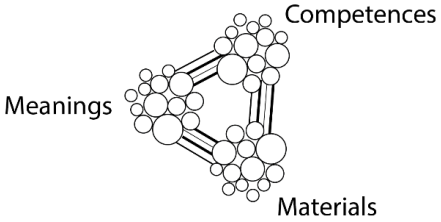

Figure 4: Model of a social practice.

Figure 4 shows a model of a practice as it has been adjusted by design researcher Kuijer (2014) (to whom I will return), in order to illustrate its complexity and make it fit better with design-oriented projects. According to Shove et al., it is

the making and breaking of links that constitute a practice and how it emerges, develops and perhaps ultimately disappears over time. Clear and Comber argue that efforts to design for sustainability should focus on 'designing for the making and breaking of linkages between elements of practice' (Clear & Comber, 2017).

Taking practices as the smallest unit of analysis rather than individual behaviour, product design or product-user interaction not only structures the analysis of empirical data, it also structures the framing of research questions and design problems (Nicolini, 2013; Shove et al., 2012). From this perspective the target of interest moves away from individual intentions and actions towards 'a collection of materials, competences and meanings that come together and are reproduced in socially meaningful ways through the performance of activities' (Clear & Comber, 2017:2). The objective of Shove et al. (2012) is to study how practices emerge, stabilise, change and disappear over time. In PODS this timeline extends to the future, and the previous trajectory of practices is studied as a means of understanding and inspiration. The approach was proposed as a way of departing from product-centred and user-centred design in order to harness the potential of design in influencing practices as they evolve and change over time. The concept of PODS opposes previous assumptions that design meets already existing needs and embeds value in products themselves.

Although theories of user-centred design acknowledge that the perception of value is contextual and not an inherent quality of the product, PODS goes a step further in arguing that 'material artefacts themselves configure the needs and practices of those who use them' (Shove et al., 2007:136). In PODS, products are seen to exist in order to enable practices (Scott et al., 2009). How and where the value of products is to be observed is a central issue to design theory. From a product-centric perspective, value is seen as something the designer embeds in the product, whereas in user-centred design value is seen to emerge in the product-user interaction. In PODS, the value of a product depends on its role within everyday practices, such as its capacity to enable and facilitate everyday activities and pursuits, and its significance for a larger ecology of practices and socio-technical systems. 'Whereas the conventional design process focuses on products and services as the final outcome, a practice-orientation redefines the role of products and services as means to another end' (Scott et al., 2012:284). Thus, innovation in products and practices are interlinked and mutually constitutive. For design scholars working within the fragmented field of design for sustainability, this is considered a major opportunity to make design play an active part in inducing more sustainable practices.

2.2.2.1 Applying practice-oriented design methodologically

Since the concept of POPD was first suggested in 2007, several design scholars have attempted to operationalise it in their research projects (Comber, Hoonhout, Halteren, Moynihan, & Olivier, 2013; Ganglbauer et al., 2013; Hielscher et al., 2009; Kuijer, 2014; Kuijer & Jong, 2012; Pettersen, 2015; Scott et al., 2009). However, it is still quite a young research field, with contributors who are working to find proper methodological tools to grasp how practices and design are connected, and how to induce change by deconstruction and reconstruction. This section will discuss some of the main contributions.

Design scholar Lenneke Kuijer, who was involved in the abovementioned research programme led by sociologist Elizabeth Shove, observed that POPD offered designers a novel, profound and well described analytical approach to induce change through design (Kuijer, 2014). However, she found it to lack concrete and applicable tools and methods that could be applied in a design process. It needed to be operationalised to be useful to the design community. In collaboration with de Jong (2012), she developed the 'trigger product' approach, which is a research method incorporating a prototype of a product that functions as a trigger for changing practice. The product was introduced to a number of recruited participants in a living lab experiment, who were encouraged to experiment with its use in the mundane everyday practice of bathing. Participants were introduced to the prototype in a living lab setting to reduce the influence of existing structural and social limitations. Furthermore, all the participants were improvisation actors, recruited for their assumed ability not only to improvise but also to free themselves from what is considered to be 'normal' ways of doing and to imagine things that are not there. The bodily performance of a practice is central to future development of the prototype. Thus, the participants were asked to perform bathing as ′splashing′ from a basin, as if this were the normal and preferable way to achieve cleanliness. These improvised performances of bathing, labelled generative improv performances (GIP), were recorded and later synthesised and described as a *proto practice*. The result was a detailed account of sequences of performances and their variations. Furthermore, much could be learned about potential elements causing resistance. As the authors themselves point out, there are several limitations to the approach pertaining to the living lab setting of the experiment, and and to isolating one practice from other interconnected practices. However, they emphasise that the aim of the method was to generate a starting point for further exploration and development. Consequently, the authors do not engage in or position the proto practice in relation to other related practices, nor the wider socio-technical context it would have to be submerged in.

Scott et al. develop a hybrid approach, and use the same case of bathing as a practice in their study (Scott et al., 2012; Scott et al., 2009). In essence, they take a practice-oriented approach to co-design, starting with a focus group session with their participants, prompting them to reflect on and analyse their current bathing practice, and followed by at-home experiments conducted and choreographed by the participants themselves. The participants were asked to find ways of changing their bathing practice to reduce the environmental impact or simply make it more effective. Most participants chose to focus on the former. Methodologically, the approach draws on the distinction made by Giddens (1984) of practical and discursive consciousness. These are reflected in the two stages of reflexion and experimentation included in the method applied in the study. The methodology proposed by Scott et al. starts with the deconstruction of the targeted practice in collaboration with recruited participants, possibly setting goals for resource use reduction or other sustainability issues. The purpose is then to deviate from this practice as it is and design for change. The design is then integrated into the everyday life setting of the practice and experimented with. Based on the evaluated success of the practice-product prototype, it can be circulated within a wider group of people in order to expand the degree of experimentation and learn more about potentials and barriers. In line with more traditional design methodology, this process is iterative, meaning that contrary to a linear process from start to finish, there is a repetitive movement back and forth between deconstruction, deviation, design, integration and evaluation. Data collection techniques included workbooks, group sessions, a blog, probes, context mapping, sensitising tools, and generative sessions. Although the participants produced design concepts at the end of the project, these were not published, so no account exists of specific designs, prototypes or proto practices. Perhaps this is because the aim of the study was mainly to develop a methodology rather than come up with new bathing practices.

Another project facilitating experimentation with practices is Static!, in which de Jong and Maze (2017) develop prototypes that are implemented in households to create disruption in existing practices related to energy use. A number of everyday domestic products are redesigned with an emphasis on making energy visible and tangible. The radio, Static! Erratic, reacts to excessive energy use by going out of tune, and a curtain collects energy from the sun during the day that can be used at night. Both designs are meant to increase awareness amongst consumers of how much energy they use, and to reconfigure practices causing excessive energy use. De Jong and Maze found that these disruptive prototypes led participants to experiment with their energy use and to rearrange whole assemblies of other material things in their homes in order to adjust to the

impact of the prototypes. Within the same project, Ernevi et al. (2007) explore a critical design approach to energy consumption by designing products to act differently according to their use. In this way, the energy consumption becomes visible through the way the products perform.

Food waste has been addressed in similar ways by design scholars (see: Ganglbauer et al., 2013; Kera & Sulaiman, 2014; Lim, 2017; Thieme et al., 2012). More precisely, these scholars have investigated how technology intervention may contribute to change by drawing not solely on practice theory (Ganglbauer et al., 2013), but also on the theory of planned behaviour (Thieme et al., 2012) and on science and technology studies (Kera & Sulaiman, 2014). By developing technology probes and experimenting with them in real-life settings, such as in households or social networks, they explore the nature of food consumption and waste and the role of technology. Ganglbauer et al. explore food-related practices through a prototype called FridgeCam, and, in line with the abovementioned results from sociological consumption research, demonstrate how food waste becomes an unintended outcome of moments within practices of consumption, such as shopping, storing, and cooking, and not of deficiencies in knowledge or awareness. Thieme et al., on the other hand, approach food waste through the theory of planned behaviour when exploring the effect of persuasive technology on awareness, attitudes and intentions related to food waste. They conclude with some uncertainty that their experimentation with their BinCam prototype shows potential for increasing awareness, though it leaves attitudes and intentions unaffected and occasionally induces aversive emotions that could be counterproductive. Kera and Sulaiman develop and use their FridgeMatch prototype, an app matching people through the contents in their refrigerators as an educational experiment in rethinking the future of sharing food. The aim was to explore how technology could enable food commensality. Either way, sharing food is certainly a way to reduce food waste. Lim (2017) applies principles from design for sustainable behaviour methodology, such as eco-feedback and social influence to develop and test more collective solutions to household food waste. The first prototype, E-COmate, measures the amount of food wasted, while the second, Social Recipe, facilitates food sharing. Both prototypes are placed within a student living facility to observe the effect on food waste behaviour. Lim found instant feedback to be the most effective approach, and that social information applications showed promise. However, the target group for her observations were students, and thus not representative of other consumer groups.

In general, it can be observed that efforts to operationalise practice theory methodologically in design for sustainability research have mainly been adaptations of already established and well-known design methods, such as

prototyping, design/technology probes, co-design, participatory design, and iteration. These prototypes, or probes, bring relevant practices to light for scrutiny. Whether or not they are actual solutions to household food waste is in this context irrelevant, as their most important function is perhaps to serve as a vehicle for understanding relationships between social practices and technologies: practice and design. They are at best stepping stones towards future solutions. However, even if experimenting with prototypes is an approach that is recognisable and actionable to practising designers, it is not the only way to approach sustainability issues through practice-oriented design, as demonstrated by Pettersen (2013), who introduces the concept of practice-oriented design for sustainability and explores opportunities for design to support sustainable practices through case study research. She analyses three cases: thermal comfort, dishwashing. and audio-visual media use, and draws on both practice theory and system innovation theory in order to reveal barriers and unexploited opportunities for design research and practice to contribute to sustainable consumption from within companies and academia. Pettersen finds that practices and current socio-technical regimes represent significant inertia, and that much remains to enable a real-world manifestation of design for sustainable practices in the future.

This dissertation relates to this work by exploring ways of applying a practice-oriented perspective to an issue of (un)sustainable consumption in order to provide a new framing to it as a design problem.

2.2.3 Speculative design

In order to imagine future pathways for food waste reduction, I combine the practice-oriented perspective with speculative design approaches, which are currently being applied by scholars and practitioners working to envision possible futures to facilitate critical reflection on preferable and non-preferable trajectories. Design is inherently future oriented, a way of planning for and materialising the future. Furthermore, in its material or organisational form, design has an impact on the future in which it is embedded. The significance of design for future technological and social trajectories is increasingly acknowledged by industry, policymakers, social science, and of course by researchers and practitioners in the design field itself. Design philosopher Tony Fry (2009, 2011) argues that the structuring of how we live is determined by what we design (e.g. tools, architecture, infrastructure, services and systems), and that its impact is decisive to address in order to achieve a sustainable future. Furthermore, Fry posits that the socio-cultural and environmental impact of design as practice and of the designed is most often underestimated and reduced to a practical account of sustainable

design by use of materials and recycling schemes (Fry, 2011). According to Fry, it is a problem that most designers and architects today are 'uncritical service providers' (Fry, 2011:29). In his view, the profession of design is an important contributor to 'provide the practical visions' of the new economy of sustainment.

This view of design as a vehicle for creating visions of futures has spurred the development of a number of concepts and design approaches, such as: design-orienting scenarios (Manzini, 2003; Vergragt & Green, 2001); critical design (Dunne, 2006); design futuring (Fry, 2009); design fiction (Bleeker, 2009; Sterling, 2005, 2009); adversarial design (DiSalvo, 2012); speculative design (Dunne & Raby, 2013) transition design (Irwin, 2015) experiental scenario (Candy & Dunagan, 2017) and discursive design (Tharp & Tharp, 2019). However, the hierarchical positioning of these different concepts is not clear (Lindley, 2015). These are all similar but distinct approaches to future inquiry through design. What they have in common is the purpose of challenging norms, exploring possible manifestations of developing technology, and of impacting the imagination and perception of how things are and how they could be (Poynor, 2016). The value lies in the 'broadening out of what we think of as possible, that alternative perspectives on everyday life are valuable in themselves' (Poynor, 2016: 58). These approaches represent a form of research through design in that they enable the exploration of various societal challenges by making them tangible through the creation of material and of visual prototypes. The aim is often to disrupt trajectories in motion that are moving forward without being sufficiently questioned. These approaches to envisioning futures through design are making possible futures that could be the result of socio-technical system innovation, tangible to decision makers and anyone else who is exposed to them. In some cases, users (or stakeholders) are included in the co-creating process of imagining speculative futures, while in others it is purely a design-focused endeavour later disseminated to a wider audience. The goal is to provide a critical and often provoking prototype of what might come, in the form of a utopia, dystopia or something in between; possible sustainable futures or warnings about the consequences of unsustainable trajectories (Tanenbaum, Pufal, & Tanenbaum, 2016). A single prototype of a material item can stimulate interesting reflections on the risks and opportunities of future socio-technical developments by illustrating and making tangible possible futures. Furthermore, it can prompt questions about values and ethics, and enable public discourses that relieve anxiety about dystopian futures (Tanenbaum et al., 2016). What these approaches all have in common is that they are characterised by 'inventive problem making' and are not aimed at problem solving (Michael, 2012).

Methodologically, these future-oriented design approaches have been applied by a number of design scholars to play out possible consequences of

technological innovation extrapolated into the future, and to speculate about the relationships between science fact and science fiction in future scenarios. Speculative design and design fiction have also been the conceptual basis of several current design studios, such as US-based The Near Future Laboratory, the British studio Superflux, and the French studio Design Friction. These studios employ design to help their clients with their future business strategies and to help policymakers navigate complex issues relating to technological innovation and its possible impacts on our societies in the future.

In this dissertation I have chosen to explore the usefulness of design fiction in imagining sustainable food futures and related critical issues in order to open up a wider solution space for discussion. Design fiction differs from the other speculative design approaches in its focus on the diegetic prototype, which by its very existence implicates an entire world. Through the design of tangible artefacts, often supported by visualised narratives, images of possible futures are created and made accessible for reflection and critique. Similar to the work of Wakkary et al. (2013), I use design fiction as a bridge between design and practice theory, incorporating narrative and visual tools from science fiction to present a prototype and a critique of a possible future practice. According to Raven, science fiction can 'represent the social alongside the technological; move fluidly between micro, meso and macro scales; reconcile historical trajectories with extrapolated trends and speculative leaps; and – perhaps most importantly – speak across (and beyond) the disciplinary and administrative silos of both the state and the academy' (Raven, 2017:164).

A few examples of design fiction are being applied to the issue of food consumption and waste as a method to explore ways of imagining reconfigurations of food practices (Dolejsova, 2018; Oogjes, Bruns, & Wakkary, 2016) or to explore unsettling futures (Dunne & Raby, 2013:153; Kera & Tuters, 2011). In the project Edible Speculations, Dolejsova explores speculative futures related to digital food sharing, smart technologies and AI in the kitchen, using a deck of tarot cards designed specifically to 'read' future imaginaries as they become co-created with participants. Oogjes et al. use a prototype of a hearing aid for the refrigerator they have called Lyssna, in order to discuss how food practices might be reconfigured through the visual, sensory, and temporal qualities of an integrated designed artefact. Lyssna is a device that sits on the fridge much like a fridge magnet. By pressing one's ear to it, the sound of the different stages of ripening food can be heard, which in turn may inspire certain actions and influence how food is perceived and handled. By designing this fictional device, the authors aim to highlight the significance of sensory, temporal, and visual aspects of food in its different qualitative stages. A grimmer picture of the future of food consumption

is envisioned by Dunne and Raby in their dystopian Foragers project, a design speculation about future food scarcity. They visualise a bottom-up response enabled by technical and scientific knowledge, applied by groups of people whose abilities are inspired by existing marginal cultures, such as guerrilla gardeners and garage biologists. This fictional scenario is used to engage critical discussion about the future of food. In this same, rather uncomfortable, manner, Kera and Tuters (2011:2) explore how to 'provoke powerful associations' connected to the future of food consumption in relation to developments in genomics coupled with social technologies. Seen together, these contributions add various layers to the debate on future food consumption, illustrating the diverse issues that may arise and have impact in order to facilitate broader discussion.

Future scenario building is conducted in many different fields, and in foresight and futures studies, approaches such as forecasting and backcasting are frequently used to attempt to predict or direct future outcomes of current trajectories. What differentiates approaches from these more commonly used concepts is the focus on tangibility and on opening up a broader mind space for critical reflection on possible preferable and non-preferable futures rather than on predicting or setting goals for certain outcomes. Nevertheless, adjusting goals and setting a new course could be an outcome of speculative design projects.

2.3 Discussion of background and research gaps

After reviewing the literature on household food waste in Norway and other Western countries, I realised that most of the research (particularly in a Norwegian context) was based on quantitative methods such as surveys, and that some of the conclusions drawn from this might be further investigated by using qualitative methods. Not so much to disprove them, but rather to create a more holistic picture, and reveal some of the more hidden and unarticulated reasons for food waste. When it comes to the reported reasons for food waste, there are still many open-ended questions. The main reasons given in the conclusions of the reports from the Norwegian food waste project ForMat are these: the date had expired; the food was forgotten in the fridge; it had lost its good quality; I make too large portions; I buy too much food; the food packaging is too large; and I always throw away leftovers (Stensgård et al., 2018). While these reasons may well be valid, they lack explanatory depth. Why do people forget the food in their fridge? Why do they make unnecessarily large portions? Why do they always throw away leftovers? Thus, the aim of my research approach has been to come closer to some of the answers to these questions by illuminating other less visible relationships between the socio-cultural and material drivers of household food waste. Furthermore,

what I could observe from the literature on design solutions and policy recommendations aimed at household food waste was that there are two dominant strategies currently being promoted by governments and industry: 1) information and education strategies and 2) technological innovations (such as digital tools, refrigeration, and packaging). However, neither of these seems to yield the intended results.

The problem of household food waste has been approached by scholars of sustainable consumption and design for sustainability and in a number of different ways by academia, industry and policymakers. Contributions from scholars in consumption studies show how food waste is a result of a multitude of practices and routines, and how complex relations between food, products, technologies, skills, meanings, values, purposes and concerns about thrift, food safety, responsibility and care are related to the food waste problem (Comber et al., 2013; Evans, 2014; Lucas, 2002; Mavrakis, 2014; Miller, 1998; Southerton & Yates, 2014; Watson & Meah, 2012). These contributions contend that reducing the problem of food waste to a matter of individual lifestyle changes, thus framing the consumer as inept and overlooking important socio-cultural aspects of contemporary eating in the process, is counterproductive. In order to illuminate the complexity of practices that influence food waste, they look at food waste through the lens of social practice theories. What they find is that food disposal should be seen as a performance that is embedded in a number of eating practices, such as provisioning, cooking, and organisation of meal occasions. Furthermore, food waste is often a result of unresolvable tensions between conflicting goals. As such, wasting food cannot be seen as a practice in itself, nor as an effect of individual lifestyle choices.

This account of how an array of interconnected everyday practices, composed of materials, meanings and competences, directly and indirectly are causing food waste, makes approaching the issue from a design perspective a daunting task – calling for design approaches able to address this kind of complexity. No single product, service or system can promise to solve the problem, and social practices represent barriers in the form of inertia.

In sum, there are currently three main categories of design interventions aimed at food waste at play in European countries: (1) product design, (2) information design, and (3) service/sharing/app design, introduced by two groups of stakeholders: (1) industry and (2) governments. Industry is making specific products available on the market for food storage that can be seen as potential food waste interventions. Their innovations in packaging, containers and refrigerators aim to provide optimal shelf life for food products. Interventions initiated by

governmental bodies take a different form, and are mainly information oriented, seeking to inform and motivate consumers to waste less food. In addition, there are actors developing and launching various apps in order to redistribute food at risk of becoming waste. However, apps that are business-to-consumer oriented (such as Too Good To Go) have been more successful at this than consumer-to-consumer sharing apps (such as Resterant). In general, while commercial actors seek to enable consumers to reduce food waste, governments seek to persuade them. However, neither the enabling of industry nor the persuasions of government has had the desired effect on food waste reduction in households.

Both interventions and research efforts tend to focus on two main aspects which pertain to (1) social (knowledge and awareness, attitudes and preferences) and (2) material (labelling, packaging, portioning, planning, storing) drivers of household food waste. The policy recommendations made are mostly campaign-oriented efforts to raise knowledge and awareness and to improve food skills through communication and education. This approach to food waste seems to lean on cognitive psychological models of behaviour and to expect a stronger link between attitudes, beliefs, motivations and behaviour than can be observed in the case of household food waste. The emphasis on awareness presupposes that, provided with the 'right' knowledge, consumers will change their behaviour and reduce their waste. However, a growing body of social scientific inquiry based on social practice-oriented qualitative accounts of food waste drivers provides some nuance to this understanding of food waste in households. Simultaneously, a small group of design scholars are drawing on social-practice theory to explore ways of inducing sustainable change by design.

Approaching large societal problems from a design perspective is an endeavour that demands theoretical and methodological tools for grasping complexity and messiness. According to Buchanan (1992), all design problems are to some degree wicked problems. The (design) problem of household food waste is certainly a major wicked problem given that, in line with the definition of wicked problems by Rittel and Webber (1973), there is no uniquely 'correct' view of the problem. Furthermore, it is a problem that is connected to other problems consisting of multiple value conflicts and ideological, cultural, political and economic constraints, approachable through numerous potential intervention points. However, the consequences of interventions are difficult to imagine, and are associated with a high level of resistance to change.

Social practice theory, practice-oriented design and speculative design approaches can contribute the analytical and methodological tools to imagine such complexity and illuminate the entanglement of elements of materials,

competences and meanings to increase our understanding of how material infrastructures, socio-cultural contexts and formal and embodied knowledge influence current and future trajectories of change. They can also illustrate how various modes of design might contribute by intervening in strategic places of systems or entanglements and, last but not least, they can contribute tools for creating a space for critical reflection and imagination. Interestingly, both practice-oriented design projects and speculative design projects design – and in some cases implement – a prototype or design probe into a real-life setting. However, there are some differences regarding the intent behind this approach. In practice-oriented design projects the intent is to experiment and observe how the intervention could induce change in order to reflect on how interventions might reconfigure particular practices, while speculative design projects are more about broadening the space of what is possible and provoking critical reflection and new ideas about the future.

Methodologically, there are some challenges related to both approaches. For instance, in practice-oriented design the interconnected nature of practices might be overlooked by approaching single practices, such as bathing and energy use of particular objects. Furthermore, if design intervention could reconfigure practices, it is still difficult to move from theory to actual change by implementation. Moreover, there are important ethical aspects of practice-oriented design to be considered, concerning how the power to reframe and reconfigure practices should be distributed. Co-design might be a method to distribute this power in a more egalitarian and democratic way, avoiding the reproduction of present inequalities when visions of futures are produced (Chatterton & Newmarch, 2016). However, both practice-oriented and speculative design projects run the risk of becoming spectacle rather than evoking critical reflection and dialogue (DiSalvo, 2012). Furthermore, they can be misunderstood as simply being ironic and entertaining images of exaggerated current trends. DiSalvo (2012) shows how speculative design and design fictions will to some degree replicate and reproduce contemporary culture, and cannot be seen as pure inventions detached from the socio-technical constraints of the present. DiSalvo argues that although the aim of speculative design is to create reflection and dialogue, this effect has proven difficult to capture and has not been documented. Moreover, he observes that many speculative design projects avoid addressing politics in social contexts, thereby missing important opportunities to spur reflection on contemporary issues related to future consequences of developments within science and technology. He then goes on to suggest that the problem can be redeemed by designers' providing the audience with a 'scaffolding' of political and societal context, providing 'access to a breadth or depth of subject matter'

(DiSalvo, 2012: 119). The approach of practice-oriented design for sustainability could provide such scaffolding by unpacking the elements of social practices in political contexts.

Based on this background, this dissertation addresses the research gap that can be concluded to exist, namely the lack of empirically informed suggestions for interventions that could reduce household food waste by design, and a need to develop approaches to cope with wicked design problems such as household food waste. In the next chapter, which describes the research design of my project, I will elaborate how I have applied resources from the diverse thematic, theoretical and methodological backgrounds presented in this chapter.

3 RESEARCH DESIGN

This chapter presents the research design of the overall project, including theoretical position, methods, data material, analytical strategies, and participants. Design research 'takes design beyond its focus on the visual and form […] and into academia and interdisciplinary collaborations' (Bærenholdt, Büscher, Scheuer, & Simonsen, 2010:5). It is eclectic in its way of seeking both generalisation and application, insights about both past and future, producing both understandings and solutions as a result (Stappers, Sleeswijk Visser, & Keller, 2014:164). This eclectic quality of design research is expressed in an equally eclectic approach to research methods and speculative design, drawing on diverse theoretical and methodological resources from other disciplines such as sociology, psychology and anthropology. In line with this practice, this project has applied a mixed methods approach consisting of qualitative research methods adopted from social sciences: semi-structured interviews, and shop-along interviews, a method developed within the project called Fridge Studies, and design methods such as co-design/co-creation, design fiction and workshops. Theoretically, it draws on social practice theory and its integration into design for sustainable practices. Through this approach I have elicited narratives of current and possible future practices of food consumption and waste, illuminating opportunities for design intervention. Furthermore, I have demonstrated an approach that contributes towards developing practice-oriented design for sustainability (PODS) as a way to explore wicked design problems. Twenty-six households, 40 design students, seven design professionals and three researchers participated in this research project. The figure below illustrates the research design and how the elicited narratives and opportunities are products of an iterative process of continuous negotiations between theory, methods and participants.

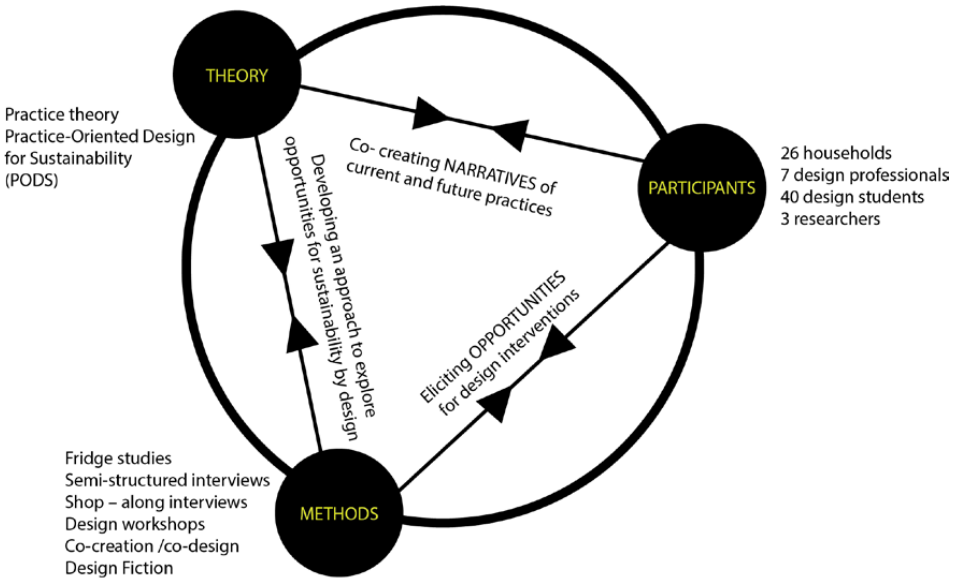

Figure 5: Research design.

I have found the use of the concept of narratives helpful in connecting the results from the fieldwork with the results from the workshops. Both collections of data provide accounts of practices related to food in terms of the material, meaning and competence they consist of. These accounts are discursive, but also material. Observing practices as they unfold naturally in everyday life is an unachievable ambition, as the presence of the researcher and the different context this presence creates will influence the performance of the practice. This leaves us to piece together a view of the practice through conversations and observations of the materials visible to us, meaning that some elements of a practice can be observed (such as the materials) and some need to be elicited through conversation using techniques that enable participants to talk about their practices. Nevertheless, what comes out in the end are discursive accounts of practices – or narratives as I have called them here. These narratives are in this work being co-constructed by participants and researchers during the fieldwork and workshops.

Different kinds of narratives have emerged from this research: actual and fictional narratives of personal experience (Riessman, 2005), small n-narratives, big N-Narratives, Master Narratives (Tannen, 2008), and narratives of futurity (Raven & Elahi, 2015), which I will describe in this section. The definition of narratives of personal experience varies between disciplines, from a life story (i.e. in anthropology or social history) to shorter accounts derived from one or more interviews (i.e. in sociology and psychology) (Riessman, 2005). It is to this latter

tradition that the narratives of food waste-related practices elicited from the data material collected in this project belongs. Tannen (2008) divides the narrative into three analytical levels: the *small-n narrative*, the *big-N Narrative* and the *Master Narrative*. The small-n narrative is the narrative of personal experience (such as preparing a meal), the big-N Narrative is the theme the participant develops to support the small-n narrative (such as everyday time constraints), and the Master Narrative is the cultural ideology driving the big-N Narrative (such as the sustainability discourse). In both the actual and the fictional narratives elicited from this research, I have searched for and included all three levels of the narrative. Furthermore, I have viewed the emerging narratives as *narratives of futurity* (Raven & Elahi, 2015), meaning that they represent but a few of the infinite number of possible futures. According to Raven & Elahi, this view of the future narrative differs from how it is perceived in, for instance, the foresight industry, where *futures* refer to a finite number from which the most preferable can be selected.

3.1 Participants

Table 16 presents the participating households in the fieldwork and the participating designers in the three workshops. The fieldwork was conducted in two waves. The first wave of 10 households was conducted in January 2015, and the second wave of 16 households was conducted in February 2017. The participating design students and design professionals were part of two workshops on PODS and one design fiction workshop. The first two workshops were conducted in the fall of 2016, and the final design fiction workshop was conducted in the spring of 2019.

The participant households in the fieldwork were recruited by the agency Norstat to fit the profile of those wasting the most food as identified in the ForMat-project, i.e. young adults and families with children. The participants to the first two workshops were design students recruited from Oslo Metropolitan University (OsloMet) and the Norwegian University of Science and Technology (NTNU). The professional designers who participated in the final design fiction workshop were recruited through social networks. These designers were my co-students in the product design class of 2006 at what was then the University College of Akershus and what is now part of OsloMet. At the present time, they work as professional designers in various industries and design fields such as product design, service design, interaction design, packaging design, retail design and software design. Two of the participants run their own design practice. Figure 6 shows an overview of participants in the fieldwork and workshops.

Fieldwork		
Participants (26)	First wave (January 2015)	Second wave (February 2017)
Age	25–51 y	
Gender	Evenly distributed	
Household	2 x Single 2 x Couples 6 x Families with children	4 x Single 4 x Couples 6 x Families with children
Area	Oslo, the capital of Norway	

Workshops	Participants
Workshop 1 Practice-oriented design for sustainability, Oslo Metropolitan University, fall 2016 20 participants	**Age:** 22–34 (the majority between 22–25) **Gender:** F14/M6 **Status:** Students **Place:** Kjeller
Workshop 2 Practice-oriented design for sustainability, Norwegian University of Science and Technology, fall 2016 20 participants	**Age:** 20–32 (the majority between 20–25) **Gender:**F10/M10 **Status:** Students **Place:** Trondheim
Workshop 3 Design fiction workshop, Oslo Metropolitan University, spring 2019 9 participants	**Age:**37–46 **Gender:** F4/M5 **Status:** Design professionals **Place:** Oslo

Figure 6: Table of participants.

3.2 Theoretical position

Before moving on to the methods, this section will position the work presented in this dissertation in the theoretical landscape of design research and social science. Both Frayling (1994) and Cross (1999) divide design research into three types according to distinct aims: 1) research *for* design (informing a design process or developing tools for design practice); 2) research *on* design (describing and explaining design practice phenomena); and 3) research *through* design (creating new knowledge through the development of design objects). This work positions itself between 1 and 3, as both research *for* and *through* design. It is research *for* design in that it aims to inform design processes engaged in enabling sustainable consumption, reducing household food waste in particular. It is also research *through* design in that it develops design objects within a design fiction in order to envision and make tangible possible future (food) practices. The ontological and epistemological assumptions underpinning this research are grounded in a social

constructionist worldview, meaning that I do not see us uncovering an objective truth, but would argue instead that we are uncovering a multitude of truths which we construct together and which, seen together, provide us with an increased understanding of the issue under investigation. I find this stance to be fruitful in the way that it diverts the project away from becoming overtly reductionist, a risk of taking a more positivist approach. I does so in the way it lifts up the diverse circumstances and phenomena that move food between the categories of edible and inedible within households, rather than assuming to identify one major cause.

3.3 Methods and materials

Based on the dominant quantitative approach to food waste in existing literature and on the limited effects of current reduction strategies, I found a need to supplement the knowledge about food waste in Norwegian households with thicker qualitative descriptions of how food becomes waste, and to explore the potential and shortcomings of current interventions and future opportunities. This project thus seeks to increase the understanding of two dimensions of household food waste: looking at the circumstances that cause food to become waste, and exploring future design opportunities to reduce food waste. One dimension is situated in the past and present and the other in the future. This dual empirical and temporal aim has led me to apply a mixed methods approach, a triangulation of several qualitative methods that supplement each other allowing for a cumulative process of producing new insights. The main argument for a mixed methods approach is to compensate for methodological problems in single methods (Kelle, 2006). The assumption is that by using more than two methodological approaches they will complement each other and thereby weigh up for each other's weaknesses (Brewer & Hunter, 1989; Tashakkori & Teddlie, 2008).

Table 2: Overview of articles, methods and materials.

	Article	Methods	Material
1	*Household Food Waste: Drivers and potential intervention points for design – An extensive review.* Marie Hebrok & Casper Boks, 2017, *Journal of Cleaner Production*.	• Literature Review	Selected articles and reports
2	*Food waste in the shadow of ideals: A case for practice-oriented design.* Marie Hebrok, 2018, *Journal of Design Research*.	• Semi-structured interviews • Fridge studies • Shop-along interviews • Audio/photo documentation	• Transcripts • Photo • Audio
3	*Contextualising Food Waste Prevention: Decisive moments within everyday practices.* Marie Hebrok & Nina Heidenstrøm, 2019, *Journal of Cleaner Production*.	• Semi-structured interviews • Fridge studies • Shop-along interviews • Audio/photo documentation	• Transcripts • Photo • Audio
4	*Bird: Design fiction and the futures of food consumption*. Marie Hebrok & Henry Mainsah, submitted January 2020.	• Workshop • Co-creation • Design fiction • Visualisation	• Affinity maps • Photo & audio • 2D and 3D visualisations

The table above shows an overview of the four articles included in this dissertation, the methods that were applied, and the materials that were produced. The following sections will elaborate on the applied methodological approach, starting with the notion of co-creation.

3.3.1 A co-creation approach

The co-creation approach became increasingly central to the project as it progressed. In line with the conceptualisation of co-creation by Sanders and Stappers (2008), I take co-creation to refer to any collective creativity applied to both material and non-material work. This means that I see the work presented in this dissertation as a product of co-creation between researchers and participants who have produced tangible narratives of food-related practices from a sustainability perspective, with a primary focus on household food waste, situated both in the now and in a possible future. As such, participants have acted as co-researchers in creating narratives of present and future food consumption. These narratives have served as a tool for discussing the potential avenues for design in reducing food waste and facilitating sustainable food consumption in the future. Within a workshop setting a co-creation approach offers a format for participants to share their ideas, interact with the ideas of other participants, and collectively generate new ideas. Participants in our design workshops made use of a series of design techniques, such as paper prototyping, brainstorming, quick sketching, and

mock-ups. In an ethnographic interview setting, we enabled co-creation through a set of techniques foregrounding the material presence of food, kitchen, appliance, etc. By guiding participants' attention towards these objects, we were able to elicit narratives otherwise untold. In this regard, we perceive the role of participants as partners in a research and design process rather than research subjects (Sanders & Stappers, 2008).

3.3.2 Co-creating narratives of food practices: fridge studies

The insights presented in this dissertation is a result of a number of methodological approaches, amongst them the semi-structured interview. I conducted 26 such interviews in the homes of participating households. What lies in the term 'semi-structured' is that the interviewer has prepared an overall structure for the interview in terms of topics to be covered and main questions that need to be asked (Drever, 1995). Our interview guide contained specific topics of interest such as planning, shopping, storing, shelf life, labelling, meal habits, household members, food waste, and sustainability in general (see appendix 3). The rest of the interview is improvised during the time available, leaving room for unexpected turns and the pursuit of new trajectories. This gives the interviewees the freedom to influence which topics to discuss, how much to share and how to express themselves. Furthermore, ethnographic interviews, such as the semi-structured, are a means to elicit narratives about the experiences and actions of participants (Spradley, 2016). I see these narratives as co-produced between the researchers and the participants. The outcome is a form of situated knowledge which can only be produced by fieldwork studies (Flyvbjerg, 2006).

The first 10 home visits commenced with a shop-along interview with participants. The shop-along interview is a version of the go-along or walk-along interview that accompanies shopping (Carpiano, 2009; Jackson et al., 2006; Kusenbach, 2003; Pink, 2007). When accompanying participants to the grocery store, the primary aim was participatory observation, including asking questions along the way about specific actions, considerations and choices. I was interested in the way participants navigated their way through the store, the degree of planning, routines and patterns, the way they moved and thought, and in how they planned meals before, during or after the shopping trip. I was also interested in how much attention they paid to labelling and communication in the store. After the shopping trip, I accompanied the participants to their homes where the interview continued while they unpacked their groceries and placed them in the fridge and kitchen cupboard. However, the finding that the most elaborate narratives of food-waste related practices emerged from conversations about

particular food items present in the fridges of the participants led us to focus on a new method that had been developing intuitively throughout the course of the interviews. This new method, which we called fridge studies, incorporates a number of techniques to encourage and enable participants to talk about the trajectories of specific foods rather than asking them to recollect past events and express their opinions and attitudes.

In the case of sustainable consumption in general, and of household food waste in particular, people tend to underestimate their own contribution, or lean towards what they believe to be the most 'virtuous' answers in surveys. Of course, this mechanism is also present when conducting semi-structured interviews. However, by applying certain techniques, it is possible to move beyond this self-representation mode often adopted by informants. In this case of household food waste, we developed such techniques and assembled them within the method of fridge studies. The starting point for developing this method was when we found that the kitchen tour part of the at-home interviews was yielding much more insight into food-related practices than the introductory session, which was mostly situated at the kitchen table. The reason was that when sitting at the kitchen table, participants tended to speak more generally about how they think about their everyday dealings with food. Although this was not without interest, it did not provide much information about what they actually did in particular situations and with particular food, or how certain trajectories of particular food would come about. However, we soon noticed that asking participants to show us around the kitchen enabled us to learn much more about the trajectories of food within the household. In their kitchens, participants would convey detailed narratives of how particular food items travelled between categories of quality and use occasions and how they came to be consumed or wasted.

The primary objective of fridge studies is to enable participants to talk about their practices through the materiality of the food and the kitchen. We used the method to backtrack trajectories of particular food items because it was a far more time-efficient alternative to participant observation. In this way we managed to bring out the complexity inherent in food-related practices, such as how people assess the edibility of food, by applying embodied sensory skills combined with formal and informal knowledge, and how food was kept 'at mercy' in the fridge to minimise anxieties related to foods in a liminal phase between 'good' and 'bad'.

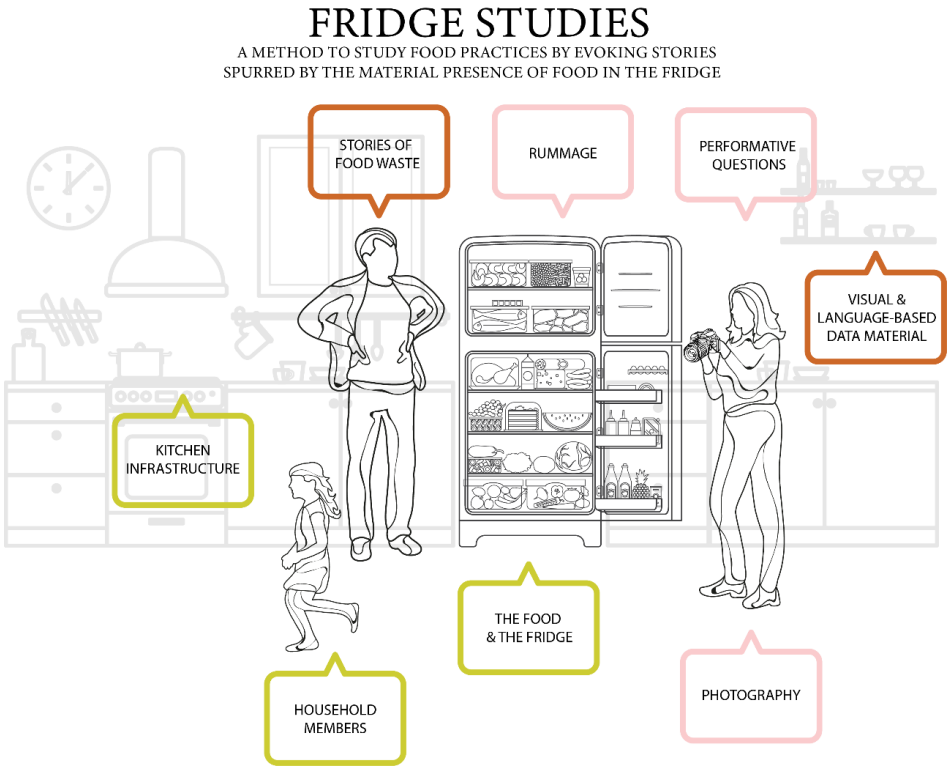

Figure 7: Fridge studies. Source: (Heidenstrøm & Hebrok, forthcoming).

In fridge studies, data is collected in a joint effort by participants and researchers rummaging through the fridge. The researchers ask permission to point at or even take out certain items, and encourage participants to point out items themselves. Participants are then asked specific *performative* questions around each item, such as why and when it was purchased, to what end, and what would happen to it. Performative questions relate to a specific context of action (Halkier & Jensen, 2011), such as: 'How did you prepare the dinner for your family yesterday?' Some participants offer their accounts without much encouragement while others must be motivated by more persistent 'digging' for details on the researchers' part. A general challenge we sought to address at the beginning of each interview was the mundane nature of our object of inquiry. Some participants found it hard at first to understand why these everyday dealings with food were of interest to research, so we made sure we explained our focus early on. In our experience, this put participants at ease. Furthermore, it instilled some of them with enthusiasm, particularly those who reflected a great deal on this issue in everyday life but had no one who shared their interest. For documentation purposes, photographs were taken of the food items discussed and of the fridge

and kitchen more generally, other storage units and kitchen appliances, and of waste bins and systems. The interviews were audio recorded. The images were later used in the analysis, both as illustrations to particular narratives and as objects of analysis themselves. Presented below are a few examples of such photos accompanied by quotes from the fridge studies.

Quote

(A 37-year-old woman showed us a bottle of white wine vinegar that she had purchased for a specific meal, and never used again)

I bought that because I was inviting some friends over for an international dinner, and everybody was supposed to cook a dish from another country. I was making a dish from Peru, and it contained white wine vinegar, but that is not something I normally use (…) Ingredients that belong to a fancy dish, I don't think I would use it again.

Figure 8: Quote 1. Source: Article 3.

Quote

(A 37-year-old man shows us a salmon packed in a plastic bag that has high relational and time value)

Participant: My bad conscience is this salmon, 1,5 kg that my dad caught.
Interviewer: What do you think you would use it for?
Participant: We'll see (…) these things can be kept fresh for a long time, there is little fat on it.
Interviewer: So you want to try to use it?
Participant: Yes. It's my bad conscience.

Figure 9: Quote 2. Source: Article 3.

Quote

(Man, 31, couple, one child 5 months)

*Participant: We usually store apples in the fridge, but now we have them on the counter because my wife, well, every time she feels the urge to eat something sweet she can have an apple. I am not very good at eating fruit, but when they are in this crisp form I like them *laughing* (they have a machine that dries fruit).*
Researcher: So, it is because she should eat more apples that you put it there?
Participant: Yes, and for me it is like, I can have an apple if it is out there, but if it is in the fridge I will most certainly not have one

Figure 10: Quote 3. Source: Article 2.

Quote

(Woman, 43, single parent, two children 9,10)

Researcher: is there something that you throw away a lot? That they don't eat at school?
Participant: Yes. I don't really manage to pay attention to when they eat a lot and when they don't.
Researcher: Is it different from day to day?
Participant: Yes. I have a girl who can eat six sandwiches one day, and just half a sandwich or an apple the next. It is her appetite. Mostly I make two sandwiches for her, but one often goes in the trash. My son usually finishes his sandwiches, but if for instance grapes have gotten butter on them, he won't eat them.

Figure 11: Quote 4. Source: Article 2.

The images and quotes presented above illustrate how the fridge studies approach could generate a diversity of narratives about how food becomes waste, by focusing on the material and performative aspects of food waste.

Although we have applied our method to the subject of food waste, it could easily be applied to other food-related research topics; for instance, health, sustainable food consumption, eating patterns, and food cultures more generally. In 2020 we plan to further develop this method in our current participation in the EU project PLATEFORMS. The next step will be to develop predefined systematic tools to ensure consistency in the collected data. Further development will entail creating a framework for a more systematic recording of food items by characteristics, such as time of acquisition, intended use occasion and labelling. Furthermore, we wish to explore how participants can be even more integrated as co-researchers by collecting their own data over an extended period of time. Digital tools such as apps and food diaries could be useful methods to achieve this. This extension of the method could provide us with even more detailed data on what actually happens to particular food items, moving beyond the current snapshot of food handling which fridge studies currently can provide.

3.3.3 Co-creating narratives of future food practices: design workshops

Once the project had generated valuable new insights, the next step was to convey and frame these insights in a way that could enable designers to engage with them as a starting point for new ideas. To explore how this could be achieved, two workshops were conducted in the fall of 2016 with master students in product design (20 students), and master students in a design thinking course (20 students). To learn more about the workshop format, I participated in two external design and innovation workshops on the subject of food waste, and studied various literature on the subject. The third and final workshop was conducted with seven professional designers at the facilities of Consumption Research Norway at OsloMet in 2019. I will describe these three workshops in this section.

Figure 12: Images from the first workshop at OsloMet, 2016.

The first workshop was conducted in the Department of Product Design at Oslo Metropolitan University (then Oslo and Akershus University College of Applied Sciences). Twenty participants attended the workshop, which lasted for two days. The students were introduced to the topic of food waste, gained a basic understanding of practice theory and practice-oriented design, and of three concrete practices linked to food waste that were identified and described by the researcher: planning, shopping and meals; portioning; and putting leftovers 'on hold' in the fridge. The brief given to the students can be found in appendix 4. The aim of the workshop was to choose one of the practices and explore how it could be changed in a way that would reduce food waste. On the first day the groups worked on generating a range of ideas by creating affinity maps and then systematically reducing them into three final ideas that were visualised and presented on the second day. Seen together, the concepts that emerged revolved around two key themes: app-based facilitation of food sharing and shelf-life tracking, and storage solutions. One example of a proposed food sharing app is called *Kjøttmarked* (in English: Meat Market*)* with the slogan 'single and starving', a dating app that aims to reduce food waste by matching people based on their food preferences. The concept aims to provide a digital platform for young people that can help them achieve three important goals: save money, find love and reduce their environmental footprint.

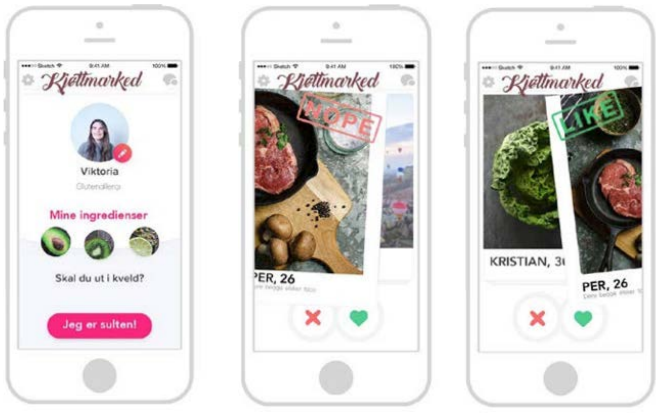

Figure 13: Illustration of the concept Kjøttmarked (Meat Market).

Another example is the imagined new IKEA modular oven dish, marketed with the slogan 'Make leftovers great again!' To go beyond the notion of leftovers, this group proposes making leftovers 'sexy'. They envision a modular oven dish sold by IKEA that contains separate dishes that make the food look more organised, attractive and presentable the next day. In this way, food that has not been touched within the separate dishes can be served again the next day, not as

leftovers, but as a new dish. It could even be served to guests without them having to know that it was not made the same day.

Figure 14: Illustration of the concept Make Leftovers Great Again!

The second workshop was conducted in the Department of Design at the Norwegian University of Science and Technology (NTNU). Twenty participants attended the workshop, which lasted for two hours. The students were briefly introduced to the topic of food waste and presented with a narrative describing some underlying causes of food waste, in particular colliding ideals, meaning ideals that collide with the ideal of not wasting food, such as food safety, conviviality, and variation. Inspired by these colliding ideals, the students were asked to generate ideas about how consumers could be enabled to handle these conflicting ideals in everyday life. Divided into five groups, the students discussed ideas, made notes and sketches, and created affinity maps of their ideas. These were presented to the whole group at the end of the session. The researcher took the written material home and made audio and video recordings of the session. The brief given to the students can be found in appendix 4. Similar to the first workshop, the participants zoomed in on ideas about sharing food, storing food in better ways, and on better ways of managing the time span in which food is edible using digital tools.

Although, the students came up with a large number of ideas for how design might influence practices causing food waste in households, I found many of these ideas to represent incremental rather than radical innovations. Moreover, they were ideas that treated the symptoms but not the cause. Even if the ideas about sharing food between households represented a radical change in food practices, they would be a means of consuming surplus food rather than avoiding that surplus in the first place. Given these experiences from the workshops, I wanted to explore spaces outside these incremental modes of product design and digital tools

and look at food practices as an integral part of the food system, a system that could look different in the future. I also wanted to find ways of engaging designers in ways of thinking that were not restricted to the design of products for imagined clients or customers, but rather explore ways of engaging an audience – the public – in narratives of future food practices enabled by design. My wish to move on to a more explorative and radical future-oriented approach eventually led me to consider the potential of speculative design methods. Design fiction seemed to be a promising method for moving beyond current constraints while still retaining the mundane everyday-life perspective. Methodologically, design fiction focuses on developing tangible objects which by their very existence tell a story of the world in which they are embedded. We applied this method in order to create narratives of possible everyday food practices of the future through design. The aim has been to use such narratives as a vehicle for discussing opportunities for design to facilitate more sustainable practices and to explore and critique current trends and trajectories extrapolated into a not so distant future. My fellow researcher and I therefore invited a number of professional designers to attend a design fiction workshop, and seven designers accepted.

In order to facilitate the workshop process, I developed a set of cards inspired by the card game The Thing from the Future created by the Situation Lab in the US (Candy, 2018), and the Inspiration Cards developed by Halskov and Dalsgård (2006). Its content is based on results from the fridge studies introduced earlier, and the purpose of the card deck is to embed these results into the ideation process as cues rather than presenting the group with them in a more traditional way. In this way, we seek to provide some direction and constraint to the activities of the workshop without reducing it to a design brief.

Figure 15: The card game CASE.

The card deck is in Norwegian and consists of four different categories of cards, which we have translated into English for the purpose of this description as follows: Context (C), Artefact (A), Signal (S) and Epoch (E). Together they spell CASE (or KASE in Norwegian). The C-cards point to a specific context in which the artefact named on the A-card exists. Examples of relevant contexts for our food fiction are in the kitchen, public and commercial food distribution, self-sufficiency, scarcity, food production, etc. Examples of artefacts are tools, public services, user manuals, packaging, documents, architecture, products, prosthetics, infrastructure, etc. The S-card suggests strong signals from current observable trends, tendencies and technologies that could affect the future in a profound way. Some of these trends are already making large impacts, such as big data, social media, and AI, while others are more marginal, such as insect protein used in food, micro farming, and synthetic meat. The E-card defines the epoch in which the artefact exists, i.e. 10, 50, 100, 200, 500, or 1,000 years from now.

Figure 16: Images from the design fiction workshop at OsloMet, 2019.

The participants were divided into two groups and asked to agree on four cards in each group, one from each category, so that the cards spelt CASE (or in Norwegian: KASE). Figure 15 shows an example of four category cards put together. C(K): The Meal, A: Commercial service, S: Big Data and E: 2119 (100 years from now). This hypothetical combination is an imagined starting point for discussing ideas pertaining to these elements. Additionally, the participants were provided with equipment to visualise their ideas along the way, such as modelling clay, paper, cardboard, markers, glue and Lego bricks. At the end of the workshop they presented sketches and mock-ups of the artefacts they had imagined. The brief given to the designers can be found in appendix 4

This card deck was specifically adapted to our topic, and was aimed at a specific workshop with a specific group of professional designers in Oslo, Norway. However, with minor adjustments it can be adapted to other topics or made more general in scope. Thus, we hope to have the opportunity to further develop the deck in future projects.

3.3.4 Visualising narratives of present and futurity

The methods applied in order to visualise the narratives of present and futurity produced in this project were multiple. As part of the fridge studies narratives were visualised by juxtaposing images of particular food items next to the quotes that told the tales of how they became superfluous. Furthermore, a gigamap was created in order to visualise the landscape of food waste related practices, interventions coming from different stakeholders and barriers towards those interventions. Gigamaps are used in systems-oriented design as a method to make sense of complexity, create a shared understanding of a problem field, and to critique boundaries, amongst other objectives (Sevaldson, 2015). I found this method helpful to my process of mapping out the complexity inherent in food waste-related practices and their relationships with (design) current interventions. The content of the gigamap is collected from my own research published in Articles 1, 2, and 3. It can be viewed in its readable original format online here: https://foodfictiondesignblog.wordpress.com/gigamap/.

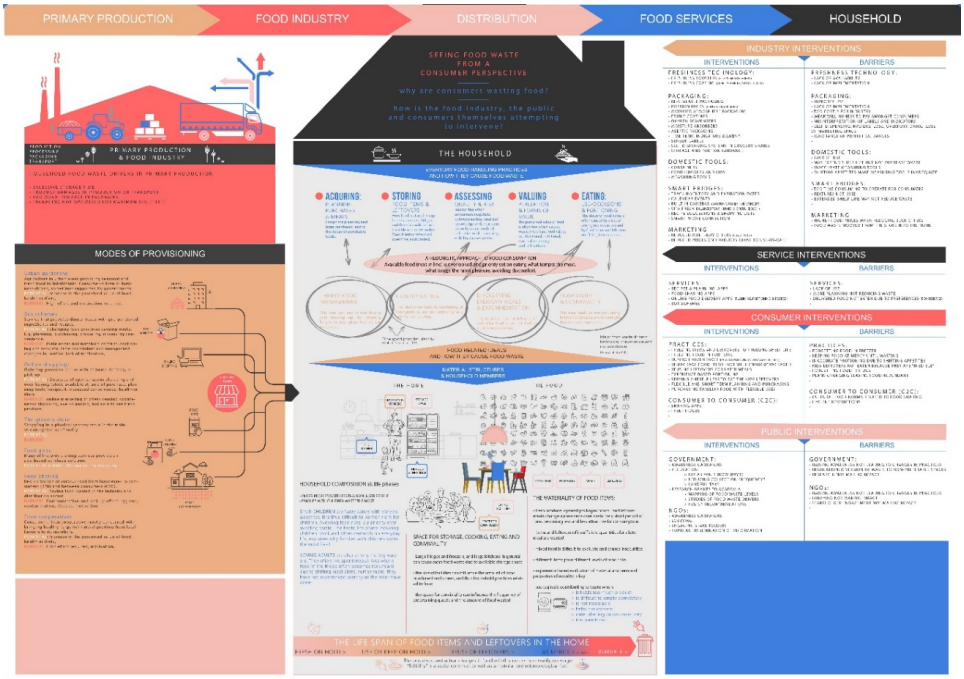

Figure 17: Gigamap of food waste-related practices and interventions.

During the design workshop, participants expressed their ideas by creating affinity maps with sketches and text. Moreover, final conceptual designs were visualised through the use of graphics software such as Adobe Illustrator and Photoshop, and presented to the group in a PowerPoint presentation (in the first

design workshop). Narratives extracted from the transcriptions of fieldwork interviews were visualised by placing photographs taken of items described in the narrative next to the text in Articles 2 and 3. However, the most elaborate process of visualisation was the work conducted to envision the design fiction Bird. The visualisation of this design fiction was both two- and three-dimensional. The two-dimensional elements consisting of a website showing a logo, images and text, creating an illusion of the existence of Bird, were designed through the use of the same graphics software as mentioned earlier, and the online blog-maker WordPress. The three-dimensional elements were first, the CASE card game, and second, the Bird starter kit, which consisted of a brochure, a water bottle, a bracelet, and a snack.

Figure 18: Bird website and starter kit

These methods of visualisation served different purposes. The photographic visualisation of narratives extracted from the fieldwork was applied in order to strengthen the connection between the material context and the narrative, as we have emphasised in our methodological approach. The card game CASE was designed in order to transfer results, themes and ideas from the fieldwork to the design workshops. While the ad hoc visualisation created through affinity maps served as a way to bring up and document ideas, the developed designs presented through PowerPoint presentations took selected ideas one step further, enabling us to imagine what it might be like to experience them. The visualisation of the design fiction Bird moved even further in this direction by creating an illusion of an actual food service in the shape of an online presence and physical starter kit. Such, visualisation methods have played a significant role in eliciting narratives and exposing potential intervention points for design by making both narratives and intervention points more accessible to a potential audience.

3.4 Data material & analytical strategies: narratives of personal experience

This section presents the data material gathered in this project through fieldwork and workshops and the analytical strategies applied to it. In addition to a general grouping of the data material into themes and categories, I searched for narratives that could reveal opportunities for design interventions and enable us to explore and critique possible futures. Thus, a general inductive approach that allows a diversity of themes and narratives to emerge from the raw data (Thomas, 2006) was applied as a strategy for analysing the material collected from the 26 at-home visits. The semi-structured interviews, shop-along interviews, and fridge studies were audio recorded and transcribed. Photographs documenting the fieldwork were catalogued according to a number of categories. The transcripts were analysed in HyperResearch according to a three-step analytical strategy: 1) multiple readings and interpretations of the raw data aimed at making 'findings arise directly from the analysis of the raw data, not from a priori expectations or models' (Thomas, 2006: 239); 2) development of categories from the raw data that were embedded as codes into HyperResearch; and 3) construction of larger concepts based on the coded material.

The material from the three workshops were documented in four ways: 1) field notes, 2) photographs, 3) collecting the physical material that emerged (i.e. posters with post-its, drawings and notes); and 4) audio recording groups discussions. These sources of data were analysed by searching for and grouping emerging themes and ideas. The data from the design fiction workshop provided a basis from which we proceeded to develop fictional artefacts and narratives of future food practices. These narratives and artefacts were developed collaboratively between me and my fellow researcher during three workshops. The design and authoring of the final design fiction were conducted by me.

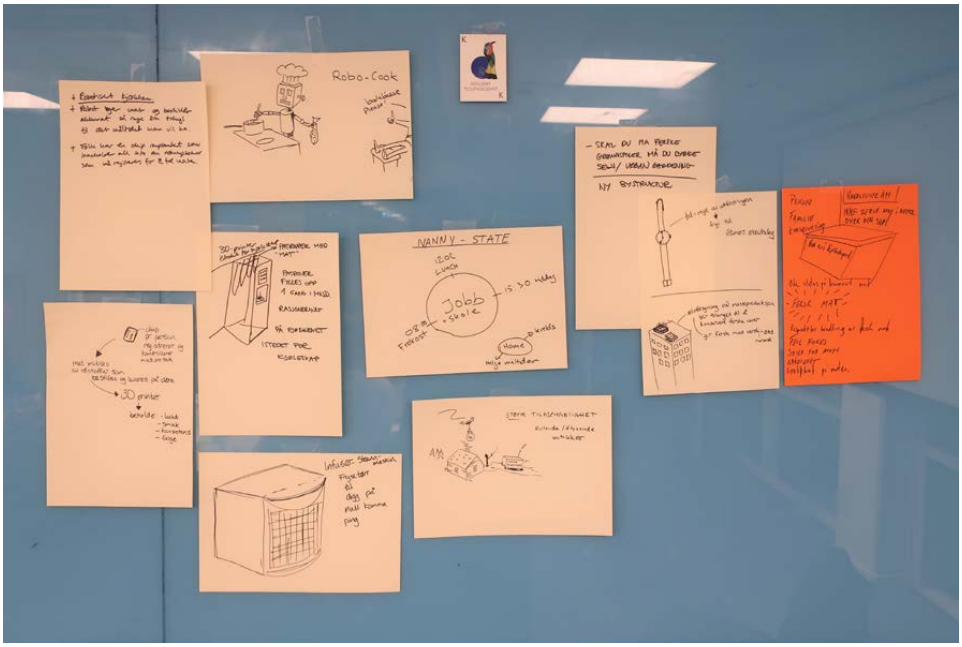

Figure 19: Sketches and notes from workshop 3.

The 26 transcribed interviews from the fieldwork were meticulously searched for relevant narratives, and some sections were selected for closer analytical examination and interpretation. We searched for narratives on the three levels described by Tannen, using both a *thematic* and an *interactional* analysis (Riessman, 2005). The thematic analysis resulted in a number of themes illustrated by selected narratives representative of many, while the interactional analysis included how researchers participated in foregrounding certain material and social contexts (i.e. particular food and family constellations). By steering the conversation by, for instance, physically taking food items out of the fridge and asking about the organisation of family life, we were co-constructing meaning in collaboration with the participants (Riessman, 2005:4).

Of course, narratives are not necessarily exact representations of the past; they are in fact representations influenced by a number of factors such as memory, imagination, emotions, social norms and identity. However, by foregrounding material contexts, as we do in fridge studies, we argue that the narratives are less biased by these factors because the approach is more direct and demands concrete answers to mundane questions. We found that asking questions about particular trajectories of particular food items as opposed to asking more general questions about actions, attitudes to and knowledge about food and food waste, yielded quite different responses. The latter tended to provide responses such as 'we never waste food', 'we always eat the leftovers', 'only peelings go to waste', etc. These responses

were narratives as well, however they were more normative and symbolic in nature than the ones elicited through our fridge studies approach. These narratives were of course not free of normativity or symbols, yet they seem to give more detailed accounts of concrete trajectories of food after entering the household. Even though we focused on the small-n narratives during the interviews, Big-N Narratives and Master Narratives would surface as well, triggered by the small-n narratives. For instance, the small-n narrative of a specific item of food, observably in the process of becoming waste, would move to a Big-N narrative about the challenges of time constraints in the busy everyday life of families with small children and how this made it hard to avoid waste, and to the Master-Narrative of sustainable (food) consumption.

The narratives co-created with design students and design professionals in a workshop setting and subsequently developed also incorporated the three different levels of the narrative, though narratives of futurity rather than of the past and present. In all three workshops, the participants were instructed to imagine something concrete (a product, service or system) that would enable a change in food waste-related practices. The difference was that participants in the design fiction workshop were urged to think about radical provocative change that was not limited to preferable futures but that also encompassed non-preferable trajectories in order to open them to critique. The written narratives were constructed by the researchers after the workshop by synthetising the data and including the main elements and levels of narratives discussed. These narratives of food practices were in this case elicited not through personal experience but through the design of artefacts. In the process of arriving at artefacts, participants needed to imagine small-n narratives, big N-Narratives and Master Narratives that would support the existence of those artefacts.

To take the design fiction Bird as an example, the artefacts comprising Bird only make sense when inserted into an everyday setting of use (small-n narrative), and into a wider context of food systems and services (big-N Narrative), embedded in an even wider social, cultural, technological and political context exemplified by discourses on Bird´s impact on physical and mental health, privacy, human rights, and the environment (Master Narrative). The diary narrative, presented in Article 4, represents a small n-narrative while the New York Times article, embedded and linked to in the diary, represents the big N-Narrative and the Master narrative. Another less developed but similar example is the Meat Market service from the first workshop, which can be seen as a design fiction even though it was not labelled as such at the time. Participants used the narrative of food sharing, conviviality and love matching as a way to reduce household food waste. In a similar way as in the work with the design fiction Bird, the participants combined

current trends and technologies, extrapolating them into a not so distant future. As a result, they created a service that would reduce food waste through technologies associated with dating apps and food sharing. Implied in the existence of such a service lie the big-N Narratives and Master Narratives that provide the necessary wider socio-cultural and technological support for the small n-narrative from the perspective of a user of the service. These narratives could be further explored in a design fiction similar to Bird.

I applied two approaches to elicit opportunities for design interventions from the narratives. First, in the data material describing current practices, I searched the narratives for potential areas where redesigning existing products, services or systems or designing new ones might have an impact on practices. Second, in the material from the design fiction workshop I looked for radical ideas that could entail food waste reduction by design in a possible and not so distant future, seeing those ideas not as suggestions for ultimate solutions to the food waste problem but rather as vehicles for interrogating current beliefs, trends and trajectories concerning food consumption and waste. Through this dual approach, I could not only recommend specific design interventions, but also discourage or at least question and bring to light some of the current socio-cultural, technological and political trajectories that could impact the food system in the future.

3.5 Ethical considerations

The collection of data during the fieldwork has been approved by the Norwegian Centre for Research Data (NSD). Furthermore, it follows the guidelines for research ethics in the social sciences (NESH, 2016). Participants in the fieldwork and in the workshops signed consent forms stating that they understood what their participation entailed, and that they did not oppose the use of audio, photo, video or written materials for research purposes. All participants were thoroughly informed verbally and in writing about the purpose and nature of the research project.

4 SUMMARIES OF ARTICLES

This section will summarise the four articles on which this dissertation is based. The table below provides an overview of the articles, their aims and research questions. Seen together, these articles provide answers to the general research questions of this dissertation presented in the introduction. These will be answered separately in chapter 4 *Conclusions*.

Table 3: Overview of articles and research questions

	Article	Aims and research questions
1	*Household Food Waste: Drivers and potential intervention points for design – An extensive review*, Marie Hebrok & Casper Boks, 2017, *Journal of Cleaner Production*.	AIM: To explore how household food waste has been addressed in literature with a focus on potential intervention points for design. RESEARCH QUESTIONS: • What are the drivers of food waste? • Where can designers intervene in order to influence consumers to waste less food?
2	*Food Waste in the Shadow of Ideals: A case for practice-oriented design*. Marie Hebrok, 2018, *Journal of Design Research*.	AIM: To explain how idealised practices influence food waste levels in households and to suggest practice-oriented design for sustainability approaches to address this connection between ideals and food waste. RESEARCH QUESTIONS: • How do idealised everyday practices cause food waste? • How can a practice-oriented product design approach food waste reduction in households?
3	*Contextualising Food Waste Prevention: A decisive moments within everyday practices*. Marie Hebrok & Nina Heidenstrøm, 2019, *Journal of Cleaner Production*.	AIM: To identify decisive moments within everyday practices and explore contextual measures against food waste. RESEARCH QUESTIONS: • How do food-related practices cause food waste? • How can measures against food waste be more effective by becoming more contextual?
4	*Bird: Design fiction and the futures of food consumption*. Marie Hebrok & Henry Mainsah, submitted, January 2020.	AIM: To expand the way we think about food waste as a design problem, by combining the concepts of practice-oriented design for sustainability and design fiction. RESEARCH QUESTIONS: • How could future food practices be reconfigured by design to reduce or eliminate waste?

4.1 Article 1: Household food waste: Drivers and potential intervention points for design – An extensive review

Marie Hebrok and Casper Boks, 2017,
Journal of Cleaner Production, vol. 151, pp. 380–392.

This review explores how household food waste has been addressed in academic and grey literature to identify food waste drivers and potential intervention points for design.

The results show that there are a number of different disciplines engaging in food waste research, employing various methods to generate knowledge about what drives food waste in households. Although both qualitative and quantitative methods are used, much of the data available at the time the review was conducted seems to come from surveys. Furthermore, these surveys seem to attempt to collect data on quantities and categories of food waste as well as on food waste drivers. Two strands of food waste research thus emerge in the review. First, the quantitative strand, focusing on consumer behaviour and drawing on theoretical resources from behavioural psychology and economy. Second, the qualitative strand, seeking to explore social practices and how they relate to food becoming waste in households, and drawing on theoretical resources from sociology. The two strands differ significantly in how they conceptualise the drivers of household food waste. Whereas the first strand sees the ineffective performance of food-related behaviour such as planning, shopping, storing and preparing as an effect of a lack of knowledge, awareness and skills, the second strand incorporates these instances of action into a larger construct of social practices, arriving at an understanding of food waste as the unintended consequence of many interrelated practices of everyday life.

These two academic approaches to household food waste are in some ways complementary in that the second strand provides explanatory depth to the first. However, conflicting conclusions are also being made by contributors from the two strands, both in terms of the relationship between cause and effect and in terms of policy implications. One example of such a conflict concerns planning and purchasing the meals for the week, or the lack thereof. Weekly planning is seen as both causing and preventing food waste, depending on which strand of research you look at. The reasons for planning or not planning are, on the one hand, seen as being influenced by the level of awareness, skills and availability of tools and, on the other hand, as a result of how planning fits into the nexus of practices constituting everyday life. Of course, even if the lack of planning causes larger purchases of food, it is difficult to determine whether subsequent food waste is the

result of a lack of planning or a lack of incorporating available food into meals, or both. It is also difficult to determine whether information campaigns about better planning would be the appropriate policy measure, as is often suggested.

On the whole, the reviewed research shows that food waste in households cannot easily be attributed a few decisive causes, and is instead the result of multiple interrelated actions, meanings, ideals, infrastructures, materials, and skills that are part of the practices of everyday life. This dispersed nature of food waste drivers makes it difficult to imagine effective design interventions. Certainly, there is no singular design product or system that could fix the food waste problem. Design interventions to reduce household food waste described in academic literature and in grey literature could be sorted into three categories: intelligent fridges and apps, packaging and containers, and information. The first two categories are interventions in the shape of commercial products, both material and digital, promoted by business and industry actors. The third category comes in the shape of knowledge and awareness campaigns initiated by public authorities and NGOs and in some cases by commercial actors (such as in-store campaigns). However, there is no empirical evidence of the effect of different intervention types as part of a potentially larger system. In conclusion, there seems to be a research and innovations gap to fill in order to envision and create holistic practice-oriented solutions rather than information-oriented solutions, aimed at enabling consumers to avoid food waste in everyday life.

4.2 Article 2: Food waste in the shadow of ideals: A case for practice-oriented design

Marie Hebrok, 2018,
Journal of Design Research. Vol. 16, Nos. ¾.

This article explores how idealised practices influence food waste levels in households and suggests practice-oriented design approaches to address this connection between ideals and food waste.

The study presented in this article is based on a qualitative multi-method research approach consisting of at-home semi-structured interviews, shop-a-long interviews, fridge studies, and audio and photo recordings, as described in chapter 2. We visited 26 households between 2015–2017 in the Oslo and Akershus area in Norway. The recruited participants were between 25–51 years old, living alone, in couples or in families with children. These households were recruited based on previous research identifying young adults and families with children as the biggest wasters of food.

In the analysis of the resulting data, I identified a number of practices directly or indirectly related to food which contributed to food becoming waste in the households. I found that many of these practices were rooted in a number of ideals concerning thrift, health, care and diversity. These were ideals that would most often take priority over avoiding food waste. They were also more present in the minds of the participants and in the various sequences of events in everyday life. Thus, although participants preferred to avoid wasting food, this would conflict with other, perhaps more pressing, ideals. These ideals were related to saving money, catering to preferences, ensuring food safety, providing a healthy diet, showing generosity and abundance, and enjoying novelty and diversity. The figure below shows these ideal practices, which I have called: planning meals and purchases; healthy eating; caring through food; and diversifying food experiences. The figure also illustrated how these ideal practices are made up of materials, meanings and competences.

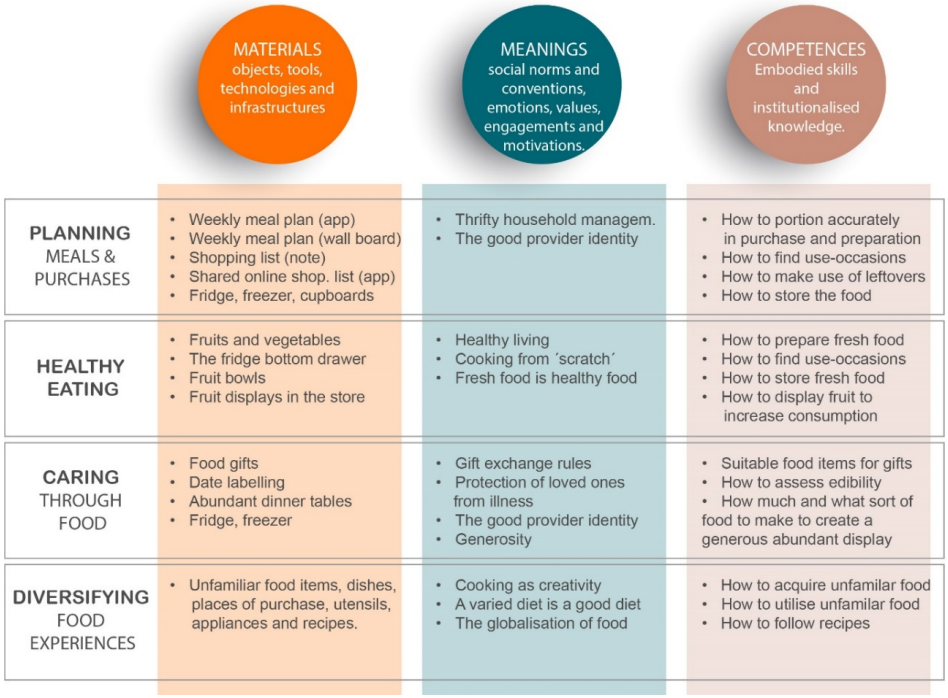

Figure 20: Ideal practices. Source: Hebrok, (2018).

One example of a practice that rooted in such an ideal and that could be related to food waste was that of healthy eating. Participants gave various accounts of how they repeatedly purchased large amounts of fresh fruit and vegetables, motivated by ensuring a healthy diet for themselves and their family. However, many of them struggled to incorporate all of the fresh produce into everyday meals before it became inedible, and thus ended up wasting much of the food. Another example is the practice of caring through food. Participants explained how they would always prepare more than enough food when entertaining guests because they wanted to appear generous and for people to enjoy themselves. They feared that the food would run out before the guests were satisfied. Other forms of caring through food observed were the practices of giving food as gifts, and leaving out potentially hazardous food when preparing meals for children. All of these practices cause food to be wasted.

The article calls for exploring how practice-oriented design might contribute to enable people in achieving their everyday ideals without wasting food in the process. Without defining what should be designed or redesigned, I provide a starting point for thinking about design interventions to food waste from a practice perspective. The starting point I propose is to depart from the current assumption pertaining to lack of knowledge, awareness, skills and motivation as

the main driver of food waste, and instead ask practice-oriented questions. For instance: How can we design products, services and systems that help people live up to their ideals by enabling them to: 1) organise meals and purchases in a more effective, flexible and spontaneous way?; and 2) eat healthily and safely without wasting food? I argue that reframing the problem of household food waste in such a way could inspire unprecedented ways of approaching it through design. I also argue that the idealised practices identified in this article represent promising intervention points for design to reduce food waste, and should be further explored.

4.3 Article 3: Contextualising food waste prevention: Decisive moments within everyday practices

Marie Hebrok & Nina Heidenstrøm, 2019,
Journal of Cleaner Production. Vol. 210. Pp. 1435-1448.

In this article, we identify decisive moments within everyday practices as windows of opportunity for food waste prevention, and explore potential contextual measures against food waste.

Our main argument in this article is, as emphasised in Article 2, that purely information-based measures are inadequate for reducing food waste in households, and that new measures need to be developed that can be implemented within the contexts of the practices that are causing the waste. The article illustrates how food waste occurs when purchased food items and leftovers do not fit into the everyday pattern of food consumption, and explores how the material infrastructure of food-handling practices (e.g. kitchens, refrigerators, cupboards, grocery stores, packaging, labelling, etc.) and the materiality of food itself represent opportunities for interventions. The research is based on fieldwork in 26 Norwegian households and on the same data material presented in Article 2. In this article, we focus on describing decisive moments in everyday practices where we see an opportunity to intervene in order to avoid food waste. We suggest developing contextual measures implemented within time and space of the practices causing food to become waste. By illuminating the connection between food waste, practices and contexts, we aim to inspire future research and policymakers to explore a more contextual approach to food waste prevention. Five practices we find to be significant to the emergence of food waste in households are presented: 1) acquiring food by purchasing and planning for meals; 2) storing food; 3) assessing the edibility of food; 4) valuing food; and 5) eating food by creating use occasions and portioning. The figure below summarises the decisive moments we identified within food handling practices where we suggest implementing contextual measures.

Figure 21: Food handling practices. Source: Hebrok & Heidenstrøm, (2019).

We argue that, contrary to current messages conveyed by awareness campaigns, meticulous planning of meals and purchases does not necessarily reduce food waste in households; in fact, it can increase the amount of waste. Plans often fall through, and people are left with food items for which they cannot find an alternative use occasion. The ability to find use occasions for food that is in stock is important to avoid food falling out of the rhythm of meals in everyday life and becoming waste. We find that this skill is decisive, and that people who purchase food items for specific recipes seem to waste more than people who are more flexible and who purchase items they know how to use in a variety of dishes. Furthermore, many seem to struggle with accurate portioning when preparing meals. Thus, a more important skill to foster is creative cooking whatever food is at hand, and to enable flexibility in food purchasing and preparation, avoiding food items that are difficult to use outside a certain recipe. New services for food

purchasing and preparation (such as box schemes and online shopping) could contribute to this goal.

Food packaging and the refrigerator are central material infrastructures that significantly influence food waste levels. The fridge is the main storage unit in the kitchen for ensuring prolonged shelf life and keeping food safe for consumption. We observe that the traditional design of the refrigerator is suboptimal for providing a sufficient overview of the food in stock. Thus, we suggest that there is untapped potential in redesigning the fridge to reduce household food waste. Redesign efforts should focus on increasing visibility, triggering use occasions and reducing uncertainty about edibility. Some food packaging could be better adapted to the way food is handled at the consumer stage. This concerns portioning, visibility, stackability and so forth, taking into account the functional needs for the full life cycle of food products.

Assessing food quality and safety is a decisive moment in food handling at home that often leads to food waste. Insecurities about the risk of falling ill or experiencing discomfort is a major cause of food becoming waste. Sensory evaluations and previous experience with food items have a strong influence on people's decision to eat, waste or to choose the third alternative, which is to store food *at mercy* in the hope of eating it later or becoming sure of its inedibility at a later time. Innovations in shelf life indicators may contribute to reducing this uncertainty. Some adaptions to packaging could also be appropriate, such as increasing visibility of mixed and liquid food products.

Unsurprisingly, we find that food that is perceived to have a high value is less often wasted than food that is considered to be of low value. However, food is not valued according to its monetary value alone. We find three other influential forms of value that are significant in relation to food waste: utilisation value, relational and time value, and quality and taste value. This shows that increasing the monetary value of food is not the only way to reduce food waste. Exploring how these other forms of food value may be increased could be a way forward in the development of food waste reduction measures.

In sum, this study describes practices related to food waste and to moments of reflexivity within the contexts of these practices, illuminating how they represent promising intervention points for design and imagining them as future pathways for food waste reduction by design.

4.4 Article 4: Bird: Design fiction and the futures of food consumption

Marie Hebrok & Henry Mainsah,
submitted, January 2020.

This article explores the use of design fiction as a vehicle for promoting discussion and critical reflection on the complex issue of sustainable food consumption.

The work leading up to this article applies a practice-oriented design for sustainability approach to household food waste, suggesting that the drivers of food waste are linked to the complex interrelations between everyday practices, and that measures should address specific contexts of food handling rather than relying on raising knowledge and awareness amongst consumers to reduce waste. In this article, we go one step further by exploring a space outside the realm of incremental design improvements, where we situate practices at the core of the sustainability of food systems and explore the potential influence of current technological and social trends. The article presents the design fiction, *Bird*, a commercial food delivery service, existing in a not so distant future (2049), that provides food subscriptions to its customers using a number of already existing and emerging technologies, such as big data, drones, location tracking, and sensors. Food-related practices representing the entire food value chain – from production, harvesting, distribution and provisioning to storage, preparation and eating – have been significantly modified in the fictional world of Bird. Some practices, such as shopping in the grocery store and planning and preparing meals, have been removed from the household and moved to the facilities of Bird. The service leverages the motivational mechanisms inherent in the self-improvement industry by promising to deliver aesthetic self-enhancement through food. The aim is to make the food system sustainable by design without needing to appeal to the environmental awareness of individuals.

Figure 22: The Bird logo. Source: Hebrok & Mainsah, forthcoming.

The fiction was co-designed with a group of professional designers in a workshop setting and through following iterations conducted by the authors. The aim of creating a design fiction on the topic of sustainable food consumption was spurred by the observation of shortcomings in current measures against household food. We observe that the reduction of household food waste is approached in two main ways; 1) by public knowledge and awareness campaigns, and 2) by various commercial products enabling better storage and planning. In an effort to expand

the way we think about sustainable food futures beyond the incremental innovations in food handling products and increased of knowledge and awareness, we created a tangible fiction to facilitate and provoke critical reflections about preferable and non-preferable trajectories based on current trends projected into a not so distant future. We find that this fiction brings forward a complex set of ethical, social, cultural, political and aesthetical issues relevant for the sustainability of future food consumption, enabling us to see these issues on different levels from micro to macro views. Furthermore, we can make it accessible to the public to reflect on and critique in subsequent sequences of this research by illustrating through aesthetic devices how one of many possible food futures might look and be experienced. In this way, design fiction has the potential to democratise future visions of social and technological change by enabling a broader audience to critique and discuss potential futures, thereby illuminating preferable and non-preferable trajectories of change.

Figure 23: Example of aesthetic devices: the fictional New York Times article and the Bird brochure.

The discussions and reflections Bird brought about centered around how current trends in the technology and self-improvement industry might influence food futures, and what the ethical and aesthetical consequences might be. Issues of power surfaced as we discussed how the power over food will be distributed in the future, how people can be moved to act more sustainably, what actors will have the power to move them, and how that power could be misused or lead to unfavourable outcomes. Aesthetic issues pertaining to food cultures and landscapes emerged as we saw technology transform how food is produced and consumed. All of these issues made it easier for participants and researchers to

grasp possible consequences of political agendas, such as those related to ideas about green growth, to the way we deal with food, and to the sustainability of our food systems.

We argue that the method of design fiction has enabled us to achieve three distinct but connected goals: 1) to inscribe socio-political critique into tangible narratives of futurity; 2) to provide a rich space for reflection for researchers and designers working on wicked problems; and 3) to make complex issues accessible to the public by rendering possible futures more tangible.

4.4.1.1 Elaboration of the background material for Article 4

Since the format of Article 4 only allowed for inclusion of one fiction, many of the themes that emerged during workshop 3 had to be excluded. Thus, in order to provide a more comprehensive account of the discussion, this section provides a summary, followed by a synthesis of the main ideas and themes that emerged in the shape of a future scenario which we did not develop further but from which the design fiction Bird was born.

The group particularly addressed two quite different forms of value connected to food consumption. First, the instrumental function of food as nutrition. Second, food as a cultural and social component. Of course, what is considered to be nutrition is also matter of culture. Nevertheless, these two perspectives on the value of food represent different starting points for imagining alternate food futures. Interestingly, the group found ways of reconciling the two perspectives. We discussed how, if food is primarily available purely as nutrition, the social and cultural aspects could be constructed in new ways or perhaps even detached from the food itself through, for instance, virtual reality food experiences. Following the same logic of seeing the value of food as nutrition, and spurred by the big data card from the CASE card deck (described in the methods section), several participants voiced ideas pertaining to rationing of food based on nutritional needs defined by an authority. Two ideas of quite intrusive ways of calculating and monitoring these nutritional needs amongst citizens emerged, namely: 1) a chip implant that monitors its host's food consumption and calculates the exact amount of nutrients needed, and 2) the somewhat ludic Ass Print technology that monitors the food people consume based on what goes into the sewage, and uses big data to develop the perfect nutritional balance for citizens. What you eat decides what food will be delivered to you. The needed nutrients are automatically ordered and drone-delivered to the doorstep just in time.

A less dystopian version of the rationing nutrients concept was based on food preservation technology. Starting with the insight that perishable fresh food

is currently wasted in the largest quantities, a suggestion was made to increase the preservation of fresh food at the source, perhaps making preservation part of all food production in order to prolong shelf life to the absolute maximum. Additionally, food preservation revolved around ideas of organising food consumption in a more communal and social way by, for instance, establishing food hubs in neighbourhoods, where people can obtain memberships and gather around meals.

These ideas about food preservation, rationing of nutrients and collaborative food consumption represent the starting point for a scenario I created based on the discussions in the workshop from which the design fiction Bird grew. I include this scenario here as it illustrates the multitude of issues and ideas pertaining to the future of food consumption that were discussed by the group and which Article 4 could only cover in part. The scenario is entitled:

The 'preservation turn' and the era of collaborative urban food production

The food system in 2100 is based on a combination of mass preservation of fresh food (i.e. by canning) and a community-driven explosion of collaborative urban food production. Climate change has caused a massive reduction in food production globally, and each country has to be self-sufficient. Export of fresh food is prohibited. In many countries, this has resulted in a radical redesign of the food system. Authorities have decided that all commercial food crops must be preserved immediately after harvest in order to avoid losses. Meat production is banned due to its low output of nutrients in relation to its input, environmental impact and ethical low ground, and protein is mainly harvested from insects. The preserved food items and protein products are then distributed amongst the population according to individual needs and wants.

It is a modified form of rationing where people can still order food according to their preferences; however, the amount of food that can be ordered is limited. The food is drone-delivered in the form of conventional preserved food items or as a food mass suitable for 3D printing. In the latter case, the fridge is replaced by a 3D printing unit containing refillable tubes of food material that can be combined in a wide variety of dishes. Natural colouring is added to create colourful appealing dishes with the push of a button. Those who can afford it employ a Robo-cook (RC), an in-house kitchen cook with complete control over food consumption in the household. RC is responsible for ordering the exact amount of ingredients needed to prepare the meals wanted by its owners and for managing the food from storage through preparation and handling of leftovers.

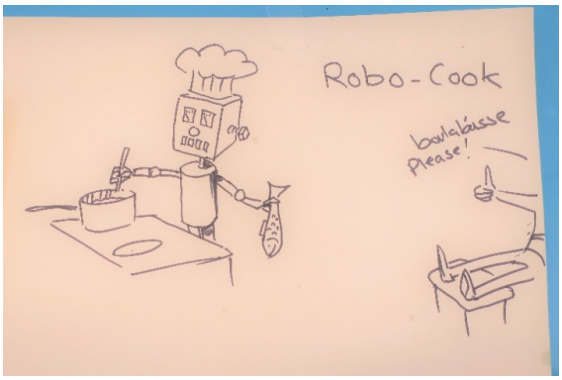

Figure 24: Sketch of Robo-Cook from workshop 3.

To compensate for the loss of variety due to the import ban and the social and cultural values in the way food is consumed, the idea emerged of services to fill this gap, ones that provide virtual experiences of flavours, food items and meals that could be experienced in a social context, emulating how things used to be. The service provides the socio-cultural experience of food without the actual food. This becomes a way of still experiencing the eating meat, tropical fruit and dishes that are no longer available.The production of fresh food outside of the system is only allowed for non-commercial purposes. As a result, fresh food becomes almost impossible to obtain, which sparks an explosion in urban gardening initiatives. People establish neighbourhood food production hubs (NFHs), and over time they develop their skills to maximise their returns from what they grow. However, the total returns are only enough to supplement the conserved food items that are now mainstream. How much each individual is allowed to harvest depends on the amount of work hours contributed and credits earned. Financial transactions are not allowed. However, NFHs engage in bartering in order to increase the diversity of fresh food available to their members, leading to the formation of increasingly large networks of NFHs.

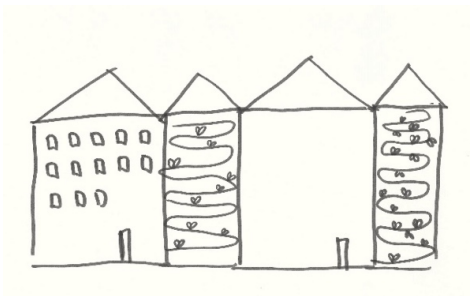

Figure 25: Sketch from workshop 3.

Members of an NFH are entitled to five hours a week off work to labour in the NFHs. The NFHs are initially constructed in a variety of ways, from rooftop gardens and clusters of greenhouses to large vertical high-tech urban food production units with closed nutrient and watering systems. As time goes by, innovation accelerates, and by 2150 all new housing projects include a high-tech NFH facility, neatly integrated into the architecture. As the sense of community grows within the NFHs, people increasingly gather for meals, enjoying the fruits of their labour together. This spurs the establishment of the neighbourhood kitchen and dining hall, which serves their members meals a few days a week, made from the crops they have all laboured to yield. The staff working there earn credits that can be exchanged for food. Because the

scarcity of fresh food increases its perceived value enormously, almost nothing goes to waste. Meticulous systems are developed to sort food crops according to criteria which indicate its suitability for different methods of preparation. Because the amount of fresh produce produced in NFHs can never cover the total amount needed to feed the members, this scarcity ensures that there is never a surplus that can be lost. Thus, everything that is harvested is prepared and consumed within a short period of time. Because each country is self-sufficient, new food cultures develop based on the food items available in each country. In Norway, the main food items produced consist of a variety of seafood, grains and vegetables that can be cultivated in the far north. Due to increased temperatures, more kinds of vegetables can be cultivated there, and the growing season has been prolonged by a few months.

Figure 26: Sketches from workshop 3.

This scenario illustrates possible future food systems which the participants in workshop 3 discussed as a response to potential future results of climate change on the world's food supply. They also discussed some of the potential downsides of such systems, such as black markets for illegally produced and imported meat, fruit and vegetables. Furthermore, they discussed issues concerning the governance of equal rights to access food and the distribution of power over food sources when food becomes a scarce resource. The latter issue pertaining to power distribution was embedded in the design fiction Bird, illustrated by the scandal portrayed in the fictional New York Times article.

What I found particularly interesting whilst analysing the discussions from workshop 3 was the effort participants made to reconcile two seemingly opposing but, as they saw it, not mutually excluding approaches to sustainability seen in a political context: the top-down approach and the bottom-up approach. Participants saw arrangements and initiatives coming from both governments and grass-root movements as existing side by side. However, before combining them they discussed these solutions separately as utopian visions of how food consumption could be made sustainable by design in the future. Sharing, collaborating and community became central to one vision, whilst technological progress extrapolated from current trends dominated the other. In this technocentric vision, a form of technology-enabled dictatorship ensures maximum yield of food in production and fair and equal distribution of food. Later, ideas of how sharing, collaboration and community could supplement the technology-enabled system emerged. This process shows a tension between two different views of how change for sustainability might be achieved in the best way. On the one hand. participants would like to see what bottom-up actions of sharing, collaboration and community could provide in terms of solutions, while on the other hand they think that top-down force is the most effective way to bring about large-scale change – and that technological development will provide us with the solutions. Put simply, these two views represent two kinds of values: the bottom-up approach is an expression of social values, whilst the top-down approach expresses values pertaining to progress, control, and efficiency. These two views of the path towards sustainable solutions are recognisable from discourses observable in Norwegian media and politics today. Increasing techno-optimism amongst Norwegian consumers indicates that technology-enabled change is the approach most widely supported. Nevertheless, bottom-up approaches such as community gardens might have a certain aesthetic appeal to some consumer groups interested in food, sustainability and nutrition, though at present they are not supported by the majority of consumers in terms of use. Side by side, these two views and the ideals and values they represent influence the way we think about future food

systems and sustainability, and should be further investigated to explore how they direct, inhibit and fuel current trajectories.

What the design fiction method has provided is an illustration of this dualism in how participants think about sustainability in the context of food futures and how thinking about food futures from a PODS perspective by way of design fiction can contribute to unpacking a multiplicity of opportunities, possibilities, risks and barriers pertaining to the future of food. Moreover, it may enable us to reflect on what we perceive as preferable and non-preferable trajectories and outcomes.

5 CONCLUSIONS

This chapter summarises and discusses the overall contribution of the project. I start by discussing the three sub research questions, proceed to the main research question, and conclude with a discussion of limitations, implications and recommendations for further research.

5.1 SRQ1: How do social practices influence household food waste?

As described in the summary of Article 1, the existing literature on food waste drivers in the context of the household is diverse in terms of both theoretical stance and discipline. What these different scholars agree on, however, is that there are certain sequences of food handling that influence food waste levels in significant ways, such as the planning of purchases and meals, portioning for and preparing meals, and the storing of food items and leftovers. Within these sequences, scholars identify ways of dealing with food and infrastructural deficiencies such as inadequate packaging and refrigerator temperatures as elements causing food waste. Poor planning routines, in particular not planning meals for longer time spans such as a whole week, are argued to cause food waste because food is left without purpose for specific meals. Furthermore, planning is expected to contribute to avoid purchasing more than needed. Poor portioning and preparation skills are identified as driving food waste by producing large amounts of leftovers that are left uneaten. Storing food inadequately in a way that reduces its shelf life is another frequently mentioned food waste driver. Instances of suboptimal storage conditions earlier in the value chain, for instance during transport or in the grocery store, are also recognised as significant drivers, as is the way in which stores influence consumers to buy more than they need through offers and large-size packaging.

However, contributions including more of the socio-cultural aspects of household food waste point out that its causes cannot merely be reduced to poor skills and lack of awareness. Rather, food waste is seen as a result of multiple interrelated actions, meanings, ideals, infrastructures, materials and skills that make up of the practices of everyday life. Similarly, to the existing research on the drivers of household food waste in European countries, and as described in the summaries of Articles 2 and 3, I have found that there are a number of everyday practices that often or occasionally lead to the unintended outcome of wasting food. Five practices I found to be particularly significant to the emergence of food

waste in households were: 1) *acquiring* food by planning and purchasing for meals; 2) *storing* food; 3) *assessing* the edibility of food; 4) *valuing* food; and 5) *eating* food by creating use occasions and portioning. I found that there were specific aspects of these sequences of food handling that were particularly important: 1) the lack of flexibility inherent in overtly planning for purchases and meals did not respond to the way plans tend to change during the course of a week; 2) the way food is stored, making it invisible and unavailable for use; 3) the insecurities that arise when assessing the edibility of food; 4) the way food is valued according to its qualitative, utilisation, relational, sensory, and monetary value; and 5) the ways in which use occasions are created and food is portioned.

What surprised me when conducting the study that led to the writing of Article 2 was that many of these drivers of food waste were rooted in ideals and good intentions. I have called them *idealised practices*, and identified four distinct types: 1) planning meals and purchases; 2) healthy eating; 3) caring through food; and 4) diversifying food experiences.

The first idealised practice of planning meals and purchases relates to the ideal of thrift and to ideas about how to be a good provider. The ideal of planning in order to organise meals and purchases effectively, saving both time and money, is observable both in our interviews and in the campaigns and messages directed at consumers to encourage them to reduce waste. However, we found that planning and purchasing food for a whole week, which is the recommendation made by most awareness campaigns, often leads to waste. The reason for this is that everyday life is unpredictable, and sticking to a meal plan is therefore difficult. Ad hoc changes in plans leaves food items redundant, and often no new use occasion is found for it.

The second idealised practice of healthy eating leads to food waste in a rather predictable way. Many of the participants entertained the ideal of healthy eating, relating it to the consumption of fruit and vegetables. Not only did they want to eat healthily themselves; they also wanted their family members to do so. This ideal would trigger them to purchase larger quantities of fruit and vegetables than they would actually consume. Furthermore, it would lead them to store the produce in suboptimal ways, such as displaying fruit in a bowl on the kitchen counter to inspire themselves and family members to eat it – as well as for aesthetic purposes.

The third idealised practice of caring through food manifests itself in several ways. It relates both to food safety and to conviviality. I found that food safety would trump food waste avoidance in most cases, particularly where children are involved. Participants expressed low tolerance for risks pertaining to food they

would feed their loved ones, and would rather waste food than risk illness or discomfort. Participants who only had responsibility for their own safety would not be as restrictive. Food waste related to conviviality was often a result of ideals of abundance, and of giving food as gifts. The idea of not having prepared or displayed enough food when hosting a dinner party is uncomfortable, and thus preparing more than enough food to be on the safe side is a common strategy which often leads to waste. Furthermore, the trend of giving food as a gift to the hostess or as a Christmas present is a practice which in many cases causes food waste if the recipient does not like or does not know how to consume it or never finds a use occasion for it.

In sum, it can be concluded that everyday practices influence the trajectories of food from being food to becoming waste in many different ways across sequences of food handling and through practices rooted in certain ideals.

5.2 SRQ2: What current products, services and systems aim to reduce food waste in households?

A variety of devices designed to reduce food in households has already been produced using communication design, graphic design, product design, interaction design and service design.

Most policy recommendations found in the general literature suggest using knowledge and awareness campaigns to reduce household food waste to respond to the assumption generated by this research, i.e. that lack of knowledge and skills amongst consumers is decisive to the amount of food wasted. These campaigns seem to represent the most widely applied measure to reduce food waste by public authorities. However, tests are being conducted on a technology-enabled measure called the 'pay as you throw' (PAYT) system, which is a weight-based billing system directed at consumers that aims to increase recycling of food waste and divert food waste from landfills. To my knowledge, pilots are currently running in a few countries.

The actors behind knowledge and awareness campaigns are both public and commercial. Commercial actors, such as retail chains and box scheme services, tend to use similar language and references pertaining to the drivers of food waste identified in research. These campaigns seek to educate people on the importance and advantages of planning routines, interpreting date labelling, portioning, etc.

Of course, commercial actors do not only design campaigns against food waste; they design products and services, too. A vast amount of food containers, refrigerators, freezers, packaging, and labels are marketed on their ability to keep

food fresh for longer in order to avoid wasting it. Food services, such as box schemes and online retailers, are promoting themselves by claiming that their service will reduce the amount of food wasted in households (Norwegian examples are Adams Matkasse and kolonial.no). Furthermore, food-sharing apps have emerged providing a platform for making surplus food from households available for redistribution, though most of them seem to have stranded, with a few exceptions such as British Olio, and German foodsharing.de.

The field of design research takes a different approach, experimenting with prototypes of various digital and non-digital tools to explore how these might enable people to waste less, such as apps that keep track of food in the fridge and expiration dates or that provide recipes, portioning guides and other support for avoiding food waste. These kinds of technology are already available on the market to some extent in connection with smart fridges.

In sum, consumers are targeted by awareness campaigns, they have access to a variety of products that can prolong the shelf life of their food, they can access digital tools that help them plan and portion their meals to avoid buying and/or making too much food, and they can subscribe to food services that do the planning and portioning for them.

5.3 SRQ3: What future pathways towards reducing household food waste by design can be identified from a social practice perspective?

*"*We should not limit ourselves to the present in design; we should consider long-term projections into the future, but social practice theory reminds us of the importance of considering the process of incremental change in practice to get there*"* (Clear & Comber, 2017:8).

In line with the call from Clear and Comber (2017) above, I have identified two routes towards reducing food waste by design which are not mutually exclusive. They differ in terms of level of innovation, again referring to the levels defined by Ceschin and Gaziulusoy (2016): 1) the product level; 2) the product-service level; 3) the spatio-social level; and 4) the socio-technical level. Sustainability gains are expected to increase with each level. The first route consists of product-level and product-service-level innovations, such as the ones that can already be seen in packaging, labelling, fridge/freezer technology, apps, box scheme services and online grocery shopping services, and which I have described in the previous section. The second route is on the spatio-social and socio-technical levels of innovation, and consists of reimagining and reconfiguring

food-related practices more deeply. This route entails rethinking how we go about provisioning for food, when and where we eat, how and where food is stored, etc. In the following section I will discuss these two routes in more detail, and how the insights provided by the practice-oriented design for sustainability approach developed in this dissertation can contribute to informing future pathways of food waste reduction and more sustainable food futures.

5.3.1 Product-level and product-service-level innovations

I argue that the first route of product-level and product-service-level innovations addressing household food waste should become more contextualised and sensitive to the competing ideals that influence food waste-related practices. By arguing for innovations to become more contextualised, I refer to the conclusions in Article 3 that call for design interventions directed at decisive moments in everyday practices where an opportunity exists to avoid food waste. The claim that innovations should become more sensitive to competing ideals refers to the idealised practices identified in Article 2 pertaining to ideals of thrift, health, care and diversity.

5.3.1.1 Contextual innovations and decisive moments in everyday practices

I will begin with the first argument pertaining to contextual innovations and decisive moments in everyday practices. Examples of such decisive moments are when consumers are: 1) acquiring food by purchasing and planning for meals; 2) storing food; 3) assessing the edibility of food; 4) valuing food; and 5) eating food by creating use occasions and portioning. These moments represent opportunities were the design of products and services can be inserted into the time and place of food waste-related practices and divert those practices from resulting in food waste. The general recommendations I make for addressing these moments of opportunity through design are:

a) Increase flexibility pertaining to acquiring and planning for purchases and meals to avoid over-buying as a result of long-time planning. I find that making weekly meal plans and purchasing large amounts of food to execute that plan often lead to waste when plans inadvertently change and unexpected turns of events arise. Greater flexibility could be promoted through, for instance, innovations in food delivery services such as box schemes, online grocery shopping, and takeaway services.

b) Increase the visibility and aesthetic appearance of food items in storage units, particularly in the fridge and freezer. Food items that are out of sight are out of mind, and therefore often perish. Furthermore, unattractive leftovers are often wasted instead of being consumed. This recommendation points to the redesign of

storage units such as the fridge and freezer to improve the visibility of food items and containers for leftovers, making them more attractive.

c) Reduce insecurities associated with evaluating the edibility of food items. Consumers negotiate between institutionalised knowledge (e.g. date labelling) and their own know-how (e.g. sensory evaluations) when assessing the risk of experiencing discomfort or disgust when consuming food that has turned bad or – even worse – the risk of illness. Innovations in shelf life indicators may contribute to reducing this type of uncertainty. Some adaptions to packaging could also be appropriate to, for instance, increase visibility of mixed and liquid food products.

d) Increase the perceived value of food by addressing a multitude of values important to consumers, such as relational, qualitative, sensory, monetary, and utilisation value. I find that food that is perceived to have a high value is less often wasted than food that is considered to be of low value. However, food is valued not only according to its monetary value. I also find other forms of value related to, for instance, the relational attachment to the food (e.g. the food is home-made or a gift from a loved one), the degree to which it has been utilised (e.g. still in original packaging or only a small percentage left) or its perceived quality (e.g. organic, local, sensory). These forms of non-monetary value could inform innovations in food design, communication and packaging design in order to increase the perceived value of food.

e) Increase use occasions for food items and leftovers by supporting flexibility in meal preparation in order to avoid food items not fitting into routines and to avoid food items not being used due to unfamiliarity. I find that the ability to find use occasions for food that is purchased is important to avoiding food waste, and that purchasing food items that only apply to certain recipes seems to increase the risk of waste. Conversely, purchasing items that knowingly can be used in a variety of dishes reduces this risk. Furthermore, accurate portioning is a challenge to many consumers. This leads me to conclude that creative cooking using whatever ingredients are at hand is an important practice to support. Again, innovations in food services such as box schemes and online shopping could contribute to this goal. Packaging designs that enable better portioning and promoting use occasions beyond printed information could be another design opportunity to explore further.

5.3.1.2 Innovations coping with competing idealised practices

In Article 2 I describe a number of idealised practices I found influenced food waste in households when they conflict with ideals of avoiding such waste. These idealised practices related to ideals of thrift, health, care and diversity, and would most often be prioritised above avoidance of food waste. I found that efforts to save money, cater to preferences, ensure food safety, provide a healthy diet, show generosity and abundance, and enjoy novelty and diversity would indirectly and

directly cause food waste. Four examples of such mechanisms observed that relate to these ideals were: 1) thrift: people would make weakly meal plans and shop in bulk to save money, only to experience that plans changed and made stocked food items superfluous; 2) health: people would repeatedly purchase large amounts of fresh fruit and vegetables but not manage to incorporate all of the fresh produce into everyday meals before it perished; 3) care: people would prepare a lot more food than necessary when entertaining guests, or to show generosity would give food as gifts, not knowing that it would be stored away and never eaten, or leave out potentially hazardous food when preparing meals for children; and 4) diversity: people like to experiment with new food items and dishes to create diversity in their food experience, but find it difficult to find use occasions for leftover food items due to unfamiliarity, rendering these items superfluous.

The design challenge that can be deduced from these insights is to explore how practice-oriented design might contribute to enabling people to achieve their everyday ideals without wasting food in the process. Without defining what should be designed or redesigned, I seek to provide a starting point for thinking about design interventions to reduce food waste from a social practice perspective. In the case of food waste, I suggested starting by framing the design problem through questions such as:

How can we design products, services and systems that help people live up to their ideals by enabling them to: 1) organise meals and purchases in a more effective, flexible and spontaneous ways, and 2) eat healthily and safely without wasting food?

I argue that framing the problem of household food waste as a design problem in such a way could inspire unprecedented ways of approaching it through design. Exploring ways of how idealised practices, such as the ones I identified in Article 2, can represent promising intervention points for design to reduce household food waste.

5.3.2 Spatio-social and socio-technical levels of innovation

The second route I propose towards reducing food waste by design is on the spatio-social and socio-technical levels of innovation, and consists of reimagining and reconfiguring food-related practices more fundamentally. This route entails rethinking how we go about provisioning food, when and where we eat, how and where we store food, etc. For instance, during the course of the project, I observed that much of the food that is wasted in Norwegian households is purchased for the main evening meal. Thus, in line with the concluding reflections of Evans in his

book on food waste (2014) I would suggest that changing this practice by simply moving the main meal in both time and space might reduce food waste in households substantially. In Norway, it is customary to bring sandwiches to work, school and day care for lunch. If we were to switch these eating practices around by eating the main meal at lunchtime prepared by professional kitchens streamlined for efficiency, and having a simple sandwich at home in the evening, this would most probably reduce the amount of food items provisioned for, stored, prepared and wasted in the home. This transformation of eating practices seems unlikely from the perspective of the status quo. Nevertheless, it could still emerge as a result of current trajectories of innovation and politics in a number of ways.

Thus, in order to explore this route of spatio-social and socio-technical innovation, this dissertation has applied a co-creation approach to create narratives of possible future food practices together with participants, as described in previous sections. The creation of a design fiction and a scenario has provided two sources of imagining, discussing and critiquing different ideas about how the way we deal with food and food consumption in everyday life could be transformed in the future through design and innovation. The design fiction Bird (described in Article 4) and the scenario entitled *The 'preservation turn' in the food system and the era of collaborative urban food production* (included as background material in this dissertation) have provided a space for a research-based conceptual exploration of possible future trajectories and have been visualised to increase tangibility.

The outcomes of these explorations have provided both discursive and visual accounts of discussions amongst participants about how different ways of balancing between two extremes could lead to contrasting solutions in the future, such as the ways in which the distribution of power over food production and distribution could lead to individualistic versus collective solutions in various degrees, and the way of conceptualising food as pure nutrition versus food as a socio-cultural component could bring various kinds of innovations about. Furthermore, how the different outcomes of innovation pertaining to the balance between these extremes would embody ethical, aesthetical, and political values. For instance, the concept of the Bird food delivery service is an example of a product that appeals to what is framed as individual needs and wants (although these are of course shared with others and produced by Bird), is governed by a commercial actor controlling the supply chain, and promotes certain aesthetic values derived from the self-enhancement industry. Furthermore, the service is the result of political incentives modelled from ideas about green growth. The existence of Bird raises a number of ethical concerns, such as the utilitarian ethics

of the act of manipulation for the sake of sustainability, and the use of food as a means of aesthetic enhancement of the body.

By contrast, the idea of bottom-up establishment of neighbourhood food hubs (NFHs) represents a collective approach to food production, distribution, and consumption encompassing a different set of ethical, aesthetical and political values. The top-down idea about forced mass conservation of food at the source of production and distribution by the government through the use of big data on individual nutritional needs is perhaps the antithesis of the NFH system. Finally, the ideas about techno-fixes such as the Robo-cook, 3D printing of food, big data surveillance of individual nutritional needs, and virtual reality food experiences, are representations of a distinct narrative of progress observable in the discourses on innovation and future developments and solutions.

As I have illustrated in this dissertation, imagining these diverse food futures has brought to light a number of critical issues and questions pertaining to ethical, aesthetic, and political values that are inevitably embedded in any new product, service or system. These issues should be thoroughly considered by actors working on innovation and advocating for certain trajectories of change in the food system.

5.4 MRQ: How can a practice-oriented design for sustainability approach contribute to new insights about how food waste can be reduced by design?

The figure below illustrates the approach developed in this dissertation to explore opportunities for sustainability by design through the lens of social practice theory.

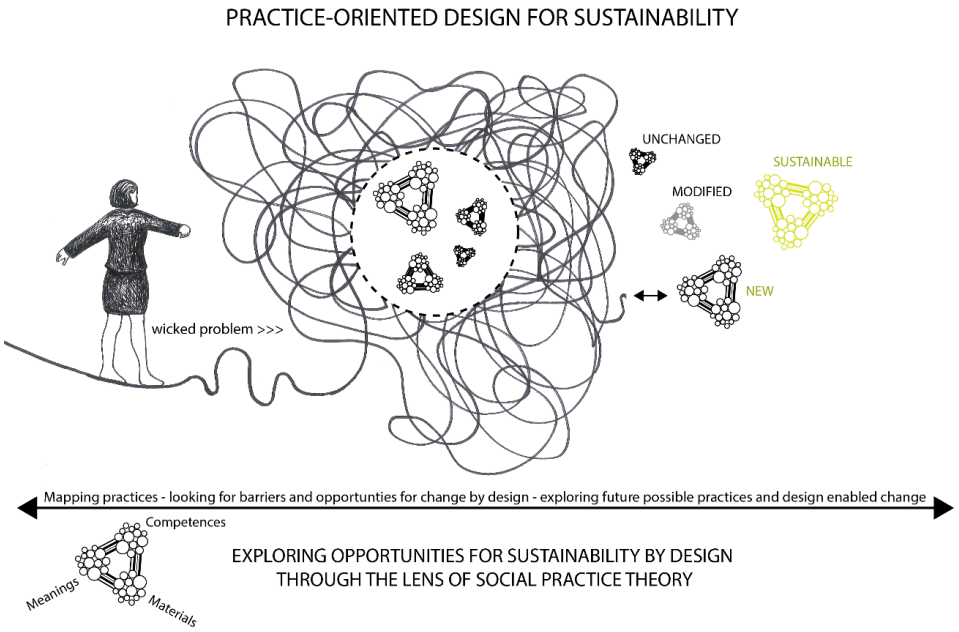

Figure 27: Illustration of approach: Practice-oriented design for sustainability.

The approach commences with a wicked problem – in this case household food waste – and proceeds into the field of chaotic interrelationships between practices, seeking to identify opportunities for modifying existing practices or creating new ones through the design and redesign of products, services and systems. The aim of the approach is not to design a final solution, but rather to map out a breadth of promising opportunities for design that can be acted upon in subsequent design processes, informed by a thorough investigation of relevant practices. By adding the speculative design approach of design fiction, these opportunities can be extrapolated into possible preferable and non-preferable futures in order to expand the way we think about future sustainable practices.

The approach departs from previous work on practice-oriented design in its focus on a broad unpacking of opportunities and constraints relevant to the wicked problem at hand rather than to historical trajectories and experimentation with single practices. Furthermore, the approach is expanded to include speculative design tools to address future systemic and radical opportunities and risks.

However, there are also obvious similarities between design fiction and the development of proto-practices, trigger products, and design probes, in previous practice-oriented design projects, as demonstrated by, for instance, Kuijer and de Jong (2009), de Jong and Mazé (2017), and Kera and Sulamain (2014), particularly in the way of approaching practices through speculative tangible elements, thus making them explicit and visible in new ways and by rendering them open to change through experimentation and critical discussion.

The overall contribution of the results of the approach presented in this dissertation can be summarised as follows:

1. It provides empirical knowledge through rich qualitative data about food waste-related practices in Norwegian households.
2. It identifies opportunities for food waste reduction by design on multiple levels of innovation.
3. It explores critical issues pertaining to future trajectories of sustainable food consumption.
4. It demonstrates an approach for exploring opportunities for sustainability by design through the lens of social practice theory.

The case of household food waste illustrates the usefulness of the approach in the way that it sheds light on how everyday practices influence food waste levels, and how promising intervention points and design opportunities can be derived from these insights about practices. The approach enables an exploration of both current and future possible practices and opportunities for sustainability by design by including design fiction. It differs from similar approaches to sustainable consumption issues that take social practices as the main unit of analysis, such as the written scenarios produced by social practice imaginaries (Strengers, Pink, & Nicholls, 2019), the utopian scenarios visualised through practice-oriented participatory backcasting (Davies, 2013), and the proto-practices produced in practice-oriented design projects (Kuijer, 2014). The novelty of the approach lies in the way it emphasises the importance of fleshing out and documenting the complexity inherent in the intertwined practices of everyday life, and how they cause undesired and/or unintended outcomes rather than forecast or prototype possible solutions too soon or envision preferable futures. However, by exploring and speculating about the potential impact of current trends on possible futures through the design of fictional aesthetic artefacts, the approach allows us to examine and compare critical issues that live side by side and are framed in different ways within current discourses and narratives.

Framing matters profoundly to how we imagine the solution space for a particular (design) problem (Schön, 1993). In the design industry, due to financial

restrictions and time pressure, the framing is usually given in a brief in terms of constraints and affordances, goals and timelines. This framing is then interpreted and operationalised according to the expertise of the designers working on the brief (Cross, 2004). The structural constraints beyond the brief, pertaining to social norms, politics, and material infrastructures, often become part of a fixed backdrop. Both policymakers and innovators work within these constraints of current systems, infrastructures, social norms and cultures, occasionally pushing beyond these limitations but mostly improving things incrementally within the given frame. Furthermore, the opportunities for the individual designer working in an industrial company or design consultancy, to approach wicked design problems, such as household food waste, are limited to non-existent. Consequently, such approaches become insufficient and limiting in terms of framing. In my opinion, this limitation in industry should be compensated for by academia through research projects exploring and communicating complexity and framings of wicked problems that can be operationalised by industry.

There is no uniquely 'correct' way of' viewing a wicked problem, it is related to other problems involving multiple value conflicts and ideological, cultural, political and economic constraints, all of which can be approached through numerous potential intervention points. The fact that the consequences of interventions are difficult to imagine and are associated with a strong resistance to change requires us to approach it from many different angles simultaneously, framing and reframing it as we learn more. In this way, framings that are based on rigid current conclusions that can only reproduce the status quo or provide micro-level change – such as household food waste being the result of lack of information – can be avoided. The dominant framing of the problem of household food waste as an information deficit represents a simplistic view of everyday practices that assumes that people will act to optimise their consumption practices if served with sufficient knowledge. This view can also be found in other areas of consumption, such as energy consumption, as argued by Clear & Comber (2017), who posit that such information-oriented interventions appeal to a limited number of people who are particularly interested, tech savvy and motivated to reduce their consumption.

Of course, I do not presume to argue that the approach I have demonstrated in this dissertation would cover all the necessary angles or provide the definitive framing of the problem. Nor do I presume that design is the answer to any wicked problem. However, I would suggest that my approach shows one particular way of expanding the range of possibilities and the imaginable solution space for reducing food waste by design. As such, it covers at least one approach to the wicked problem of food waste. Furthermore, I argue that the approach opens up for

exploring both current incremental and future more disruptive trajectories of design-enabled change related to consumption practices in general.

5.5 Limitations

The research conducted in this project has been limited to the geographical location of Norway, more specifically to the Oslo area. Furthermore, the sample was limited to 26 households in the fieldwork and to three workshops and 49 participants in the design part of the project, and the results must be considered in light of this context.

The participating households in the fieldwork were recruited by Norstat to represent the groups identified by the ForMat project as wasting the most food, namely young adults and families with children. The results thus pertain to the dynamics of these specific groups. However, since the insights generated from the research corresponds in many ways with previous research conducted in other European countries, it is reasonable to assume that they are in fact representative of the dynamics related to household food waste in Western countries.

The participants in the first two workshops were design students, while the participants in the final workshop were professional designers operating in the fields of product design, service design, interaction design, packaging design, retail design, service design and software design. Thus, the results from the workshops were limited to the input provided by these participants and by their efforts, skills, knowledge, experience and motivation. The workshop context also represents a limitation on the extent to which participants are enabled to contribute and on the degree to which they were inhibited or supported by the social dynamics within the group. Results from the workshops do not assume to represent final solutions, but rather serve as illustrative examples of applying the proposed approach to wicked design problems such as household food waste and sustainable consumption issues.

Methodological limitations pertain to the discursive character of the data collected. Direct observations of practices as they naturally unfold were not possible within the scope of this research, particularly with regard to acknowledging the interrelatedness of practices and their outcomes. Thus, as elaborated on in chapter 2, the methods and data presented in this dissertation bring forward narratives of current and possible future practices rather than practices in themselves. However, by applying certain techniques, such as focusing on the materiality of particular food items, I argue that I get as close as I can to illuminating actual practices within the constraints of this project.

As opposed to previous research in the field of practice-oriented design, this dissertation does not focus on historical trajectories of the practices examined, rather it takes a future oriented perspective that initiates from the present. In this way, it may miss some of the historical context that has shaped practices as they exist today, and the opportunities that could lie in resurfacing some of the elements from past practices. However, during my initial inquiry into the matter I found that historical practices related to food waste were to a large extent shaped by economic and social circumstances (e.g. lower incomes and inequality by women staying at home) that represent past stages of societal development for many, and might be seen as unpreferable in a future-perspective. I thus decided that I would not focus on these past trajectories of practices, and limit my research to address the present and possible futures.

Theoretical limitations pertain to the use of theories of practices as the main theoretical lens through which to explore both food waste drivers and potential intervention points for design. Other theoretical frameworks might provide different insights through a different framing of the problem and solution space.

The approach that has been demonstrated in this dissertation has produced a large amount of discursive and visual data material which could be further analysed to exhaust its potential. Thus, limitations also pertain to the data that could be analysed within the time frame of the project, leaving much of it under-explored.

5.6 Implications and recommendations for further research

This research has implications for actors working on issues related to sustainable consumption in general and on household food waste and food consumption in particular. It should be of interest to policymakers, NGOs, various actors in the food industry and to commercial and public innovators of products and services seeking to contribute to sustainable consumption.

5.6.1 Implications

The implications that can be derived from this research are contrary to two, what I argue, are false assumptions which seem to implicitly guide current approaches to the reduction of household food waste as I perceive it.

The first false assumption that I observe pertains to the belief that if provided with enough knowledge of the food waste problem, consumers will engage in actively reducing their waste. In this belief lies implicit a promise of large-scale changes in collective behaviours induced by influencing individual

cognitive processes (Clear & Comber, 2017). I argue that, this assumption excludes the significance of the interrelationships between everyday practices and how they influence food handling in households. Moreover, it disregards that knowledge and awareness are aspects not necessarily connected to action. This does not imply that these effort to increase knowledge and awareness are entirely without meaning or effect, but rather that they need to be supplemented by interventions that enable consumers to actually act on their increased knowledge and awareness. In further research efforts, I thus recommend to develop and test ways of connecting these two kinds of intervention in order to measure the effects.

The second false assumption pertains to the assumed positive effects on food waste of developing and making products and services available on the market. This assumption downplays the significance of implementation within practices. That is, incorporating not only materials but also meanings and competences, and finding ways to diffuse and ground them. This calls for a co-creation approach including all relevant actors, such as designers/industry, consumers, and policymakers. Furthermore, it calls for appropriate methods to address the complexity of contexts, interrelationships between practices, and the relationship between present and future trajectories of change. By demonstrating such methods within the approach presented in this dissertation, I have provided a starting point for further research and design-driven innovation in reducing household food waste and other wicked problems related to the sustainability of consumption practices. Thus, my recommendation in this regard pertaining to future endeavours would be to apply this approach to new cases with a view to refining it, and to address its shortcomings, as discussed in 4.2 *Limitations*.

Furthermore, the food waste case illustrates an instance of how the power to create the visions and realities of tomorrow is perceived to be distributed. On the one hand consumers are believed to hold great power to induce change just by the force of their choices, on the other there is a growing techno-optimism observable in Norway suggests an increasing belief in industry and policy makers to solve environmental problems, downplaying the power of consumers. The discourse on sustainable consumption is very much characterised by a blame game between consumers, industry and policymakers. The issue of household food waste is also tainted by this. Balancing out these power unbalances through democratising processes of change and innovation is an endeavour increasingly embarked on by actors working on societal design problems. It is seen as a way forward in consolidating the needs and aspirations of people with the inventive and constructive forces of industry and policy in order to achieve sustainable solutions and change. For future inquiry, I thus recommend further exploration of the potential inherent in the design fiction method through case studies involving

consumers, in order to let their voices be heard and acknowledged by other actors influencing future trajectories of change.

In light of the food waste case, more general implications can be derived from what the theoretical underpinnings of practice-oriented design for sustainability mean for current and future ways of addressing sustainable consumption issues by design. First, I argue that social practice theory provides a framework for increasing understanding of and unpacking the complexity inherent in the role of practices in wicked design problems by rendering explicit the elements that practices entail and how they simultaneously cause inertia and represent opportunities for change. Second, and in connection with the first implication, I argue that providing these insights enables us to approach the design problem in both incremental micro-level and radical macro-level ways – moving from ideas for product/service–user interactions to ideas for new ways of living. Third, I see practice-oriented design fiction as a potent method for expanding the temporal scope of the inquiry into change by design, not only for imagining preferable futures but also for reflecting on possible risks and on unintended and non-preferable outcomes of current trajectories.

Generating these insights and ideas does not of course automatically result in real-world impact. Thus, they should be conveyed in a multi-stakeholder/multidisciplinary context that ensures access to decision makers. As such, practice-oriented design for sustainability is most likely an approach that is not limited to design professionals, but rather represents a framework and a method that should engage all relevant stakeholders in the wicked design problem under scrutiny in order to launch actual change. Such stakeholders would include commercial, public and civil actors alike. The application of the approach could be initiated by both commercial and public actors but is of course dependent on access to funding. An elaborate process such as the one demonstrated in this dissertation would need sufficient funding, and would most probably rely on research grants, in which case academic initiators could partner with relevant industrial, public and civil actors. However, in a slightly more compressed version the approach could also be applicable for commercial innovators interested in social and environmental innovation.

5.6.2 Recommendations for relevant actors

The table below summarises the main recommendations for further research, development and action, sorted by relevant actors.

Table 4: Recommendations for relevant actors.

Actors	Recommendations
Designers	• To develop and test practice-oriented design interventions based on current knowledge. • To explore how interventions can be implemented to reconfigure everyday practices over time. • To further explore the potential of design fiction as a method for ideation and critical interrogation of future visions and current trajectories.
Policymakers	• To combine information-based measures with design-based measures to enable consumers to act on their knowledge and awareness in everyday life and increase the effect on food waste levels. • To employ design competence to develop consumer-directed concepts that both inform and facilitate change.
Researchers	• To bring relevant stakeholders together in research projects. • To develop and test practice-oriented interventions. • To explore how interventions can be implemented to reconfigure everyday practices over time. • To further develop the proposed Practice oriented design for sustainability approach with a focus on: o Implementation o Democratisation of futures o Measurable objectives
NGOs	• To redesign and develop campaigns to address food waste-related practices such as those identified in this dissertation and previous work. • To work with industry and policymakers to develop interventions and future visions, and facilitate change in social practices related to food waste.
Food industry	• To explore opportunities based on current knowledge of food waste-related practices, such as those discussed in this dissertation, for designing and redesigning packaging, labelling, food products, etc. with the aim of reducing waste at the consumer level. • To focus on design above information; i.e. focus on the shape of the packaging to make portioning easier rather than on printed information about portioning.

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7 APPENDICES

A1 Collection of articles

A2 Statements of co-authorship

A3 Interview guides

A4 Workshop briefs

A5 List of dissemination

A1 COLLECTION OF ARTICLES

Article 1

Marie Hebrok & Casper Boks (2017),

Household food waste: Drivers and potential intervention points for design - An extensive review,

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Review

Household food waste: Drivers and potential intervention points for design – An extensive review

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ABSTRACT

This review describes the consumer related material and socio-cultural drivers behind food waste found in academic and grey literature. The aim is to identify intervention points for design interventions to reduce household food waste. Within the reviewed literature, an array of different aspects of consumer food waste is studied such as consumer behaviour, attitudes, beliefs and values, quantifications and compositional analyses of food waste in Western countries, waste prevention and concrete design interventions. This illustrates that the problem of consumer food wasting practices is an issue that is complex and involves both socio-cultural and material factors. However, the literature is more focused on generating knowledge about the problem than on finding solutions. Thus, further research should attempt to find ways to test new ideas and interventions that could reduce food waste in households.
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1. Introduction

Food waste is a contemporary environmental, social and ethical issue, which in a historical context is a result of moving from scarcity to abundance in Western society. The pressing issues of climate change, food security and economic development make food waste emerge on top of the agenda at the level of The European Union (European Commission, 2011a) and The United Nations (FAO, 2011, 2013, 2014), and thus on the agenda of governments across the world. Substantial amounts of food is wasted from farm to fork. In the EU households stand for about 53% of the food wasted within the value chain (Stenmarck et al., 2016). This calls for increased attention towards finding new ways of intervening into food waste practices within households. Scholars from a wide range of disciplines, applying quantitative and qualitative methods, have addressed food waste as a topic of research. Recent research has extensively mapped amounts, composition and demographic variables, as well as social and cultural antecedents of food waste - although the latter may still be somewhat underexplored (Porpino et al., 2015; Waitt and Phillips, 2015). However, now is the time to focus on finding solutions.

Design thinking may be an approach to the problem of household food waste that could bring about new ideas. Within design research there has been some recent interest in this issue (Bucci et al., 2010; Farr-Wharton et al., 2012; and Ganglbauer et al., 2013), however the output is still modest. Thus there is still great potential in engaging the design community in this complex issue and spur practitioners to apply the problem solving tools that lie within design thinking. Several fields within design are suitable in different ways for researching the potential of interventions. For instance; Design for Sustainable Behaviour (DfSB), Practice Oriented Design (POD), User Centred Design (UCD), Service Design and Interaction Design. However, in order for the design community to contribute in a meaningful way it needs to have access to a solid foundation of knowledge, and what in design thinking is called “empathy”. Meaning both qualitative and quantitative research. Usually designers do not engage in an issue by compiling all relevant research from academia on a topic. They go straight into the field to build empathy. However, when dealing with an issue as complex as consumer food waste, this may not be sufficient to truly understand the drivers behind food waste and how to intervene. A mediator of knowledge can, as the authors attempt with this article, create a starting point for design thinking that would otherwise not be within reach.

This article reports a synthesis of consumer-relevant studies of food waste, with the aim of finding potential intervention points for design. Although, some literature on consumer food waste has been summarized within recent reviews and reports (E.g. Aschemann-Witzel et al., 2015; Canali, 2014; Parfitt et al., 2010; Thyberg and Tonjes, 2016; van Geffen et al., 2016), there is no extensive review of household food waste drivers found that is structured in a way that connects drivers with possible and existing interventions. In order to move from generating knowledge to finding solutions it is imperative that these two elements are seen in connection. The questions we ask are: What are the drivers of food waste, and where can designers intervene in order to influence consumers to waste less food?

The first section of the article describes the methods used in the relevant studies of food waste. The second section looks at the drivers behind food waste related to behaviour, practices, attitudes, beliefs and values, while the third section reviews literature related to material design interventions concerning storage, fridge/freezers and packaging. Finally, food waste drivers and their relationship to suggested interventions are discussed, and suggestions for further research and design interventions are made.

2. Method

The search was conducted using the database Oria and Google Scholar. Oria covers a large number of databases, including Scopus, Web of Science and ACM Digital Library. The results were limited to articles in peer-reviewed journals, written in English between 2000 and 2015. Older publications than from 2000 were not included in order to compile the research most up to date with social developments, thus most relevant to possible interventions today. Relevant articles that describe the relationship between food waste and consumer behaviour were identified, using the search term “Food waste” in combination with the words “household”, “packaging”, “consumer”, “behaviour” and “design”.

The reference lists from the identified relevant publications were reviewed for more relevant literature. A final inventory was made of in total 112 scientific sources, sorting them according to different criteria such as topic, academic field, country of origin and year of publication. Additionally, online available reports from three major food waste initiatives currently running in Europe were reviewed and the most relevant selected. These include:

- **ForMat** (2010–2014) was a project where the retail industry, food industry, organizations and governments collaborated to identify and reduce food waste in Norway (Hanssen and Schakenda, 2011).
- **WRAP** (Waste & Resources Action Programme) is an ongoing registered charity in the UK that works with different partners within academia, businesses and communities. WRAP is the organization that has, since 2004, published most extensively on quantification and composition of food waste, as well as issues related to attitudes and socio-demographic aspects of food waste behaviour.
- **FUSIONS** (Food Use for Social Innovation by Optimising Waste Prevention Strategies) was a 4-year EU project (August 2012 to July 2016). Amongst many other food waste related issues it focused on developing a common method for gathering food waste statistics, in order to be able to compare across countries.

The literature on household/consumer food waste is diverse and covers many angles. It reports on food waste quantities and composition, consumer behaviour, attitudes, beliefs and values, waste prevention and design interventions. The selection of literature for this review has however been focused on connecting the food waste drivers that can be identified within this literature with possible and existing opportunities for intervention.

3. Researching food waste

Many academic fields show an interest in the problem of food waste, such as sociology, psychology, design, economics, Human Computer Interaction (HCI), waste management, engineering, geography, dietetics, and biology. As illustrated in the table below an array of different research methods are applied in order to define, quantify, describe and understand household food waste. Several of these methods are familiar to the design community and routinely applied in design processes based on design thinking (see Table 1).

This review focuses on understanding household food waste from a consumer perspective. Some methods are thus more applicable than others. For instance do focus groups and interviews provide a deeper understanding of how practices are interconnected and how they affect food waste, often deeper than questionnaires and surveys are able to provide. Surveys are very useful for creating a broad view of waste related issues, but not for providing an in depth analysis of the different findings that emerge from the material. For instance, a survey may reveal that people do not plan their shopping or use shopping lists, but it does not necessarily reveal why. This can better be explored through qualitative studies.

By following consumers during shop-a-longs and in-home-tours, and in general by observing them in an everyday setting, it may be possible to gain deeper understanding of how consumers act and how they may be influenced by their surroundings. Because there is a gap between what people say they do and what they actually do, food waste diaries may be a more accurate way to assess people's food waste than self-reporting in surveys, because people generally tend to underreport the quantities of food waste by 40% (Quested et al., 2013a). Many of these methods are relevant to design research and have been identified as key methods to explore design interventions for sustainable behaviour (Daae and Boks, 2015).

However, it is not sufficient to understand why people waste food, what they waste and how much is also important to know in order to generate ideas on how to intervene. Great effort has been invested in mapping amounts of food wasted in affluent countries during the last decade. Several quantitative studies have been conducted in Europe recently on how much food is wasted in households in countries including Finland, UK, Sweden, Denmark and Switzerland (e.g. Beretta et al., 2013; Gjerris and Gaiani, 2013; Hanssen et al., 2013; Katajajuuri et al, 2013). Studies also provide knowledge about what food categories are most wasted - these are fresh fruits and vegetables, bread and other bakery goods, and leftovers (Foley and Hilton, 2011; FSA, 2016; Hanssen, 2010; Hanssen and Schakenda, 2011; Hanssen et al., 2013; Koivupuro et al., 2012; Quested et al., 2013a; Stenmarck et al., 2016; Stensgård and Hanssen, 2016; Ventour, 2008). Foods with short shelf lives e.g. dairy products, meat, and vegetables are also more likely to be wasted (Sonesson et al., 2005) and amount to about 2/3 of total household food waste in Norway (Hanssen and Schakenda, 2014).

Common methods to describe the composition and character of food wasted include waste composition analyses, surveys, and food waste diaries. Most studies of food waste do however rely on self-reported amounts stated by consumers in surveys. In order to get more accurate results studies are also increasingly utilizing food diaries and food waste composition analyses. A general problem in studies of food waste is that waste levels are underreported and efforts and environmental awareness exaggerated (Neff et al., 2015).

Table 1
Methods used in studies of food waste.

Methods	
Questionnaire	Prototyping and testing
Survey	Participatory design session
Interview	Food waste diary
Stakeholder interviews	Focus group
Literature review	Case study
Market review	Inventory
Waste weights	Photo documentation
Participant observation	Life Cycle Analysis (LCA)
Shop-a-longs (Contextual Enquiry)	Waste flow analysis
In-home-tours (Contextual Enquiry)	Waste composition analysis
Go-a-longs (Contextual Enquiry)	Action research
Experiments with design intervention/technology	
Discrete Event Simulation (DES)	

4. Food waste drivers

Food waste occurs within many different but interconnected practices of everyday life such as shopping routines, storing, cooking, and eating. Consumers are not aware of all drivers behind the food they waste because they are deeply entangled in the routines of everyday life (e.g. Quested et al., 2013b). Sociological studies of food waste describe how food practices are socially organized around everyday life activities in households (Evans, 2011a,b, 2012, 2014), and explain how cultural, social, material and temporal aspects of food waste practices determine if food is perceived as edible or inedible, and how they should be studied in context (Fiddes, 1995; Mavrakis, 2014). Also material properties of food itself and the material infrastructure in terms of living situation, available space for storing food, geographical access to stores and means of transportation have great impact on food waste as they influence every day routines (Quested et al., 2013b; Waitt and Phillips, 2015). Thus, decisions and actions made long before food is wasted may actually be the root of the cause, such as choosing what and how much to buy, how food has been treated before the consumer takes it home, how it is stored when it arrives in the household, and how meals are planned.

Seen in connection, the literature illustrates that food is wasted in households because of how it is valued and because some values people try to live by are not always compatible. Our values influence our awareness and attitudes, but so does our lifestyle and the required convenience we need in order manage everyday life. Lifestyle is mainly defined by household constellation and everyday practices that influence important food waste related practices such as planning of purchases, handling of leftovers and management of food risk. Additionally, there is an array of material and structural aspects that shape and restrain our interactions with food, for instance storage, packaging, the fridge etc. In order to reduce food waste levels cultural and social norms and values residing within people as well as material and structural conditions out there in the experienced world need to be addressed simultaneously. Fig. 1 below shows an illustration of what the author interprets as being the major interrelated food waste drivers that can be identified in literature.

In the following sections non-material, material and structural drivers of food waste identified in literature are described, and subsequently linked with interventions suggested in literature and

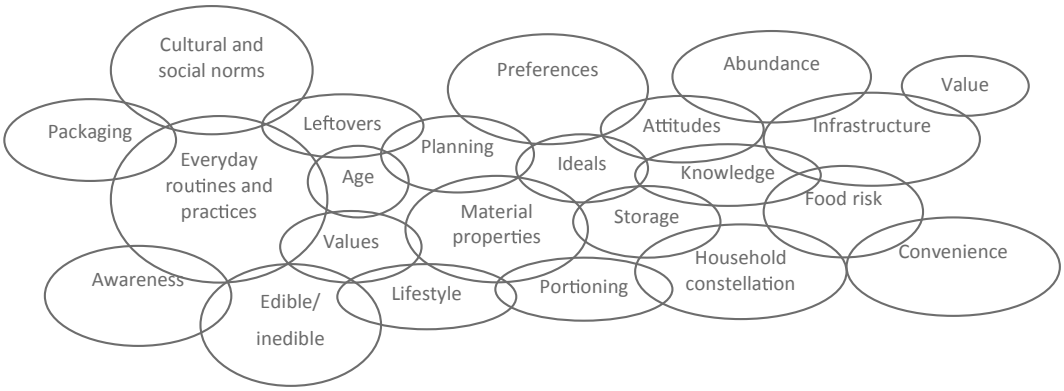

Fig. 1. Major food waste drivers.

some already on the market. The analysis illustrates the status quo and points to where further attention is needed.

4.1. Do we realise the true value of food?

Apparently not, since consumers in the EU waste 53% of the food they buy. However, educating people may not reduce food waste because knowing and valuing is not enough to change norms and practices only indirectly linked to food waste. The following section addresses food waste drivers connected to values, knowledge and attitudes described in literature.

4.1.1. Values and the perceived value of food

The abundance of food available at low prices in affluent countries influences how food is valued and how much food is wasted. Scarcity and rising food prices would inevitably reduce food waste in households (Aschemann-Witzel et al., 2015). In the absence of this condition, it remains a challenge in the Western world, to create interventions that will make a difference.

Research gives conflicting answers to the question of how income influences food waste. According to Stuart (2009) and Parfitt et al. (2010) affluent households waste more food than low income households because they can afford to, and there is a clear correlation between the proportion of income spent on food and the amount of food wasted. However, there is evidence that low-income households waste a substantial amount of food as well (Porpino et al., 2015), and that there is no significant relationship between household income and attitudes towards food waste (Melbye et al., 2016). Low income households strive for abundance because they do not want to be identified as poor – food is seen as wealth (Porpino et al., 2015).

Age is a significant factor in how food is valued within different consumer groups. British people over 65 years of age waste less food than other age groups (Quested et al., 2013a). However, this is not motivated by environmental concerns, but rather by financial and moral considerations about wastefulness. Researchers hypothesize that people over 65 are influenced by their past, having experienced times of scarcity; they bring with them a different "education" when it comes to handling food than other age groups (Brook Lyndhurst, 2007; Melbye et al., 2016; Quested et al., 2013a). However, this "value nostalgia" of efficiency and thrift (Brook Lyndhurst, 2007) is also found to be valued by younger consumers. Hval (2012) finds that her informants often agree that food should not be thrown away, but cannot really explain why. It is "just the way it is", something they might have learned growing up that has been internalized and incorporated into routines. Some argue that wasting food is the same as wasting money. Others point to the ethical implications of wasting food when others go hungry.

The connection between food waste and environmental issues is not necessarily established within peoples' minds (Graham-Rowe et al., 2014; Stancu et al., 2016). A "global warming fatigue", makes messages focused on environmental issues tiring, just like messages against smoking or obesity (Brook Lyndhurst, 2007). Thus, targeting food waste prevention campaigns at the environmental conscience of people may have a limited effect. Australian, US and UK studies show that consumers are more motivated by saving money than by protecting the environment when it comes to food waste (Baker et al., 2009; Graham-Rowe et al., 2014; Neff et al., 2015; Quested et al., 2013b). Moreover, money is found to trump environmental concerns even among environmental aware groups studied (Graham-Rowe et al., 2014). Nevertheless, people (most often women) often feel guilty when wasting food because they feel they are not doing a good job managing the household and providing for the family (Brook Lyndhurst, 2007). Thrift, sacrifice and family relationships are in the centre of Cappellini and Parsons (2012) analysis of food waste related to the creation and handling of food leftovers, and the mother often sacrifices her preference in favour of the family. The "good provider identity" (Graham-Rowe et al., 2014) or the "good mother identity" (Porpino et al., 2015) are therefore seen as barriers to minimize food waste.

Both what value consumers attribute to food, and what values are triggered in the management of food, is important when analysing the drivers behind household food waste. Mavrakis (2014) argues that monetary value, novelty value, resource value and the value of social relations may all determine disposal decisions. Unsurprisingly, efforts are greater to preserve food that had a high perceived value, for instance by having a high price, by being something new and interesting, by having required work and effort to grow, or that had been made by a loved one. Furthermore, freedom of choice is highly valued and deeply embedded in the consumer identity (Brook Lyndhurst, 2007). People feel that they should be able to consume any food they like at any time. This abundance of choice influences food waste quantities.

Both Mavrakis (2014) and Hval (2012) find that how the value of food is constructed influences the amount of food wasted. Small amounts of left overs are for instance often discarded because they have low value for a new dish. Food such as rice, potatoes and pasta is seldom saved for a later meal, it is cheap and difficult to portion

(Hval, 2012). Hval finds that her informants do not adjust their attitudes to their actions - they rather manipulate food in a way that it becomes "OK" to throw it away because they have no other choice. For instance by letting it go bad in the fridge. They still hold the attitude that it is wrong to waste food, but in those particular cases where food has become inedible it is ok. Through this Hval shows that wasting food is not a mindless activity conducted by people with "bad" attitudes, but a process involving a complex network of social interaction, routines and practices, material infrastructure, emotions and knowledge. Furthermore, different ideals can collide such as the ideal of not wasting food with the ideal of offering guests an abundance of food.

4.1.2. Awareness and attitudes

The majority of consumers are not conscious of the food they are wasting, and see food waste as inevitable and a mere fact of life, and in that way unavoidable and therefore acceptable (Brook Lyndhurst, 2007; TÆNK et al., 2012). The effect of raising consumer awareness about food waste is however debated amongst researchers. Some studies conclude that awareness needs to be raised in order to change food wasting behaviours (WRAP, 2015; Quested et al., 2013b), as it will cause a sense of responsibility and guilt, which can influence practices in a way that reduces food waste (Grandhi and Singh, 2016; Parizeau et al., 2015; Quested et al., 2013b). Other studies find that interventions aimed at increasing awareness do not sufficiently reduce food waste, because it is caused by complex processes that are in motion in order to feed the household, and that raising awareness does not change these processes in practice (Watson and Meah, 2013). Food practices are part of daily routines, and people use mental short cuts to get through the day most efficiently (European Commission, 2011b). Moreover, Cappellini and Parsons (2012) find that attitudes and lack of knowledge and skills are not the main problem for reducing food waste, and that blaming consumers is unproductive. Evans (2012) proposes therefore that efforts be targeted at the material context of food practices such as for instance packaging sizes in order to make food products better adapt to everyday challenges (Evans, 2012).

Moral awareness may define people's intentions not to waste food, but does not necessarily impact behaviour and food waste (Stefan et al., 2013). The Theory of Planned Behaviour (TPB) suggests that intention is connected to awareness, knowledge, and attitude, and hence determines behaviour (Graham-Rowe et al., 2015; Visschers et al., 2015). There is however the problem of the intention-behaviour-gap (Ajzen and Fishbein, 1980; Sheeran, 2002) - intentions to avoid food waste may not lead to behaviour because of lack of actual control, due to for instance the behaviour of other family members, or lack of appropriate tools (Graham-Rowe et al., 2015). Ganglbauer et al., (2013) derive from this that design interventions should support positive intentions to avoid wasting food.

A paradoxical consequence of persuading people (through raising awareness and education) to do something for the environment, such as composting food waste, has shown to make them feel that they are already 'doing good', and that there is no need to make an effort to reduce food waste (Brook Lyndhurst, 2007). This suggests that how people perceive their environmental efforts does not necessarily reflect the environmental impact of their practices. People make many excuses for not making an effort to reduce food waste such as 'Supermarkets and restaurants waste more', 'The problems don't immediately affect me', 'What's the point in me changing if others won't?', 'Half of my food waste is peelings', and 'There are other, bigger, issues to contend with' (Brook Lyndhurst, 2007). These reasons partly externalize the responsibility of food waste, partly deny that it is a problem, as well as express a sense of helplessness.

4.2. The hurdles of everyday life – convenience is everything!

As the organization of the household has changed in recent history, with the increasing participation in work life by women, so has the management of food, with convenience gaining importance in order to free up time (Jackson and Viehoff, 2016). Danish consumers argue that what is not convenient to do in a busy everyday life will not be done in the long run (TÆNK et al., 2012). This is symptomatic for the ever-increasing demand for convenience in food provisioning (Bava et al., 2008). Consumers are constantly working to minimize inconvenience (Graham-Rowe et al., 2014) and perceived constraints. This causes trade-offs between ideals and convenience (Bava et al. (2008). Ideals such as keeping leftovers, managing food risk, eating healthy, being hospitable, planning, and food diversity (Southerton and Yates, 2015). Moreover, the creation of excess food has become normalized within the interrelated practices of everyday life (Evans, 2014). The next section will address how household composition, lifestyle and practices are driving food waste.

4.2.1. Households and lifestyles

Research concurs that age and gender influences food waste amounts - older people waste less than younger people, and women more than men. (E.g. Brook Lyndhurst, 2007; Jörissen et al., 2015; Melbye et al., 2016; Quested et al., 2013b; Secondi et al., 2015). According to a comprehensive study conducted by WRAP in the UK in 2008, single person households waste the most food per capita. This result concurs with results from studies in Australia (Baker et al., 2009), Finland (Koivupuro et al., 2012), and the EU (Canali, 2014). Food practices of young food consumers are characterized by pleasure, improvisation and social activity, but also by a view of it simply as necessity and contributor to health. Hanssen and Møller (2013) find that Norwegians over 40 become more aware about food waste as a problem and are more likely to reduce their waste.

Recent research shows that household sizes, life phases and constellations greatly influence food practices and food waste quantities. Planning for shopping and meals is more difficult in some life phases than in others. As formulated by Watson and Meah (2013:10) it is within a "mess of practices and routines through which food provisioning is accomplished within a household (…) This ongoing accomplishment demands coordination of complex flows and relations between foods, products, technologies, skills, meanings, values and purposes, all within the spatial and temporal conditions of people's lived days". Unsurprisingly, households without children have much more freedom in how they organize food practices (Comber et al., 2013). Families with children produce more total waste and types of food waste, but less per capita – they also more often plan for shopping and buy in bulk (Parizeau et al., 2015). An OECD Working Paper states that "the presence of children under 5 years of age has a positive significant impact on food waste" (Millock, 2014:20). It can be difficult to foresee how much food children eat at each meal, which often results in preparing too much. Also, lunch boxes that children take to kindergarten and school are often not finished, and food waste from this source seems inevitable and out of parental control (TÆNK et al., 2012).

The impact of unpredictable busy lifestyles on food waste is an issue that emerges in many studies on food waste and consumer behaviour and practices (e.g. Bava et al., 2008; Comber et al., 2013; Evans, 2011a). The most important aspect of food practices as expressed by informants of many studies is that eating has to be fitted around main everyday activities, such as work and socializing (Comber et al., 2013; Halkier, 2009). According to Evans (2011b)

disruptions in everyday food practices are a main cause of food waste. This causes a mismatch between the time slot in which fresh food can be consumed and other household activities. Family members not eating together, but at different times has also be found to cause food waste (Brook Lyndhurst, 2007). Time is often restricted, and many people are concerned that quick food is not healthy food, which is a worry they often encounter when trying to fit food into their busy timetables (Comber et al., 2013). In the end, food consumption is about caring for oneself and those that are close (Watson and Meah, 2013).

4.2.2. Planning

A busy lifestyle and a family with children makes it difficult to plan food provisioning, meals and food stock. This is identified as a significant driver of consumer food waste. However, not only families with children do not bother planning, this is a general phenomenon across consumer groups. Few consumers make shopping lists, younger people more seldom than older. Comber et al. (2013) find that a third of their informants use shopping lists but only for items they might forget. The shopping list serves as a reminder rather than a detailed plan for exactly what items to shop. Many consumers go for a weekly large shopping trip and then add one or two top-up-shops (Quested et al., 2013b). There are both planners and improvisers among consumers; those who plan tend to have a better overview of the stock at hand and thus avoid overbuying (Farr-Wharton et al., 2014). The improvising consumer seldom makes plans for shopping or meals; food products bought and the meals prepared are rather a result of improvisation. For them, it is important that preparation and eating of the meal is pleasurable and social (Halkier, 2009). Flexibility and choice is highly valued by consumers. Planning meals for a whole week can be difficult and tiresome and feel inflexible (TÆNK et al., 2012). Stocking food is thus a strategy often used for being set for all eventualities (Graham-Rowe et al., 2014). To have food available just in case can save time, but it can also cause food waste, because it becomes unpredictable how and when stocked food will be consumed. Buying food in bulk that will not perish, such as canned food and freezer food, in order to have food available without wasting it, is a strategy that could reduce food waste by over stocking (Comber et al., 2013).

4.2.3. Leftovers

This lack of planning often results in overstocking and over preparing of food. Leftovers is the category of food waste that consumers are the least aware of (Brook Lyndhurst, 2007). According to Mavrakis (2014) laziness and safety issues are the main reasons for leftovers not being eaten. The feeling of disgust towards leftovers is another problem voiced by informants (Watson and Meah, 2013). Waitt and Phillips (2015) see the refrigerator as a means to avoid disgust, and to maintain boundaries between that which is fresh and that which is spoilt, edible-inedible, clean and dirty. Furthermore, they see the practice of piling up left-overs in the fridge as both a sign of care (for the family) and of wastefulness.

What happens with leftovers is determined by different material and socio-cultural aspects of food consumption. Socio-cultural aspects may pertain to preferences of the other family members and what they consider a proper meal (Cappellini, 2009), how everyday life is organized and planned, and if serving leftovers is compatible with "the good provider"/"good mother" identity (Evans, 2012; Graham-Rowe et al., 2014; Porpino et al., 2015). Material aspects may relate to the organization of the fridge, and how leftovers are stored.

People are generally not good at saving and eating leftovers. They prepare too much food because they do not know how to portion or do not care, and because they are afraid that there will not be sufficient food, especially for special occasions with guests (e.g. Brook Lyndhurst, 2007; Mavrakis, 2014; TÆNK et al., 2012). Many consumers routinely buy too much food every week, and then struggle to consume all of it. The reason is often that a food product is bought for a specific meal, and that the quantity bought is too big (Evans, 2011b). Portioning is something many consumers find difficult. However, some people cook more than they need on purpose to store leftovers in the fridge or freezer in order to save time on a later occasion (Mavrakis, 2014). Even if they do save food in containers in the fridge, they may forget about it and/or find it undesirable to eat after a while, and dispose of it after all.

Leftovers are often put in the fridge after the meal in order to postpone any uncomfortable feelings that may result from wasting it immediately (Evans, 2012; Waitt and Phillips, 2015). Porpino et al. call it a "maturation time" which will reduce perceived guilt. This use of time as a way of ridding oneself of responsibility is also found by Evans (2011b). Even though the intention is to eat it later, food may be forgotten in the fridge and thrown in the bin at a later time when it has gone bad and it is "easier" to do so (Hval, 2012). This shows that people may find it difficult and/or undesirable to use their leftovers in new dishes; because they desire to eat something new and fresh, or because they are uncertain if it is still good to eat. A survey in Australia shows that many people plan meals according to what they desire to eat rather than what is in the fridge (Baker et al., 2009). Several campaigns across Europe (e.g. Love Food Hate Waste (UK), Matvett (Norway), Kliekipedia (the Netherlands) and Stop Spild av Mad (Denmark) try to inspire use of leftovers through websites and apps providing tempting and easy recipes with leftover foods. However, utilizing this information requires time, effort and dedication that might not be present in every-day-life, and may only appeal to consumers that already have the intention to prevent waste.

Social media platforms that aim to connect people with excess food with people who want a home cooked meal are emerging, but there are some barriers to this kind of distribution of leftovers both related to social norms and food risk. Giving excess food away may be suitable for redistributing leftovers, but according to Evans (2012), people may experience this as being too much within the perceived private sphere of food preferences and food skills, causing potential embarrassment and loss of privacy.

4.2.4. Food risk

There is a conflicting relationship between reducing food risk and reducing food waste (Watson and Meah, 2013). According to Neff et al. (2015) literature shows that people have different ways of judging if food is still fit for consumption. Date labels and use of smell and visual judgements are the most practiced ones. A Canadian study shows that people who use the highest number of strategies to determine edibility tend to waste more food than those relying on only one or two strategies, for instance look and smell (Parizeau et al., 2015). This is probably due to having more occasions for defining something as waste. Most people are aware that different food poses different levels of risk; meat being high risk and vegetables low risk. Food management in families is often determined by emotions and sense of responsibility to 'provide and protect' (Brook Lyndhurst, 2007). Causing food waste is not something most consumers take lightly on, rather the opposite, many consumers are troubled by it. However, avoiding risk and ensuring food safety is a priority over avoiding food waste (Evans, 2011a; Farr-Wharton et al., 2014). People do not want to risk getting ill and rather dispose of food that could be edible than take that risk (Graham-Rowe et al., 2014). Thoughts of health are closely connected to food risk and nutrition. Some people report to buy lots of fruits and vegetables as they are healthy, but when it comes to it they do not eat them (e.g. WRAP, 2007a,b,c). Sometimes good

intentions come in conflict with each other, for example continuously putting fruit out in a bowl on the counter to encourage the family to eat healthy, but resulting in high amounts going bad every week (Mavrakis, 2014).

4.3. Managing food stock in households

Wrong and too long storage is a significant driver of food waste. The storage of food is most often connected to fridge/freezer practices and packaging as described above, but food is also stored outside the fridge/freezer. In the following section the literature addressing storage, packaging related drivers of household food waste is presented.

4.3.1. Storage

Farr-Wharton et al. (2014) argue that storage is the most critical practice to address when aiming for food waste reduction, and that consumers should be enabled to organize food storage better to allow for easier location of food items. Campaigns such as the British Love Food Hate Waste, the Danish Stop Spild av Mad and the Norwegian Matvett provide detailed advise online as to how different food products should be stored, however the extent to which this information reaches consumers is uncertain. There are also conflicting advice given on this by different parties. For instance, WRAP advises to store tomatoes in the fridge for optimal freshness (WRAP, 2008a,b), but in Norway the Norwegian Food Safety Authority advises to keep tomatoes outside the fridge (Matportalen.no, 2016). This may pertain to different goals, where keeping them in the fridge will make them last longer, whilst keeping them outside gives them more flavour. However, some food may be damaged by storing them at too low temperatures such as bananas, melons, papaya, and avocado. How to store different kinds of fruits and vegetables seems to cause the most confusion amongst consumers and the practices are diverse. Fruit and vegetables release ethylene gas that causes deterioration, thus WRAP recommends using polyethylene bags to store the most wasted fruits and vegetables. Matprotalen recommends that some vegetables such as potato, carrot, asparagus and chicory should not be exposed to light because they will turn bitter and sprout. Furthermore, keeping the moisture balance and avoiding decay at the same time is a challenge, as well as keeping products that ripen away from fruits that release much ethylene gas. The ideal for fruits and vegetables not stored in the fridge is to be in a cool place, about 10–15 °C.

A recent report from the UK Food Standards Agency shows that consumers are confused about when food can be frozen, how long it can be frozen, an if it is safe to freeze cooked meat (FSA, 2016).

Refrigerators and freezers play an important part in the modern household, enabling convenience, freshness and food safety (care) (Waitt and Phillips, 2015). Changing practices related to incorrect storage and wasting food after an arbitrary time-period, as well as correct use of fridges/freezers and packaging will prolong the lifespan of food (WRAP, 2013).

How food is placed and moved around in the fridge has considerable influence on food waste - visibility and timely consumption is essential, and the fridge is not a neutral part of this process. Two categories of solutions are suggested in literature pertaining to fridge and freezer use and reduction of food waste. The first solution category to reduce food waste focuses on improving information, labelling and advice, to encourage consumers to refrigerate and freeze food that could become waste. The second category suggests technology-oriented designs (such as apps) to help people get a better overview of stock and to plan better for their meals.

Freezing food is often used for unforeseen events, such as more people for dinner than usual, or to enable flexibility when days are difficult to plan due to for instance working hours (Comber et al., 2013). Many consumers also state that they sometimes cook in batches to freeze or refrigerate for a later meal in order to save time and avoid food waste (Graham-Rowe et al., 2014). Freezing food to avoid waste is mainly done by those who find time and convenience more important than freshness (Mavrakis, 2014). No reference was found in literature to reasons for freezing food related to buying in bulk because certain products are temporarily on offer (like frozen pizzas or ice cream).

Many consumers in the UK are uncertain about what food is suitable for freezing; freezing advice on packaging is usually absent (Brown et al., 2014; George et al., 2010; Maxey, 2010). Encouraging people to freeze food to avoid food waste by providing more and simplified information, labels and advice is recommended. Lowering refrigerator temperatures and ensuring food stays cold from store to home can also reduce household food waste (Brown and Evans, 2012; Brown et al., 2014; George et al., 2009, 2010). Better storage advice on packaging to refrigerate food that is sometimes kept outside the refrigerator, but will stay fresh longer in the fridge, such as apples and carrots, is suggested by Johnson et al. (2008). Emissions caused by increased use of energy by freezing food and lowering refrigerator temperatures are far smaller than those caused by food going to waste, which justifies the recommendations (Brown and Evans, 2012; Brown et al., 2014).

4.3.2. Packaging

The role of food packaging is to protect, preserve, inform and seduce. It plays an important role through the whole value chain of food from farm to fork. A Swedish study (Williams, 2011) estimates food loss due to issues with packaging to be 20–25% of household food waste. Excessive packaging sizes, difficulty completely emptying packaging and date labelling were reported to be main causes for food waste related to packaging. A report by WRAP (2011, 2012a) estimates that approximately 20% of food waste in the UK is discarded due to being out of date, and that it is the most important reason for 30% of disposal decisions. Nevertheless, mere understanding does not necessarily influence action; factors such as perceived health risks may be more important, as discussed earlier. At home date-labels are most often used to justify or confirm the disposal decision, not so much when deciding what to eat. As could be expected, simple clear formats are most easily understood. The study shows that younger consumers tend to rely more rigidly on the date to evaluate food safety and when to discard compared to older consumers. The most risk sensitive consumers depend strongly on, but often misinterpret date labels when using them to determine safety. WRAP (2011, 2012a) argues that how people use date labels is often related to their confidence in their own knowledge and skills with food. Attitudes and practices related to food planning, risk, leftovers and food expiry are found to be significant in how date labels are interpreted. Unsurprisingly, the majority of consumers would purchase products with the longest use-by periods, and they pay more attention to date-labels on high safety risk products such as meat and dairy products. To optimise the use and understanding of date labels, WRAP (2011, 2012a) recommends further clarification, removal of 'display until' dates, consistency within product categories, label redesign for better interpretation, improve storage and freezing guidance.

In the debate about the environmental impact of packaging, the material of the packaging itself is often the focus of attention. Consumers frequently have negative attitudes towards packaging when asked in context of the environment - however, Plumb and Downing (2013) find them to be equally concerned about food waste. This contradicts findings from Brook Lyndhurst (2007) that people are significantly more aware of throwing away packaging

than food waste, and consider it a bigger problem, underestimating the amount of food waste they are actually wasting. Scholars generally agree that for packaging, the function of preserving and protecting food is significantly more important in an environmental perspective than reducing packaging material or making it more biodegradable (Silvenius et al., 2011; Wikström and Williams, 2010; Wikström et al., 2014; Williams, 2011; Williams et al., 2012). Less packaging may mean more food waste, and often trade-offs need to be made between the environmental impacts of packaging versus those from food waste (Verghese et al., 2013). The balance between packaging and food waste is influenced by what kind of food product is analysed. For example in the case of cheese, large increases of packaging impact can be justified in order to preserve it (Verghese et al., 2015; Williams, 2011). This is not the case for ketchup, were the packaging has a high environmental impact relative to its content. There is however, great uncertainty about the impact packaging design may have on consumer behaviour and thus on real food waste reduction through changes in packaging, and urge for more research in this area.

Date labelling on packaging is a way to create trust and distribute responsibility in the relationship between producer/retail and consumer – which has become more important as consumers have less and less knowledge of the place of production (Watson and Meah, 2013). There are two sorts of date labelling, the "use-by-date" and the "best-before-date". The latter pertains to freshness and quality, and not to decay or health risk. Wansink and Wright (2006) suggest that there "may be more to lose than to gain from freshness dating". They find that perceived quality of the product decreases substantially from the first day after the "best-before-date has passed.

Consumers often use rules of thumb instead of checking storage guidance on every product. They are also sceptical towards information that does not resonate with their own experiences. For instance, they more often follow freezing guidance on packaging (e.g. freeze on day of purchase or freeze before use by date) if it corresponds with perceived speed of deterioration of the product (WRAP, 2011, 2012a). Nevertheless, reported use of storage guidance is very high – it is however unsure if it pertains to product quality or safety.

4.4. Top-down control of food waste practices

Is it possible to control consumer food waste practices through laws and regulations? As of today this option is not particularly well explored. However, there are a few examples of governments attempting just that.

Policies and regulations across nations aim to a great extent to increase recycling of food waste and diversion of food waste away from landfills through for instance landfill tax, incineration tax and "pay as you throw" (PAYT) (Chalak et al., 2016). The weight based billing system or PAYT, has proven to increase recycling in Sweden (Dahlén and Lagerkvist, 2010). However, the effect on reducing food waste is not investigated specifically. It is however expected to have an impact on amount of food waste as well. This is also concluded by a new report from the FUSIONS project that investigates the potential of market based instruments and economic incentives as mechanisms in international policy for reducing food waste (Aramyan et al., 2016). Thyberg and Tonjes (2016) propose to change the design of municipal waste collection systems, such as a transition towards volume based systems or reducing collection frequency. The economic incentive is seen as a tool to reach those that are not reached by awareness campaigns, but the risk of waste being discarded in illegal ways, such as dumping and burning, is considerable. In Seoul, South Korea a new high-tech system for weight based billing through the use of key-card-registration is being tested in selected urban areas (YALE Environment 360, 2016). The effect of this innovation is yet to be measured, and the possible diverting of food waste through other conduits to be discovered.

Several studies have indicated that there may be a connection between household food waste collection services and reduction in the amount of food wasted (E.g. Mills and Andrews, 2009; Parfitt and Bridgwater, 2010; Robb and Parfitt, 2009; Somerset Waste Partnership, 2010; Tucker and Farrelly, 2015). Researchers have suggested that seeing the amount of food collected in the separate bag within the household may influence food waste related attitudes and behaviours (E.g. Miliute-Plepiene and Plepys, 2015). However, a literature review undertaken by WRAP (Foley and Hilton, 2011) concludes that there is little evidence to support this. Although a decline of food waste amounts has been observed it is unclear whether food waste that is not collected ends up as for instance municipal waste or home compost.

When speaking about big societal challenges, to which extent the individual or the governments are responsible for contributing to change is widely debated. Halkier (2009) suggests two kinds of routinisation initiated by both entities. She argues that environmentally friendly food practices can be routinised in such a way that they are fully integrated in the consumption of food. Such as for instance buying organic food, or deciding what to buy based on perishability. She calls it routinisation of environmental reflexivity'. Another kind of routinisation she describes is routinisation as relief from reflexivity'. It is when larger regulatory systems enable people to act environmentally friendly without actively reflecting about it. Halkier concludes that environmentalised consumption should neither be understood as dependent on the political consumer nor the victims of social conditions. Furthermore, environmentally friendly food practices can be seen both as part of food practices, as well as practices by themselves. Thus, when searching for potential intervention points for design, and identifying those that will bring about actual change, the challenge is to address practices on different levels of routinisation and reflexivity.

Similarly, Spaargaren and Oosterveer (2010) propose two perspectives on changing consumer practices - the individualistic/agentic approach from economics and social psychology, or the structuralist/systemic approach from sociology. In order to reduce household food waste changing consumer food practices is imperative. It is however unclear how this change should come about; whether it is the individual consumer who should be persuaded through awareness campaigns and good suggestions for how to manage leftovers and portioning, or whether it a systemic challenge that can be addressed by policy, or perhaps both. Answering these questions is beyond the scope of this article, but they illustrate the multilevel challenge of food waste.

5. Interventions

Literature reports on several design interventions aimed at food waste reduction in households; some prototyped and tested, some merely suggestions for improvement, and others already on the market. The majority of literature is to be found on packaging, refrigerator and freezer related interventions. Other concrete objects of interest are bins, plate sizes, written communication, mobile technology, social innovation, fruits and vegetables, potatoes and milk. Of course, design interventions with potential to reduce household food waste are not only found in academic literature, some already exist in real life, and will be mentioned here. These interventions all seek to address different drivers of food waste. In this section we will describe the interventions found in literature and how they relate to the drivers of food waste. The first part of this section pertains to interventions aimed at the storing and portioning of food, and the second part discusses interventions

aimed at increasing knowledge, awareness and attitudes.

5.1. Storing and portioning food

An important aspect of food handling is storing food in the home. Many products are essential in this, most of which are located in the kitchen. Food is stored in fridges and freezers, in cupboards, containers, packaging and drawers. How food is stored is important to its shelf life, and consequently to how much is eaten or wasted.

5.1.1. Intelligent fridges and apps – keeping track of our food

In the past twenty years, literature has provided several suggestions for fridge concepts that tackle one or several of the challenges pointed out above, such as modular solutions or transparent doors. Recently, more advanced technology has enabled affordable intelligent solutions in fridge concepts to tackle food waste issues. Scholars within Human-Computer-Interaction have developed three different fridge concepts that aim at helping the consumer reduce food waste (Bucci et al., 2010; Farr-Wharton et al., 2012; and Ganglbauer et al., 2013): 1) ZmartFri, 2)Colour Coding the Fridge and 3)FridgeCam.

1) The ZmartFri technology developed by Bucci et al. (2010) is an intelligent fridge concept, based on insights from field methods and results from a participatory design process, which include an expiration date alert and an ability to print a grocery list and send it by sms or email. 2) The concept of the Colour Coding the Fridge aims to raise people's awareness of what they have in the fridge, in order to reduce expired food waste (Farr-Wharton et al., 2012). The qualitative methods used in the study are interview protocols and visual ethnography, and seven households participated. Based on the insight that expired food waste is caused by lack of visual overview of what the fridge contains, the design intervention is based on a colour coding scheme where each colour represents a food group and its placement in the fridge. It is reported to potentially reduce food waste by a quarter to a half through heightened awareness of the content of the fridge. 3) The FridgeCam concept (Ganglbauer et al., 2013) is also based on ethnographic methods to identify everyday practices related to food and their influence on food waste. The FridgeCam is a camera that is attached within the fridge displaying its content and sends images to a website. In the experiment, some users actually used the camera to plan shopping for instance by accessing the website from work or from within the store. Some were confronted with the disparity between their perceived and aspired food practices and their actual food practices.

An intelligent fridge may provide consumers with updated knowledge of stock, and what is about to expire and should be used. It may answer to causes of food waste addressed in literature including food storage, planning, shopping, preparation and consumption, provided it can be successfully integrated into the household routines. As of 2016 some brands such as LG, Samsung, Bosch, and Siemens already offer smart-fridges on the market. LG's *Smart ThinQ* concept enables use of a screen to track inventory of groceries, expiration dates, and calendar events. It also has four "smart-functions" mainly aimed at saving energy. Siemens and Samsung have already implemented camera concepts in some of their refrigerators. *The Family Hub* concept by Samsung has a Food Management function enabled by three built-in cameras, that make it possible to see what is in the fridge when not at home, using a smart phone. The Family Connection function enables family members to share calendars, photos and notes from their mobile device, which could help them plan meals and food provisioning better. Bosch has integrated a new technology called Vita Fresh, which automatically maintains the right balance of temperature, humidity, and air circulation within drawers with the help of climate sensors. According to Bosch this does not only make fresh produce last longer, but also preserves vitamins and nutrients. Freshness boosters that can just be put in the drawer of a more conventional fridge can also be bought on the market, including the Green Hearts and Frigidair PureAir Freshness Booster. There work in similar ways, by removing ethylene gas from the drawers, thus prolonging shelf life.

Keeping inventory by the aid of the fridge is still hampered by time consuming scanning of items or receipts as well as manual registration. This creates scepticism towards the maturity of the smart fridge concept within tech press (Guardian, 2016). In light of the importance of convenience illustrated by food waste research, smart fridges may be not be ready yet for large scale implementation. Similar technologies have been developed outside the world of appliances. To cater to the need for convenience and planning various apps and online sharing platforms have emerged. Leftovers can be sold or donated through food sharing sites and apps. Apps are also developed to aid consumers in planning their grocery shopping and meals through shopping lists and recipes for instance. Also here it remains to be seen if these technologies will be used to an extent that will bring actual effect to food waste levels.

5.1.2. Packaging and containers

There is a widespread variation on the market of different food containers for storing food inside and outside the fridge. Tupperware being one of the most famous brands. Furthermore, Food huggers that help seal the ends of fruits and vegetables that have been cut are also in this product category of enabling optimal storage and shelf life within the fridge.

Amsterdam based designer Jihyun Ryou is rebelling against the narrow-minded mantra of keeping everything in the fridge, and has designed products that seek to translate traditional oral knowledge concerning food storage and preservation (Savefoodfromthefridge.com, 2016). She aims to re-introduce preservation techniques that make the refrigerator redundant. Her project has resulted in various objects that translate traditional knowledge into storage products to use in the kitchen. For instance the combined shelf and drawer that utilises the effect the ethylene gas from apples has on preventing potatoes to sprout, whilst keeping light away from the potatoes, the marble watering base for leafy vegetables, and the box of sand that keeps root vegetables in a vertical position and ensures perfect humidity condition. These products not only provide an alternative to storage in the fridge, but also make fresh produce more visible and thus may prevent them from falling into oblivion in the bottom fridge drawer. Seeing what you have readily available may serve as a reminder and motivation for use.

Packaging is one of the most studied design interventions to reduce food waste found in literature. Main subthemes are preservation technologies, environmental impact of packaging versus food waste, date labelling, storage guidance, pack sizes, self-dispensing systems, and supply chain packaging.

Recently much progress is observed in packaging design, especially concerning date labelling, information on storage and use and pack sizes. There has been substantial development of technology that can prolong shelf life for many food products, such as multi-layer barrier packaging, modified atmosphere packaging, edible coatings, oxygen scavengers, moisture absorbers and aseptic packaging (Verghese et al., 2015). The effect of such technologies depends however on consumer trust and appropriate use. Many consumers are not aware, and consider the protective and hygienic properties of food packaging (Plumb and Downing, 2013) only in the context of transport, and not for storing purposes. Their

practices may be counter-effective such as taking food out of the packaging and into another container, or piercing packaging to let it "breathe".

Alternatives or supplements to date labelling are the new emerging technologies that communicate food expiration through visual and tactile means. The Bump Mark (www.designbysol.co.uk/bumpmark) is a bio-reactive food expiry label that is smooth when the food item is fresh and gets bumpy when it has expired. The Keep-it label (www.keep-it.no) is continuously monitoring temperature and time and visualises time left to expiration through a line which is increasingly getting shorter as the expiration date is moving closer. These new technologies may represent a more comprehensible and intuitive way of understanding expiration of food items.

Pack sizes being too large is a problem with packaging reported by consumers, especially by smaller households (Evans, 2011b; WRAP, 2008a,b). Furthermore, consumers were willing to pay a little bit more for a smaller pack. How much more varies between products. Portioned and divisible packaging is one way to address the problem which is to some extent already on the market for some food products such as frozen fish and chicken (EMMA project, 2010). According to WRAP (2011, 2012a) adjusting the packaging of chicken in this way could reduce food waste by up to 10,000 tonnes per year. Also packaging design in general, such as using scripts or feedback, has documented influence on waste behaviour (Wever et al., 2008).

Self-dispensing systems in shops may contribute to reduce packaging and food waste (WRAP, 2007a,b,c) although so far this is only based on assumptions that people will buy quantities more in line with their actual needs. Advantages with self-dispensing systems may include cost savings and increased profits, but hygiene issues, lack of information about the content of the food in the store and the home, and reduced options for branding may be disadvantages. Hygiene issues can be resolved by using gravity-feed bins, which are also preferred by consumers. These can display product information in-store, but this will not help the consumer at home. Written information available to bring home may solve this, such as brochures and leaflets. Hygiene considerations make the bin and scoop method is less popular, and consumer fear liquid self-dispensing to be messy. WRAP (2007a,b,c) considers the following food product categories as potentially suitable for self-dispensing: cereals, rice, pasta, grains, oats, coffee, tea, flour, spices, nuts, dried fruits, salads, pet food, cheese, oil, milk, sauces, dressings, water, wine and juices.

In addition to the design and development of better packaging, the supply chain behind food and its power structures have to be addressed in order to find ways to make knowledge generated by research influence actual packaging solutions on the market (Verghese et al., 2013; Williams, 2011). Verghese et al. (2013) argue that it is imperative to educate consumers and retailers about the role of packaging in keeping food fresh and the meaning of best-before and use-by stamps on the packaging. Furthermore, they urge to improve logistics and orderings systems to avoid over ordering and bad inventory practices resulting in food going off in shelves and storage in retail, as well as to increase collaboration and awareness within the food value chain as to the reasons for food waste. Silvenius et al. (2014) argue for a value chain approach as well, improving packaging at all stages, and increase the use of retail ready packaging to avoid unnecessary handling of food products which can reduce its quality - new technology such as aseptic packaging and edible coatings should be adopted more extensively in order to keep food fresh.

5.1.3. Plate size

A Norwegian example of nudging is seen in Nordic Choice Hotels, where plate sizes for the buffet were reduced to make people serve themselves with less food, and rather go a second time if they desired more. This small intervention reduced food waste by 20% (Kallbekken and Sælen, 2013). This experiment illustrates findings from Wansink and van Ittersum (2006, 2013): plates, bowls, and spoons bias consumption volume, as people generally overestimate how much food they will eat and underestimate how much food fits a large plate. In an experiment (Wansink and van Ittersum, 2013) where diners could choose from different sized plates, those choosing the largest plate served themselves 52% more than the ones with the smaller plates. Although these people ate more, they also wasted 135% more food. The study suggests that aspects such as diameter of the verge ring (curvature), the diameter band on the lip of a bowl or plate, and patterns and colours, may be considered for redesign when aiming to reduce food waste. There are for instance plates on the market with patterns that show how to portion correctly in order to avoid over-eating. These are designed to help people to a better diet, but the same thinking would help reduce the wasting of leftovers from plates.

5.2. The limited power of information

As mentioned earlier, governmental intervention most often comes in the shape of distributing knowledge and information in order to increase consumer awareness. This approach exhibits optimism as well as some level of powerlessness, as the effects are difficult to measure. Nevertheless, both WRAP and ForMat report a decrease in consumer food waste, in the UK and in Norway, during the period of efforts to increase knowledge and awareness, and attribute this result in part to their own work (Stensgård and Hanssen, 2016; WRAP, 2012b).

The belief that awareness determines intention which in turn determines behaviour has resulted in various campaigns seeking to educate consumers and provide guidelines to food waste reduction, including Love Food Hate Waste (UK), Matvett (NO), Feeding the 5000 (UK), Stop Spild av Mad (DK) and Think Eat Save (UK). Moreover, social innovation concepts aimed at raising awareness and providing information and suggestions for how to avoid food waste have been emerging. FUSIONS is investigating how policy can encourage such innovation (Easteal, 2013; FUSIONS, 2014). Examples of social innovations are mostly based on creating accessible information, advice and suggestions for how to reduce food waste.

A successful design intervention will contribute to "nudge" people to reduce their food waste, perhaps without them having to change their attitude, be educated or raise their effort greatly. Research in the fields of behavioural science and economics has been exploring how people actually can be nudged into changing their behaviour. Thaler and Sunstein (2009) describe how sensible "choice architecture" can nudge people into making better decisions. They have shown that it is possible to nudge people into the "right" behaviour through social information. A Canadian study on food waste for instance finds that people are reluctant to see themselves as someone who wastes more food than others (Parizeau et al., 2015). Using information about how consumers "perform" in relation to their peers and neighbours may influence their behaviour. HCI scholars Comber and Thieme (2013) use this phenomenon in their development of the BinCam, a persuasive technology aimed at raising awareness and supporting intentions for behaviour change by sharing images of disposed of food waste on an online social network, evoking feelings of shame and lack of control, and thereby spurring reflection and more awareness.

The design of food waste bins has proven to be significantly influential in how much food people recycle. A Swedish study targeting increased food waste source separation rates in a residential area (Bernstad, 2014) showed that providing better

equipment had a significant effect, whereas raising awareness and increasing knowledge by using written information had none. The author attributes this result to convenience, which facilitates increased source-separation; this could not be provided by written messages urging people to do better. Written messages were however successful in improving food waste behaviours in a University dining facility in the USA (Whitehair et al., 2013); these messages urged students to eat what they took and not waste food, and provided some information about how much food is wasted at the university and how many meals that food could have provided. This reduced food waste by 15%.

6. Discussion: food waste drivers and design interventions

This section will discuss the identified food waste drivers and their relation with the suggested interventions. Research within various disciplines provide us with extensive knowledge on food waste drivers. These drivers connect to values and perceived value of food, awareness and attitudes, household, lifestyles and convenience, planning, leftovers, storage, packaging, food risk, and policy and regulation. Interventions have been suggested in literature, products have been developed that are on the market, and campaigns have been launched to address some of these drivers. Table 2 below shows drivers of food waste and the interventions aimed at influencing them.

From this table three dominating categories of interventions can be derived: 1) Technology that helps people plan, share, and keep an overview of stock, 2) Packaging and storing solutions that extend shelf life, and 3) Information and awareness campaigns.

This shows that there is a surprising lack of diversity in food waste interventions suggested in literature, and there is also a lack of studies on effects. Especially within the two product categories most extensively explored, smart fridge functions and packaging, itFoley remains to study the effect of the innovations in order to assess their impact on food waste quantities. Perhaps there are adjustments that should be made in order to enable intended use and subsequent effect? Food storage is a category that is surprisingly underexplored. There are no radical suggestions to how food could be stored in a way that reduces food forgotten in the fridge for instance. All suggestions but one (Save Food from the Fridge) are set within the construct of how a fridge looks today. Further research should look into alternative ways to store food.

Key insights from the reviewed literature show that the practices that cause food waste are deeply entangled in the routines of everyday life, and not easily influenced by providing consumers with best-practice information and education. In light of this, further research and design endeavours should focus on ways to address food waste drivers pertaining to values and perceived value of food, awareness and attitudes, food risk, and household, lifestyles and convenience in a way that does not necessarily presuppose that there is an automated relationship between knowledge, attitudes and action. Could there be potential interventions not yet discovered, in the shape of for instance new products, systems and infrastructures that could nudge consumers to reduce their food waste?

Furthermore, there is a need to address the potential of new policies and regulations aimed at households. However, addressing this issue lies outside the scope of design.

7. Conclusion

This extensive literature review has identified an array of different aspects and drivers behind household food waste. It clearly shows that the phenomenon of food waste can be seen as a process where food turns to waste within a web of interrelated practices, tools, concerns, skills, knowledge and anxieties. Attempts to change this process will require finding places within this web where one can intervene.

Seen in connection, the literature illustrates that food is wasted in households because of how it is valued and because some values people try to live by are not always compatible. Our values influence our awareness and attitudes, but so does our lifestyle and the required convenience we need in order manage everyday life. Lifestyle is mainly defined by household constellation and everyday practices that influence important food waste related practices such as planning of purchases, handling of leftovers and management of food risk. Additionally, there are an array of material and structural aspects that shape and restrain our interaction with food, for instance storage, packaging, the fridge etc. In order to reduce food waste levels cultural and social norms and values residing within people as well as material and structural conditions out there in the experienced world need to be addressed simultaneously.

There are design interventions suggested in literature as well as on the market that seek to address various material and non-material drivers of food waste, but there is little knowledge of their actual or potential effects on food waste levels. Thus there is great potential for more innovative thinking that can challenge existing practices in a more profound way.

Although designers can access published research on the subject of food waste, they most likely will not due to time constraints, lack of awareness or just unfamiliarity and set routine. By compiling and sorting this literature, this paper provides a more coherent starting point for designers wishing to focus on food waste and behaviour

Table 2
Food waste drivers and interventions.

Information & awareness	Technology & planning	Leftovers & portioning	Storage	Packaging	Food risk	Policy & regulation
• Written messages • Social information • Awareness & info. campains • Online advice	• Smart Fridge: • Grocery list • Calendar event • Expiration dates • Fridge Cam • Smart phone connection • Recipe suggestion • Inventory • Colour coding • Apps • Social sharing platforms • Online advice	• Plate size • Written messages • Food containers • Food huggers • Social platforms • Measuring tools • Awareness & info. campaigns • Online advice	• Save food from the fridge • Containers • Food Huggers • Colour coding • Freshness booster • Packaging • Storage guidance	• Resealable • Divided • Smaller sizes • Storage guidance • Date labelling • Self-dispensing • Edible coatings • Modified atmosphere • Nulti-layer barrier • Oxygen scavengers • Moisture absorbers • Aseptic • TheBumpMark • Keep-it	• Expiration dates • TheBumpMark • Keep-it • Awareness & info. campaigns • Online advice	• PAYT • Landfill tax

change, making existing research more available. However, this is not a task to be embarked upon only by designers.

Moreover, this research points to the importance of a synergy of different approaches to reduce household food waste through design, and that there is a need for collaboration between relevant stakeholders in order to address both material and non-material drivers of food waste simultaneously. Design disciplines can most certainly be important contributors to this endeavour and should be involved from the very beginning.

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Contextualising food waste prevention - Decisive moments within everyday practices

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ABSTRACT

Household food waste is a matter of increasing concern for policy makers and organisations because recent research has shown that consumers contribute to about half of the edible food wasted in the developed world. The most applied measure to address the problem has been knowledge and awareness campaigns aiming at inducing changes in behaviour by educating consumers of the scale and impact of food waste, and on the meaning of date labelling. We argue that this approach is insufficient in achieving food waste reduction on a satisfactory scale, and that the potential of implementing measures into the actual contexts of food waste related practices should be further explored and developed. The research presented in this article is based on fieldwork from 26 households in Oslo, Norway. By applying a practice-oriented approach to food waste drivers, we focus on five food waste related practices: acquiring, storing, assessing, valuing and eating. Based on our analysis of how these practices are causing food waste, we identify decisive moments and contexts for food waste prevention and discuss examples of measures that could be further explored. The aim is to inspire a more contextual approach to food waste prevention by policy makers and organisations.

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1. Introduction

Starting with the assumption that everyday life is performed through socially shared practices (Shove et al., 2012), the current paper argues that to reduce household food waste, preventive measures need to be implemented within the everyday food-handling practices of consumers. Through extensive fieldwork in Norwegian households, we identified decisive moments and contexts within everyday practices, where preventive measures should be applied to reduce food waste. Our research connects to sociological studies of food waste drivers that have shown food waste is caused by many interrelated practices within everyday life and cannot be attributed to a lack of knowledge and awareness alone (Evans, 2014; Mavrakis, 2014; Southerton and Yates, 2014).

In the last decade, the problem of increasing volumes of food waste has gained much attention globally. In the EU alone, an estimated 88 million tonnes of food is wasted annually, and households contribute to 53% of that waste (Stenmarck et al., 2016). Policy makers have struggled to find measures that can effectively reduce the large amount of food waste coming from households. Recently, the revised EU Waste Framework Directive introduced new legislation that set an EU-wide target of 50% reduction in food waste, a goal aligned with the Sustainable Development Goals (SDGs) of the United Nations (European Commission, 2018). Furthermore, the directive also mandated that member states must report their food waste annually from 2020 onwards.

The concept of the 'circular economy' is central to European environmental thinking and policy making, and the transition to a more circular economy is a major goal toward developing a sustainable, low-carbon, resource-efficient and competitive economy in the EU (European Commission, 2015). The hope is that having a circular economy will help address the environmental impact of consumption and the linear path of acquisition, use and disposal; the aim here is to keep all materials within infinite loops, reducing waste and the use of virgin materials.

The concept of a circular economy also encompasses *waste prevention*, which is placed at the top of the waste hierarchy. Thus, in the Circular Economy Action Plan (European Commission, 2015), it is stated clearly that food waste prevention is a priority area. The current article focuses on the consumption stage of the circular economy of food, as illustrated by Fig. 1 below, to identify decisive moments and contexts within everyday practices where food waste

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Fig. 1. The circular economy of food - zooming in on consumption and food waste prevention.

could be prevented.

Currently, there is a lack of effective measures available to governments when it comes to preventing and reducing household food waste. Besides information campaigns, there are no concrete strategies to cope with the large amount of food being wasted in the homes of European citizens. Nevertheless, the millions of consumers are seen as key in creating a circular economy through the power of their choices. Thus, political action taken against food waste at the consumer level is mostly directed at raising knowledge and awareness about food waste as an environmental and ethical problem, educating the consumer on date labelling and providing them with practical advice on how to avoid wasting food (Reisch et al., 2013). According to Richetin et al. (2012), raising knowledge and awareness is important for reducing household food waste but not necessarily decisive in creating changes in behaviour. Richetin et al.'s (2012) claim is supported by a number of contributions in the field, for instance by Cappellini and Parsons (2012), who found that attitudes and lack of knowledge and skills are not the main food waste drivers. Correspondingly, Watson and Meah (2012) argued that interventions aimed at increasing awareness are insufficient because food waste is caused by complex processes and that raising awareness does not change these processes in practice. In the Sustainable Practices Research Report of 2013, Spurling, McMeekin, Southerton, Shove and Welch mapped out the dominant problem framings of sustainability issues in policy, which downplay the influence of social phenomena, such as cultural conventions and shared understandings; furthermore, they proposed alternative framings from a practice perspective, arguing that routines, conventions, everyday resource constraints, infrastructures and institutions have to be more thoroughly taken into account in policy development, moving away from individual values and attitudes as the drivers of change (Spurling et al., 2013).

The research communities of various disciplines have extensively mapped the amount, composition and demographic variables and social and cultural drivers of food waste (FAO, 2011; Stenmarck et al., 2016; Stensgård and Hanssen, 2016; WRAP, 2017). Recently, a shift toward focusing on the measures and interventions targeting food waste prevention can be observed (e.g.Canali et al., 2017; Foden et al., 2017). Approaches within social psychology have been dominated by quantitative methodology and intervention studies focusing on behaviour, motivation, knowledge, the individual and what stimuli might influence consumers to behave in certain ways (e.g.Schmidt, 2016; Stancu et al., 2016). This focus on the individual and behaviour-changing interventions is different from social practice approaches, which include a focus on the factors outside the individual, such as the sociocultural and material aspects of what people do in everyday life (Foden et al., 2017).

Technology-based intervention-oriented research on the prevention of household food waste to a great extent is conducted on packaging (Wikström and Williams, 2010); labelling (WRAP, 2011); smart fridges and apps (Bucci et al., 2010; Farr-Wharton et al., 2012); and fridge and bin cameras (e.g. Ganglbauer et al., 2013; Thieme et al., 2012). The HomeLab experiment approaches the disassembly and reconfiguration of food-related practices to move them in a sustainable direction and has gained interesting insights in the process (Devaney and Davies, 2017). One insight here is that researchers – playing the role of change agents when they entered the participant's household – were crucial components of the interventions, alongside material and informational components, which rendered the latter potentially ineffective in isolation. There is still much to learn about how the sociocultural aspects of the practices of everyday life are influencing food waste levels in households (Hebrok and Boks, 2017; Porpino et al., 2015; Waitt and

Phillips, 2015), which can be explored more in-depth through qualitative methods – as in the current study – and complement quantitative accounts of food waste drivers.

In the current paper, our main argument is that informing consumers about food waste as a societal problem is not sufficient enough to change how they handle food as part of their complex and interwoven everyday lives. Thus, interventions should enable change in practices without the need for information and awareness, providing helpful cues within the moment of action and reflection. To find intervention points to reduce household food waste, the effect of everyday practices and the relationships between them must be better understood. More importantly, we argue that the measures need to be applied to the context of the practices that are causing the waste. Thus, in the context of the circular economy, waste prevention measures should address the 'use phase' to the same, if not to a greater extent, than the acquisition and disposal phases. Our approach is in line with the recommendations made by Southerton and Yates (2014) and Evans (2012). Southerton and Yates (2014) concluded in their study on household food waste practices that a more in-depth analysis of the contexts of food-related practices is needed, whereas Evans (2012) suggested that interventions should target the material contexts of food practices, such as, for instance, packaging sizes, to make food products better adapt to everyday challenges. According to Evans (2014, p. 50), practices causing food waste 'are not readily amendable to the rational and deliberate models of intervention that policy makers and campaigners are currently deploying'. Furthermore, our work connects with efforts to operationalise social practice theory, which is in line with the work of Devaney and Davies (2017).

In the present article, we explore how the material infrastructure of food-handling practices, as well as the materiality of food products themselves, may represent opportunities for food waste prevention interventions directed at households. Here, material structures include different levels of materiality, from products (food, tools) and packaging to technologies (fridges, freezers, shelf-life indicators) and infrastructures (store structure, forms of procurement). Common among these items is that they are the material part of consumers' food-handling practices and are interwoven with knowledge about food. Consumers purchase food at the grocery store, they bring packaged products home, and they store the food in the refrigerator.

The research presented is based on fieldwork conducted within 26 Norwegian households, and it describes decisive moments within everyday practices where there was an opportunity for intervention to stop practices causing food waste. We have termed the interventions aimed at these specific moments *contextual measures*, which are defined as the interventions directly linked to the time and place where food is handled. The aim is to inspire future research and policy making to explore a more contextual approach to food-waste-reducing measures.

The next sections present first how food handling is understood as practice; second, the novel method of *fridge studies* to understand food-handling practices; third, an empirical exploration of the decisive moments for food waste prevention that arise within the contexts of the practices of acquiring, storing, assessing, valuing and eating; and finally, a concluding call for a more contextual approach toward developing food waste prevention measures by policy makers and organisations. To illustrate what the concept of contextual measures might entail, we propose examples for each of these practices.

2. Fridge studies

In the current study, we understand consumption as a part of doing something else and that has 'less to do with individual attitudes or desires than it does with the shared requirements of accomplishing a satisfactory performance of a particular practice' (Evans, 2014, p. 19). Therefore, food waste is studied as a result of the performance of *food-handling practices,* meaning the practices involving food in various ways. This implies that food waste cannot be seen as an activity in itself; rather, it is produced as a result of many practices. Understanding how food handling is performed as a practice in households implies turning from normative discussions about food waste to making visible how food is part of and moves through mundane everyday life. *Fridge studies* have been developed as a methodological tool to learn about practices through the materials embedded within them, predominantly food, but also the kitchen infrastructure, technologies and products (de Jong and Mazé, 2017; Shove et al., 2007).

Hitchings (2012) showed that it is possible to talk about practices by connecting talk and material surroundings. Fridge studies focus on activating the food items in the kitchen to facilitate storytelling about the food and why the food is wasted. Evans (2014, p. 22) used a similar approach in his study of food waste in the UK, arguing that the method allows the researcher to follow the paths of food through different food-handling practices. Fridge studies are ethnographical in nature, consisting of an unstructured rummage in the kitchen that is led by both participants and researchers. Here, rummaging means that the participants and researchers stand together in the kitchen and talk about, touch and photograph food, tools and technologies. We argue that this unstructured approach toward food provides rich narratives about specific food handling that more structured inventories would not capture. The researcher's role is here to ask performative questions about food handling (Halkier and Jensen, 2011), such as assessing whether the food items are still edible, how they have been used and whether there is a plan for future use. A specific food item is used to spur more general stories about food handling; the food that are observed in the kitchen during the visits are also elements of practices that have already been carried out: leftovers from today's or yesterday's dinner or the fruit purchased for making smoothies a few days ago. These remnants of performed practices enable insights into how the food was acquired and prepared, even though these actions did not happen during the visit.

Fridge studies can produce rich data consisting of the interconnectedness between talk and materiality, which is documented by audio recordings and photographs. The photographs provide context to the talk, showing the actual food products (labels, packaging, storing, etc.) and their placement in the kitchen, as well as the layouts of kitchens, fridges and freezers.

2.1. Recruitment and sample

The data in the current paper stem from two research projects – CYCLE and FoodWaste[1] – both of which aimed at identifying food waste drivers and developing preventive measures. The data consist of 26 at-home visits to Norwegian households, which were all recruited by the recruitment agency Norstat. Previous research on food waste in Norway has identified young households and families with young children as wasting the most food (Stensgård and Hanssen, 2016), which is also similar to other European countries (Stenmarck et al., 2016). The sample was strategically selected to match these criteria to provide in-depth knowledge about why these household types generate a substantial amount of food waste; the current study's sample consists of six single

[1] CYCLE (2013–2017), financed by the Norwegian Research Council FoodWaste (2017), financed by the Norwegian Ministry of Children and Equality.

households, six couples without children, six single parents and eight households with children living at home. Households that have historically been found to waste less, such as families with older children, middle-aged and older couples, were not included in this sample. The average age of the main participant is 33 years old (variation: 25–51), while the gender distribution is 12 men and 14 women.

There are several limitations to this sample. First, all the families live in Oslo or Akershus County, which are considered urban areas. We do not have data on families in rural areas, even though the current sample does include different dwelling types (from small apartments to large, detached houses). Second, the material was gathered in two different projects. The 10 visits from the CYCLE project were conducted from January to February 2015 and included a shop-along prior to the household visit. The 16 visits from the FoodWaste project were conducted from February to April 2017 and did not include a shop-along. The fridge studies method was being developed during these visits, meaning that all the interviews were not conducted in the same manner. The first 10 visits included a section where the researcher looked into the fridge together with the participant, while the 16 subsequent interviews had the fridge study as a main research component. However, both interview guides were based on performative questions, as defined above. See appendix 1 for a full overview of the sample.

2.2. Field studies and analytical strategy

Two researchers participated in all the visits, which included a short interview section (5–20 min) about food-handling practices, including planning and acquisition from different suppliers, food labels, food storage, cooking, eating and meals, portioning and special occasions, as well as food waste and environmental issues in general. The remainder of the visits were spent in the kitchen inspecting the fridge, freezer, cabinets and countertops. The researchers photographed the fridge and freezer and each item that the participants talked about. An average of 31 photographs were taken in each household (variation 7–77). The fridge studies did not include a systematic inventory of the fridge; rather, it was used as an initiator for the participants to tell stories about their own food and kitchens. The main performative questions were 'Can you tell us about why you bought and how you are going to use this food item?'; 'Can you assess this food item and decide whether you would eat it or not?'; and 'How would you use this food item?' The average interview length was 67 min (variation: 20–114 min).

All interviews were audio recorded and fully transcribed, and the transcriptions were coded in themes and theoretical categories in HyperResearch – software for coding qualitative material such as texts and images – using the following overarching categories: planning, acquisition in store, alternative acquisition, shelf life, freezing, kitchen infrastructure, cooking, food categories, measures to reduce waste, priorities, norms, ideals and values and division of responsibility. Each overarching category with subcategories was analysed by grouping together similar narratives (e.g., the same food item, similar storyline of acquisition, storing, cooking or wasting, similar arguments of why an item was wasted or not, etc.) about food items to identify the context in which food is wasted, as well as contexts where it is not. The photographs were manually categorised as follows: type of food (e.g., vegetables and fruit, leftovers, bread, dairy, etc.); kitchen infrastructure (fridge, freezer, drawers and cabinets); labels and storage (boxes, bags, jars, etc.); package (type, opened); and shopping lists and themes (e.g., 'the unpredictable', 'double up' and 'food projects'). This inductive coding process (from raw data to categories and then narratives) was the first step in the analysis and aimed at reducing the amount and complexity of the large amount of qualitative material. In the next step, the narratives were developed into processes to capture more general features of the material that are, to a larger degree, theoretically informed. In the following section, we present five food-handling practices found in the data that cause food waste and identify decisive moments and contexts where prevention should be addressed. Furthermore, we discuss potential contextual measures inspired by previous intervention studies.

3. Decisive moments within food-handling practices for food waste prevention

In recent years in Norway, the issue of food waste and its scale has been communicated to the public through campaigns and the general media, which holds true for many other European countries. The findings from previous studies (Hebrok and Heidenstrøm, 2017) have indicated that these campaigns are increasing awareness of food waste as a general societal problem but not awareness of food waste being a problem within one's own household. Furthermore, what surfaced as particularly central to the participants in the current study was their wish to comply with their ideals of thrift and responsible management of resources, both in terms of their own financial management and their more overarching ideal of not being wasteful. Even though they possessed a large degree of knowledge about how they could avoid wasting food, they seemed to be unable to transform this knowledge into action within the practices of everyday life (Hebrok, 2018).

The present study illustrates how food is wasted in households when it falls out of the everyday patterns of food consumption. For instance, when it is purchased but not included in any dish in a reasonable amount of time and when it is prepared but not consumed. The successful consumption of food items acquired especially depends on how purchases and meals are conducted, planned and organised, on finding use-occasions for food, being familiar with food items and on the assessment of value, risk and quality. We define a 'use-occasion' as a fitting time and place for particular food items to be used in a dish or consumed as they are (as with some food products or leftovers). A situation needs to arise in time and space where particular food fits in.

In the following, we explore how food-handling practices cause food waste and identify decisive moments within these practices where contextual measures to reduce food waste could be implemented. Foremost, as a step toward bridging the gap between consumer awareness and knowledge regarding food waste, and their actual food-related practices and ability to implement food-waste-reducing measures in their everyday lives. Here, we identify five practices related to food consumption that emerge from the present study, as well as from previous research (cf. Hebrok and Boks, 2017), as the most significant to food waste generation in households: (1) acquiring food by purchasing and planning for meals, (2) storing food, (3) assessing the edibility of food, (4) valuing food and (5) eating food by creating use-occasions and portioning.

3.1. Acquiring: planning purchases and meals

How consumers plan purchases and meals has been a topic of special interest in studies on food-waste-related practices. Southerton and Yates (2014, p. 135) pointed out that the over-consumption of food is the result of a 'temporal mis-match between the rates and frequencies of food acquisition and food consumption'. A general conclusion in the literature is that consumers are not planning enough. Farr-Wharton et al. (2014) distinguished between planners and improvisers, arguing that planners waste less. The improvising consumer seldom plans for shopping or meals, and the food products bought and meals

prepared are a result of improvisation. Halkier (2009) illustrated how improvisers are seeing food preparation foremost as a pleasurable and social activity; they rarely plan shopping or meals but approach the task creatively by making use of what is at hand or by improvising on purchases in the store. By using what is at hand in a creative way, however, food waste can be avoided. Moreover, Evans (2014:42) found that 'plans are often thrown out of balance by the rather more fluid nature of the ways in which lives are lived'.

Common advice for reducing household food waste has been long-term meal planning (Love Food Hate Waste, 2018; VG.no, 2016; WRAP, 2012), making weekly meal plans and buying groceries once a week for that plan. The current study finds that long-term planning can reduce flexibility in the provisioning and organisation of meals, thus generating more food waste than short-term planning – buying what you need when you need it. In the present study, the participants who practised more *flexible planning*, for instance, by planning meals 2–3 days ahead of time, were, to a larger degree, able to adjust to unexpected events that would happen during the week. One of the participants argued, 'I think that being unorganised actually helps us waste less food, because we eat the food that has to be eaten, instead of deciding that we should eat this or that, or buy these things in advance' (Man, 38 years old). Several participants referred to past events that revealed that when planning meals for a full week, more food would become superfluous: either it would not be put to use at all, or leftovers were wasted. Consequently, we argue that what decides how much food goes to waste is not how meticulously purchases and meals are planned, but rather how flexible participants are concerning the use-occasions for particular items and their frequency of shopping. In essence, the participants who were somewhat spontaneous and irregular in their purchasing habits but purchased food items that they knew they could put to use in a variety of dishes seemed to waste less food than those who made meticulous plans but did not manage to follow through on them. Following these sorts of plans seemed to be next to impossible for most participants because of the unpredictable and constrained nature of everyday life.

Organising the events of everyday life is a never-ending task, and of course, planning is a necessary part of this effort. In looking for decisive moments within everyday practices to prevent food waste when planning, we find that the new food provisioning services could play a useful role. The use of these services may contribute to a reduction in food waste by making it possible for consumers to check their stock as they are shopping for new groceries online (online grocery shopping) and by streamlining the use and portioning of food (box schemes). Additionally, they could potentially reduce overbuying, overportioning and the amounts of food left in storage and not consumed. One participant talked about how she used an online grocery store: 'I have stored a list there called "basics" where I have butter, milk, coffee, toilet paper, all the stuff that you need on a regular basis. Then I have made separate dinner lists for different dishes, and sometimes I use the recipes at the website, as well as a blog' (Household 14, Woman, 39). The participants stated that they often forgot what they already have at home when in the store or did not know how to combine the food they had into a dish. Encouraging consumers to shop for food with long shelf lives online and to buy easily perishable food items more frequently can be one approach to increase flexibility in consumers' provisioning practices and, thus, help reduce food waste. For fresh foods, flexible planning is crucial. This kind of strategy can be made attractive by communicating the possible benefits, such as avoiding heavy shopping bags, saving money and more. In cities with a high degree of retail density, this is obviously a more relevant strategy than in rural areas.

Similarly, box schemes have some of the same potential for changing the practices of food provisioning, along with cooking practices, because the food is already portioned. However, the participants found that using a box scheme reduced flexibility within their everyday lives and that some of the food did not fit – either because they did not like it or because they found no use-occasion for it, which is exemplified in the quote shown in Fig. 2 below.

Thus, we assume that the potential of box schemes to reduce food waste could be amplified by reducing the use of unfamiliar food items, increasing flexibility in ordering and cancellation, differentiating between servings for children and adults and including tips for alternative use-occasions for the food items.

3.2. Storing: the fridge and freezer as keepers and destroyers

Evans (2012) talked about the refrigerator as 'an active participant in the process of devaluation and decay'. Storing fresh food and the long-time storage of frozen foods in households can be made possible through the refrigerator and freezer, respectively, and these technologies play a central role in how food is handled in the home. They enable people to purchase larger amounts of food than they intend to eat or store the food at home for different use-occasions. Nevertheless, when parts of this food cannot find a use-occasion, they go bad and are wasted. The quote shown in Fig. 3 below illustrates that the freezer is also used for storing food that will eventually be wasted.

The participants in the current study explained how food ending up in the back of the refrigerator is often wasted. The same goes for vegetables at the bottom of the vegetable drawer and jars forgotten in the fridge door, all of which are examples of food that lost a use-occasion. Moreover, leftovers are kept there in the hopes of someone being tempted enough to eat them, but all too often, they are tossed as soon as the food is spoiled. In this way, the uncomfortable feeling of wasting is reduced. We find that the participants' kept products 'at mercy' (Klepp, 2001) in the fridge, meaning that these products were no longer desirable and were being left at the back of the fridge to expire and then be thrown away (see also: Evans, 2011; Porpino et al., 2015). The quote shown in Fig. 4 below is an example of how food moves through the fridge during its different stages, from edible and desired to nearly waste.

What seems to be causing some of these leftovers to be thrown out is that many people are not restricting themselves to eat what is currently in the fridge; rather, they focus on what they desire to eat at the moment (Baker et al., 2009).

The most important feature of the refrigerator today is its ability to maximise shelf life; however, there may still be untapped potential for using the refrigerator to reduce the uncertainty of shelf life and create more use-occasions. The traditional design of the refrigerator with shelves and a vegetable drawer does not provide a sufficient overview of the available food items. Furthermore, location and size matters greatly in how food stored in freezers is handled. In our fieldwork, we discovered a difference between households that owned a combined fridge and freezer and households with separate units. The large freezers gave little overview of the stored foods; they were often stuffed and contained items that had been stored in them for several years. Households with limited space in the freezer were more conscious in how the space was used. Furthermore, in the households where the fridge and freezer were both located in the kitchen, the freezer was more actively used to prolong the lifespan of some food items by moving them from the fridge to the freezer. Additionally, the freezer was actively used for portioning items, such as portions of bread, vegetables and leftovers, that the families consumed daily.

Interventions aimed at the fridge have been developed in various fields. Scholars within human–computer interaction have been engaging in developing fridge concepts that could reduce food

Quote

(A couple [30 and 27 years old] were talking about their experiences with box schemes)

Woman: Too much time had passed, and then we felt that it had expired and we did not want it, so it's, I think we wasted more food than I would have expected us to do, from that box scheme, don't you agree?
Man: Yes, it contained a lot of fresh food, wasn't that it?
Woman: Yes, it had short shelf-life.
Man: Because, a lot of stuff happens, and I remember several times when we received the box and then, shit, we are away for three days this week, and have five dinners. Then it expires, so it was too many dinners at once.
Woman: It is the vegetables that do not last that long, the herbs for example.

Fig. 2. Experiences with box schemes (Household 22).

Quote

(A 30-year-old man has a large freezer that is used to keep food at mercy)

Yes, the freezer is where stuff travels to wait for death. It's kind of a terminal ward. That's my description of the freezer.

Fig. 3. Using the freezer to postpone wasting (Household 19).

waste. The ZmartFri technology is an intelligent fridge concept that includes an expiration date alert and automatic shopping list (Bucci et al., 2010). 'Colour Coding the Fridge' is a concept that aims to help people organise and keep track of a fridge's contents (Farr-Wharton et al., 2012). An eat-first prompt was tested in the 'Food: Too Good to Waste' campaign by the U.S. Environmental Protection Agency (EPA), and this programme entailed a sign being placed on a shelf in the fridge (EPA, 2016). It remains to be seen how these types of concepts may contribute to reduce household food waste. The challenge lies in how the complexity of factors related to the organisation of everyday life, preferences, experiences and uncertainties affect how food is handled. The HomeLab project has sought to address this complexity from a practice perspective, and among other interventions, there has been experiments with 'fridge triage boxes' that are supposed to aid participants in circulating food appropriately in the fridge (Devaney and Davies, 2017). A simpler, but perhaps more effective suggestion, is having a smaller fridge to reduce the amount of food that could be left forgotten in the back and in large drawers (Foden et al., 2017).

We argue that there is great potential in designing refrigerators and freezers differently to reduce food waste; the goal of these designs should be to increase visibility, trigger use-occasions and reduce uncertainty regarding edibility. Thus, how a fridge and freezer can be designed to enable better food-handling practices should be more thoroughly explored. Integrated storage solutions and tools for measuring shelf life would, for example, make it easier to keep track of a fridge's contents, increase food shelf life and reduce uncertainty.

Moreover, packaging may be able to play a more central role in household food storage than it presently does, and this can be accomplished by redesigning packaging to the way food is handled at the consumer stage. This could focus on more accurate portion

Quote

(A 30-year-old woman explains how the fridge is used and how that might cause food waste)

Then there is an onion in the back, and that is, everything that ends up in the back is really stuff that is just moved around and eventually pushed to the back, and then you forget that you have it. (…) Then there is the spring onion, I use a pack a week, and then there is the salad, we were supposed to eat that with a lasagne, but that never happened. (…)

Fig. 4. Keeping food without a use-occasion at mercy in the fridge (Household 16).

divisions, visibility, stackability and so forth. Wikström et al. (2018) argued that there is a lack of packaging designs that take into account the functional needs for the whole life cycle of food products. Furthermore, the desired practices related to food packaging can be made default through design, suggesting this is a topic for design research within the field of design for sustainable behaviour.

3.3. Assessing: food quality and safety

Reducing food risk and food waste are efforts that often come into conflict (Watson and Meah, 2012), and there is a need for coordinating messages to the public about food waste and safety (Foden et al., 2017). According to Neff et al. (2015), date labels and sensory assessments are the most practised ways to judge edibility. Parizeau, von Massow and Martin (2015) showed that the more strategies to assess edibility are used, the more food is wasted. Those relying on only one or two strategies, for instance, visual assessment and smell, seem to waste less food. Assessments of food are influenced by emotions and care-taking responsibilities (Brook Lyndhurst, 2007). Avoiding risk and ensuring food safety for oneself and one's family members is a priority over avoiding food waste (Evans, 2011; Farr-Wharton et al., 2014; Graham-Rowe et al., 2014).

The participants in the current study were continuously assessing the level of risk their food posed to their health, as well as the pleasure of eating, before deciding on the edibility of the food. Both the risk of getting ill and the risk of experiencing disgust when eating spoiled food seemed to be equally important for the participants to control. The current study shows that insecurities about risk assessments often lead to food waste. The participants mainly based their decision on whether a food item is edible or not on two types of knowledge: (i) *institutionalised knowledge and explicit rules* that consist of explicit and theoretical knowledge such as date labels, written information from authorities, media, non-governmental organisations (NGOs), and so forth and (ii) *know-how and embodied habits* that consist of sensory evaluations, such as seeing, smelling and tasting, along with previous experiences with similar foods (Gram-Hanssen, 2011). Generational aspects and upbringing seem to be central to the kind of embodied knowledge a participant possess, for example, whether they were brought up or have lived in rural areas in close connection to food production. Nevertheless, most of the participants described insecurities related to both these types of knowledge, especially when used together. For example, is the date label correct if the packaging is broken? How long can the food be stored? What types of changes in appearances, texture, smell and taste are safe? The way in which the participants drew on institutionalised and embodied knowledge to assess if a food item was still edible varied between different sorts of food items. The quote shown in Fig. 5 below illustrates how these negotiations between institutionalised knowledge and embodied knowledge can be expressed.

In some cases, knowledge about how to assess food safety and quality is transferred from one sort of food item to another. Sometimes, this can be problematic, for instance, when one of the participants stated that she would eat chicken past the best before date because she knew that most food is generally still edible past the date. In this case, her embodied knowledge that food often lasts past the expiration date, as well as her attempt to see and smell if it was edible, made her put her health at risk by eating chicken that could be infected with microbes.

Previous research into the effect of date labelling on household food waste has shown that the current date labelling systems are confusing to consumers (Wilson et al., 2017). In Norway, similarly to other European countries, there are two kinds of date labelling: *use by* and *best before*. European studies have found that consumers are confused by the different labelling systems, and some countries have reduced how many systems there are to clarify how they work (WRAP, 2011). Likewise, the current study shows that although most of the participants knew the difference between the two labels, the date – independent of the text preceding it (best before or use by) – is a trigger for food waste. Date labelling seems to contribute both to an increase and reduction in uncertainty about food risk and quality. This uncertainty is mostly connected to what the participants feared may not be perceptible (microbes and pathogens) or to one's own ability to assess an acceptable degree of change in quality (consistency, colour and odour). Furthermore, the participants challenged the date labelling system by implementing their embodied knowledge (sight, smell and taste). These negotiations created a dynamic between the two systems, leading to food waste from uncertainty.

We argue that the decisive moments for intervening into these processes of risk and quality assessment are mainly related to two contexts: packaging and the grocery store. By redesigning

Quote

(A 29-year-old woman was asked by the researchers to assess a box of chicken salad)

Yes, it has been open for two weeks, but if it had not, I would have eaten it. It is three days past the expiration date, and it does not say best before either, but I would have eaten it. But you can throw it away (…) It does not smell bad, but I don't know. Its mayonnaise, to days past, with chicken, meat, in it. No, not two weeks past the date, I don't think so, no, throw it away. I have eaten a bit of it already…

Fig. 5. Assessing chicken salad (Household 18).

packaging and labelling, along with tailoring communication and training in grocery stores, these insecurities about food risk and quality may be reduced.

Date labelling is still the prevailing way of providing consumers with information on shelf life, food quality and safety. However, new technologies are being developed to provide more accurate indicators of shelf life. 'Keep-it' is a Norwegian innovation that monitors storage conditions and how these conditions impact the food inside the packaging, showing how many days are left of its shelf life through a timeline (Keep-it, 2018). Mimica Touch, a British innovation, is an intelligent label that becomes bumpy when the food inside the packaging has gone bad (Mimica Touch, 2018). To avoid food waste caused by insecurities connected to date labelling, it is crucial to develop alternative ways to indicate shelf life and support consumers in their own assessments.

Uncertainty about the edibility of food is not only affected by date labelling, but also by the design of the packaging. The participants in the current study were especially critical of liquid food in glass or metal jars and tubes, where it is difficult to observe changes in colour and texture. Given the limited surface available for information on packaging, as well as the consumer's limited susceptibility to this information, it might be useful to examine how the shape of the packaging can help reduce the uncertainty associated with opened packages (e.g., packages with a set of sealed portions).

Another opportunity to aid consumers in their sensory assessment of food could be in the store, preferably through positive rather than moralising messages. The aim would be, as with packaging, to convey knowledge to consumers in the moment of reflexivity that occurs when buying food. Visual representations of quality changes that are acceptable and different uses for food in different 'phases' (e.g., sour milk) would be helpful for consumers to take home. It is important that the communicated knowledge that is internalised over time is activated at the moment of reflection — that is, when the consumer is holding a product in his or her hand, wondering what to do with it, or is looking into the refrigerator to see what can be made for dinner.

3.4. Valuing: perceiving the value of food

The plenitude of food accessible at low costs affects how food is valued, and although reducing the availability of food and increasing prices would most probably reduce food waste, this cannot be seen as an option (Aschemann-Witzel et al., 2015). Age seems to be an important variable in how food is valued within various consumer groups, with people over 65 years of age wasting less food than younger groups (Quested et al., 2013; Stensgård and Hanssen, 2016). According to Mavrakis (2014), different forms of value, such as monetary value, novelty value, resource value and the value of social relations influence disposal decisions.

In the following, we highlight three forms of value attributed to food – in addition to monetary value – that we find are causing food waste. Similar to Mavrakis (2014), we have differentiated between the values using our empirical findings. This differentiation serves as a way to pinpoint important aspects of the practice of valuing food. Furthermore, this will help relate forms of value to decisive moments of opportunity for food waste prevention. Previous studies have mentioned similar values but have not differentiated them in the same way because these values have been presented in other contexts (e.g. Evans, 2014; Mavrakis, 2014).

The current study shows that the participants were evaluating food according to the various perceptions they had of these different forms of value. The type of value that gained the most attention was monetary value. The share of household income spent on food in Norway has steadily declined over the last decades, dropping down to the current 12% (SSB, 2005, 2012). This means that on average, food is relatively cheap for most Norwegian consumers. Not surprisingly, the current study shows that if a food item is considered to be of low value, it is more often wasted than food items that have a high perceived monetary value. Monetary value is important here; expensive foods, such as meat and fish, are less frequently wasted than cheaper foods, such as vegetables and bread. However, the current study identifies three additional forms of value that seem to influence food waste in households. First, we find that the perceived value of food can be influenced by the degree of its utilisation – *a utilisation value* – meaning that when a product is partially used, it is easier to waste than an untouched, new product, as exemplified in the quote shown in Fig. 6 below.

Packaging divided into smaller portions, for instance, might preserve the food's utilisation value better than larger packs of food items because these smaller portions will keep the food aesthetically appealing and fresh after being consumed piece by piece.

Quote

(A 26-year-old woman uses mangos as an example when talking about utilisation of value)

I don't like to throw out mangos because they taste so good. However, when I have to throw something, if it's just a little bit of it, then it's OK, because then I have at least been able to use some of it, but if I have to throw out a whole mango, I don't like that.

Fig. 6. Partial utilisation of value (Household 24).

However, portion packs are often criticised for the extra amount of packaging used and their environmental impact, which must be weighed against its potential waste-preventing effect.

Second, there is value influenced by relationships, time and effort – a *relation and time value* – meaning that homemade food, made either by friends and family or oneself, along with food that takes time and effort to prepare, is less frequently wasted than ready-made foods, as exemplified in the quote shown in Fig. 7 below.

Value connected to relationships and social interactions to some extent is being promoted through marketing campaigns for food products, simply by creating adds that show the products placed in a meal setting, such as a family dinner or dinner party with friends. However, this is a projected value, not one attributed to personal relationships, nor to the time and effort spent on preparing a meal. Thus, it is a challenge to imagine interventions that can effectively recreate this personal effect. Encouraging people to spend more time cooking or to bring more food as gifts seems counterproductive.

Third, the *quality and taste value* matters a great deal because foods with a high perceived quality nutritionally or in terms of freshness (e.g., fresh food ingredients, meals cooked 'from scratch' and organic food) and taste are less frequently wasted than low-quality foods (e.g., processed food and less fresh food), as exemplified in the quote shown in Fig. 8 below.

For instance, increasing quality and taste attributes could be achieved through policy measures that put pressure on the food industry to deliver better products. Some producers that already provide premium quality products could perhaps improve the marketing of their products to convey this value to consumers.

This differentiation into three additional types of value – in addition to monetary value –indicates that there is a potential to increase perceived value in other ways than by increasing food prices. To reduce the food wasted as a result of value, it is imperative to explore ways to increase the perceived value of food, which can perhaps be done through industry regulations, marketing efforts, popular media, training and education in schools and new provisioning platforms where the producer and consumer develop a closer relationship. Increasing the value of food, hence, does not necessarily need to be done by increasing the monetary value, but rather by attributing values related to quality, taste, social interaction, caring and use-occasions to food products.

Quote

(A 37-year-old man shows us a salmon packed in a plastic bag that has high relational and time value)

Participant: My bad conscience is this salmon, 1,5 kg that my dad caught.
Interviewer: What do you think you would use it for?
Participant: We'll see (…) these things can be kept fresh for a long time, there is little fat on it.
Interviewer: So you want to try to use it?
Participant: Yes. It's my bad conscience.

Fig. 7. Relational value (Household 26).

Quote

(A 30-year-old man show us a box of sour cream that is ecological and produced by a small dairy, as an example of food that he would never throw out because of taste and quality)

Røros, you know. You just don't waste such good stuff.

Fig. 8. High perceived quality and taste (Household 19).

3.5. Eating: finding use-occasions and portioning

Evans (2012, p. 45, 51) explored how food waste is a result of 'a mismatch between the rhythms of everyday life and the temporalities of food, (…) between the ways in which food is provisioned and the ways in which lives are lived'; he argued that food waste occurs as part of the practices with goals not related to food waste. Southerton and Yates (2014) identified the contexts and the social organisation of meal occasions to be especially important in predicting food waste. Similarly, the present study found that not only is it important to study the effects of the practices related to meal occasions, but also how the ability to find *use-occasions* for the purchased food is an important part of organising meals and avoiding waste. In the current case, this seemed to be easier for the participants who were not buying large amounts of food but were instead buying what they knew they would eat in particular dishes the following days. Moreover, the participants who planned to use the same, familiar ingredients in several meals were generally more successful in putting all the food to use than those who tended to experiment more with unfamiliar ingredients and who planned very different dishes from day to day. The food items that were intended for specific use-occasions that never occurred in some cases could become superfluous because no new occasion was looked for or found, as exemplified in the quote shown in Fig. 9 below.

We argue that the purchasing food items that are strongly linked to intended meals or projects or to particular practices of meal preparations and organisation is, in many cases, a producer of food waste because these foods are difficult to transfer from a specific dish to a new use-occasion.

The current study shows that food waste often occurs when consumers handle food items that they are unfamiliar with, either that have been given to them as gifts or purchased as ingredients for a particular dish. We find that the food items that participants were able to apply to a small variety of use-occasions were wasted more frequently than items applicable to a large variety of use-occasions. This applicability depends on the person's knowledge, skills and routinised food practices. Food items we have characterised as *unfamiliar* – meaning that the participants were not used to eating them and incorporating them into meals – are resistant to domestication (Silverstone, 2006) into the everyday running of meals and are thus more often wasted, as exemplified in the quote shown in Fig. 10 below.

Finding a use-occasion for the food was the first step toward a making a meal, but then during preparation, portioning surfaces as the next challenge the participants faced. The participants found it

Quote

(A 37-year-old woman showed us a bottle of white wine vinegar that she had purchased for a specific meal, and never used again)

I bought that because I was inviting some friends over for an international dinner, and everybody was supposed to cook a dish from another country. I was making a dish from Peru, and it contained white wine vinegar, but that is not something I normally use (…) Ingredients that belong to a fancy dish, I don't think I would use it again.

Fig. 9. Food item with one specific use-occasion (Household 15).

Quote

(A 38-year-old man showed us a jar of duck liver as an example of a food item that was typically wasted)

We have had this for a long time. It was a gift, but it's old (…) I don't know what I would use it for, I have actually looked online at recipes for it, but it is duck liver, and I'm not a huge fan of that (…)

Fig. 10. Unfamiliar food item (Household 22).

quite difficult to portion accurately for meals and regularly cook more food than what was consumed. Cooking the right amount is a demanding task because it is difficult to assess how much household members will eat on a particular day. One of the participants talked about how she could be better at portioning in her family: 'It had to be if the kids were better at eating the food they are served. Or that I would be better at finding the key to portioning for them, being good at knowing how much they eat at certain times' (Household 8, Woman, 43). Much like assessing food safety and quality, portioning is a practice consisting of (i) *institutionalised knowledge and explicit rules,* such as recipes and information on packages, and (ii) *know-how and embodied habits,* such as knowing how much each family member usually eats and how to compose a meal with different amounts of ingredients. The institutionalised knowledge or estimation of how large one portion of rice is, for instance, that is printed on the back of the packaging may not always correspond with how much family members will eat, which makes embodied knowledge just that more important. Families with young children struggle with the ever-changing appetites and preferences of their children, and single households are not able to consume all the food that is prepacked in large portion sizes. Moreover, a strong cultural norm of serving (more than) enough food and the fear of not being perceived as offering an abundance on special occasions and weekends contributes to overestimating the required portions for meals. According to the participants, this ideal was also present during weekday meals, though not to the same extent. In addition, the store represents a material infrastructure consumers interact with regularly, on average three to four times a week in Norway (Forbrukerrådet, 2016). Thus, this is a context that has a great deal of potential to make an impact. The combination of material and informational interventions has proven to be influential on purchasing choices (Devaney and Davies, 2017). Thus, we suggest combining knowledge and awareness campaigns with material and structural measures in the store, such as using product placement and product-specific information and tools in context (on shelves or displays). To make consumers more aware of the various use-occasions of food items, these use-occasions could be communicated in stores by placing items next to each other and having corresponding recipes and information nearby. A variety of use-occasions for food items and more flexible portioning strategies (adjusted according to, for instance, gender, age, etc.) could be presented on packaging and in stores. Moreover, portion control tools could be distributed, as applied in the HomeLab experiment (Devaney and Davies, 2017). The main focus should be to convey knowledge and offer tools to increase use-occasions and to portion more accurately in a way that can be internalised by the consumer, hence being activated when handling the food item again at home.

4. Discussion and conclusions

In order to address the insufficiency of current policy efforts towards reducing household food waste, we discuss new ways of approaching the problem. We argue that the current focus on information and awareness campaigns is failing to produce large scale results because it is a strategy that does not target important everyday practices influencing food waste levels. Albeit, consumers may become more aware and knowledgeable about the issue, this does not result in major changes in practices. The reason is that they are intertwined in a web of interlinked practices making up the everyday life activities, infrastructures and meanings of consumers. Interventions must therefore be targeted at the appropriate contexts to make a difference.

Thus, in this article, we have argued for a more contextual approach toward food waste prevention as part of the ambitions of the EU's goal of developing a circular economy. Based on the findings, we emphasise the importance of targeting the contexts of everyday food-handling practices related to households and identify the decisive moments where food waste prevention measures should be implemented. In Fig. 11 below, we summarise our findings and illustrate the connection between everyday food-handling practices and food waste in households. Moreover, we include how these practices contain decisive moments for food waste prevention.

Our main argument is that the measures to reduce household food waste need to be implemented in connection to the actual food-handling practices that are causing waste – these measures need to be *contextual.* In doing so, the goal is to change these measures in a way that changes the mundane practices in everyday life that lead to food waste. We have focused on five practices that have emerged as especially significant to the generation of food waste: 1) acquiring: planning purchases and meals; 2) storing: the fridge and freezer as keepers and destroyers; 3) assessing: food quality and safety; 4) valuing: perceiving the value of food; and 5) eating: finding use-occasions and portioning. Furthermore, we explored how the material infrastructure of food-handling practices, as well as the materiality of food products themselves, can represent opportunities for food-waste-reducing interventions by targeting products (food, tools), packaging, technologies (fridges, freezers, shelf-life indicators) and infrastructures (store structure,

Fig. 11. Food-handling practices – decisive moments in everyday life for food waste prevention.

forms of procurement). In an attempt to apply our insights to concrete interventions, we have discussed the role of these material structures within the described practices and what sort of interventions might be fruitful to further explore, develop and evaluate.

Our study contributes to the existing food waste literature by providing insights into food-waste-related practices. The novelty of our contribution lies specifically in the identification of decisive moments and contexts where preventive measures could be successfully implemented. In this way, we add to the emerging literature focusing on applying insights on practices to the discussions of interventions and food waste prevention. We argue that this strand of research is imperative to support future efforts to address this important area of food waste prevention within the European Circular Economy Action Plan (European Commission, 2015).

Two limitations to be noted are as follows: 1) our account of food-waste-related practices is our interpretation of the empirical data retrieved from our ethnographic fieldwork and is not based on exact measurements of food waste quantities within the visited households, and 2) the contextual measures discussed have not been evaluated or tested but are merely provided as examples of potential starting points.

We hope that future research and policy development will engage in how contextual measures may be created and put to use in measuring the effect of such measures. Although we argue for a contextual approach, we acknowledge the need for raising awareness on the magnitude of the food waste problem. Notwithstanding the above, we argue that this is not sufficient to change consumer habits; contextual measures must be added as well. Furthermore, we acknowledge that efforts have already been made within the contexts described, but what we see lacking is a comprehensive systems approach addressing structural changes from multiple angles, constructing systems with a larger impact than the lone components these systems consist of. To achieve this, a multi-stakeholder approach is required, including stakeholders from various industries, the government, social research, and NGOs.

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Appendix A. Supplementary data

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Article 4

Marie Hebrok & Henry Mainsah

Bird: Design fiction and the futures of food consumption Submitted, January 2020

This article is awaiting publication and is not included in NTNU Open

A2 STATEMENTS OF CO-AUTHORSHIPS

NTNU

Faculty of Architecture and Design

Statement of Co-Authorship of Publication Included in Submission of the Doctoral Thesis of Marie Hebrok

Candidate's Name: Marie Hebrok

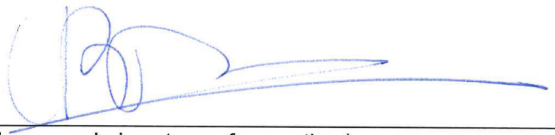
Publication:
Marie Hebrok and Casper Boks. *Household food waste: Drivers and potential intervention points for design – An extensive review.* Journal of Cleaner Production Vol. 151/pp. 380-392/ 2017

Description of Candidate's Contribution to:
Marie Hebrok has conducted the literature review and has written the main draft of the article. She has also conducted all of the editing after that and has incorporated the comments and suggestions from the co-author into the manuscript. Furthermore, she has handled the editing following the peer review from Journal of Cleaner Production.

Statement by the co-author:

I hereby confirm that the doctoral candidate's contribution to this paper is correctly identified above, and I consent to Marie Hebrok including it in her doctoral dissertation

Trondheim, 22.01.2020



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Statement of Co-Authorship of Publication Included in Submission of the Doctoral Thesis of Marie Hebrok

Candidate's Name: Marie Hebrok

Publication:
Marie Hebrok and Nina Heidenstrøm. *Contextualising food waste prevention - Decisive moments within everyday practices.* Journal of Cleaner Production Vol. 210/pp. 1435-1448/ 2019

Description of Candidate's Contribution to:
Marie Hebrok has conducted the fieldwork, analysis and development of the Fridge studies method in close collaboration with the co-author. She has written the main draft of the article and conducted about 70% of the editing after that. Furthermore, she has handled about 50% of the editing following the peer review from Journal of Cleaner Production.

Statement by the co-author:

I hereby confirm that the doctoral candidate's contribution to this paper is correctly identified above, and I consent to Marie Hebrok including it in her doctoral dissertation.

Place, 22.01.2020

NINA HEIDENSTRØM

(Name and signature of co-author)

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Statement of Co-Authorship of Publication Included in Submission of the Doctoral Thesis of Marie Hebrok

Candidate's Name: Marie Hebrok

Publication:
Marie Hebrok and Henry Mainsah. *Bird – Design fiction and the futures of food consumption.* Submitted to the journal *Futures* January 2020.

Description of Candidate's Contribution to:
Marie Hebrok has written the main draft of the article and conducted about 80% of the editing after that. Furthermore, she has done the main work in preparing for and conducting the workshop the article is based on.

Statement by the co-author:

I hereby confirm that the doctoral candidate's contribution to this paper is correctly identified above, and I consent to Marie Hebrok including it in her doctoral dissertation.

Oslo, 22.01.2020

Henry Mainsah

(Name and signature of co-author)

A3 Interview guides and consent form

Below you will find the interview guides for the two rounds of interviews conducted in 2015 and 2017. The first round was conducted by myself alone, and the second round was conducted in collaboration with my colleague and co-author on article 3, Nina Heidenstrøm. The interview guides have been translated by the author from Norwegian into English.

Interview guide semi- structured interviews in 10 households, 2015

Accompanying the informants in shopping trips to the grocery store, I will first of all observe and ask questions along the way regarding what the informant does. It will be important to observe how planned the informant acts, whether he / she has a fixed pattern of movements or acts spontaneously (possibly a combination), and what causes him / her to deviate from this pattern. How the informant plans meals during the shopping trip. Who the food is being purchased for and why different food products are chosen. Is the informant aware of labeling and product placement? What triggers skepticism or enthusiasm? How is the informant affected by the store's layout, product positioning, promotions and the like?

After completing the shopping trip, we meet at the informant's home and unpack. Observation of how the goods are placed in refrigerators and other storage places. For this sequence I will photograph the refrigerator, the kitchen, drawers, cupboards, dining area, waste bin and the like. (Take a photo before and after the new items are put in the fridge!)

In the store:

- Do you have a shopping list?
- Have you planned dinner for today or other days this week? (or do you plan as you go?)

Themes for questions along the way:

- Planning
- Packaging
- Varetrykk
- Communication / promotions in store

At the informant´s home:

Theme: Planning, storing, shelf-life/labelling

Planning

- What did you plan to buy and what did you buy spontaneously? (do you often shop spontaneously?)
- What made you buy what you had not planned?
- Did you buy anything on offer? For instance 3 for 2?
- Does it occur that you do not eat what you buy on offer?

- How often do you shop for food? (who shops?)
- Do you ever use a shopping list?

Storing

- Are food items organised in a particular way in the fridge? (How?)
- Is theer anything that must og now that you have bought new food?
- When did you last tidy in the fridge? (checking date stamps, if something is mouldy, throwing away left-overs etc.)
- How do you stor efood that is not going in the fridge? (check if something has expired?)
- Fruits & vegetables
- Bread
- When did you last check what you have in the fridge, in drawers and cupboards, to get an overview?
- What do you have in the freezer? Do you remember to use it in time? Do you use it for leftovers?

Shelf-life / labelling / packaging

- Did you check the expiration date on the food items you bought at the store?
- What do you do if something has expired?
- Do you open and smell it, or do you taste it before you waste it?
- Do you eat food that is past the expiry date? (What? Why?)
- Do you notice if the label says «best before» or «use by»?
- In your experience, are there any food items you find perishing fast due to bad packaging?
- Could we please have a look in your bin in the kitchen? (check for food waste and ask about it)

Theme: Routines in the home related to food and meals

Families/Couples	Singles
• What do you usually make for dinner? • What did you make yesterday? • Were there leftovers? • Are you eating the leftovers today? • What are you making for dinner today? • Who usually cooks? • Do you always eat together or also alone? • Do your eating routines change on the wee kends? In what way? Portioning: • How do you estimate the amount of food to be prepared for a meal? • Are there often leftovers? Why? • What do you do with leftover food? Who e ats it? Who does not? • Does it sometimes remain uneaten? Why?	• What do you usually make for dinner? • Do you make dinner every day? • What did you make yesterday? • Were there leftovers? • Are you eating the leftovers today? • What are you making for dinner today? • Do your eating routines change on the weekends? In what way? Portioning: • How do you estimate the amount of food to be prepared for a meal? • Are there often leftovers? Why? • What do you do with leftover food? Who eats it? Who does not? • Does it sometimes remain uneaten? Why?

Theme: Special occasions

- Do you often have dinner guests? To what occasions?

- What kind of food do you usually make for special occasions?
- How do you calculate how much food you need to have?
- Who's shopping?
- Who makes the food?
- Will food often be left over? More than usual?
- What happens to this food?
- When did you have dinner guests last last and were there any leftovers?

Theme: Food waste

- What kind of food are you wasting? (What did you waste last, why?)
- Would you say you waste a lot of food or not so much?
- What makes you waste a lot or a little food?
- Do you have any strategies for wasting less food?
- What kind of food are you most reluctant to throw away? (what kind of food is "easier" to waste?)
- Do you have any thoughts on how you could waste less food?

- Has the amount or type of food being wasted changed over time?
- What would you say is inevitable food waste?
- If you have food waste sorting, does it make you more aware of how much food is being wasted? (If so, has this reduced your food waste?)

- How much do you think about the food you throw away?
- Do you feel relief when throwing away food?
- Do you feel bad when wasting food?

- Is food waste a problem? (for you, for society?)
- Do you have any other concerns about food waste?

Interview guide semi- structured interviews in 16 households, 2017

Introduction

We come from the Consumer Research Institute SIFO, which is part of Oslo and Akershus University College, and are part of a research group focusing on issues of sustainable consumption such as food, clothing and energy. Food waste is one of the topics we are currently looking into. The aim of the project is to identify barriers to food waste reduction in households and to try to identify some possibilities for measures against them. We are therefore interested in what you do in your everyday life when you buy food, store food, cook food, eat food and throw away food. We are going to ask you about what you usually do, about small things that may seem mundane, but which we believe are important in documenting the everyday life of Norwegian consumers. We would also like you to give us a tour of your kitchen during the interview. First, we would like to ask if it is okay by you that we record the conversation? We will also ask you to sign a consent form after the interview is complete.

Background variables

First of all, we would like to know a little about you who live here:
- Who's living here? (gender, age)
- What are your occupations?

Planning and procurement of goods in stores

- The first thing we are interested in is how you shop for food:
- How often do you tend to shop for food?
- Who in the household buys food?
- Do you shop in a regular store or in multiple stores?
- Do you often shop spontaneously, or do you rather plan in advance?
- What might make you buy something you had not planned to buy?
- Do you make use of offers, eg. 3 for 2?
- Does it happen that what is bought on offer is not eaten?
- Do you ever use a shopping list?
- What does that shopping list look like?
- Do you have a shopping list to show us?

Planning and procurement of goods from other than grocery stores

Now that we have talked about how you shop in the store, we want to ask you if you use any other forms of suppliers, such as box-schemes or online grocery stores?

- Do you have home delivery in the form of box schemes?

- What scheme?
- Time: How often, how long have you had it?
- Has the box scheme made you waste more or less food?
- Has the box scheme led to other changes in how you store, prepare, or throw away food?
- Do you buy food online?
- If yes; how often?
- Which supplier?
- How do you shop online?
- Has shopping online led to changes in how you store, prepare, or throw away food?
- Do you procure food in any other way? (self-picking, cooperative farming, own garden etc.)

Storage, durability / labeling

When you come home with the food, how do you store it? We would like you to show us around the kitchen while we talk about storage. We would like you to tell us how you store food in the fridge, freezer and in other parts of the kitchen. We would also like to take pictures of this if you think it is okay.

(Get the informant to talk about specific food in the fridge: leftovers, something that has expired, which is hard to get used up, opened jars and jugs, etc. Let them tell the stories about this food! Take pictures!)

Storage:

- Do food items have fixed places in the fridge? (where is what?)
    - If yes; Show us your system in the fridge
- Is there something to look out for when you buy new food?
    - What foods do you waste when there is no space?
    - Are there any foods you keep longer than others? (which has greater value)
- When did you last clean the fridge? (Check date stamping, if something is moldy, discard old food, etc.)
- How do you store food that is not going in the fridge?
    - Fruits & vegetables
    - Bread
    - Dry Goods
- When did you last check what you have in the refrigerator, drawers and cabinets for an overview?
- What kind of food do you store in the freezer?

- Do you remember to use it on time?
- What are you using frozen foods for?
- Does the freezer have any function other than the refrigerator?
- How long do you think something can be in the freezer?
- Do you pack the food in a different way when it is in the freezer?
- Is there any food you do not freeze?
- Is there any food you freeze often?

Shelf life / labeling / packaging:

- Do you check date stamping on some of the items in the fridge or in other cabinets?
- What do you do if something has expired?
  - Do you open and smell it or taste it before throwing it?
  - Do you sometimes eat food that has expired? (What? Why?)
- Do you notice if it says "best before" or "use by"?
- In your experience is there anything that often expires too soon because of poor packaging?

Images
All refrigerator and freezer units in the home (closed): to document the type of refrigerator (combination cabinet or separate fridge and freezer, age, number of refrigerators and freezers)
All refrigerator and freezer units in the home (opened). Pictures of food packaging / labeling, what types of goods are frozen. Ask about freezer organization. Overview image, pictures of each shelf and door. Ask about organizing.
Dry food storage. Take pictures inside cabinets and drawers.

Routines in the home related to food and meals

Now we have talked about how you buy and store food. The next topic is about the routines you have around family meals.

Families/Couples	Singles
- What do you usually make for dinner? - What did you make yesterday? - Were there leftovers? - Are you eating the leftovers today? - What are you making for dinner today?	- What do you usually make for dinner? - Do you make dinner every day? - What did you make yesterday? - Were there leftovers? - Are you eating the leftovers today?

- Who usually cooks? - Do you always eat together or also alone? - Do your eating routines change on the weekends? In what way? Portioning: - How do you estimate the amount of food to be prepared for a meal? - Are there often leftovers? Why? - What do you do with leftover food? Who eats it? Who does not? - Does it sometimes remain uneaten? Why?	- What are you making for dinner today? - Do your eating routines change on the weekends? In what way? Portioning: - How do you estimate the amount of food to be prepared for a meal? - Are there often leftovers? Why? - What do you do with leftover food? Who eats it? Who does not? - Does it sometimes remain uneaten? Why?

Theme: Special occasions

- Do you often have dinner guests? To what occasions?
- What kind of food do you usually make for special occasions?
- How do you calculate how much food you need to have?
- Who's shopping?
- Who makes the food?
- Will food often be left over? More than usual?
- What happens to this food?
- When did you have dinner guests last last and were there any leftovers?

That which is already waste

Can we have a look in your bin in the kitchen? (see if there is any food waste there, and talk about it)

- What's there now?
- Why have these items been thrown away?
- Who threw them?
- Are these typical items you tend to throw away?

Images
Bins: Photograph any bins with food and sorting systems in the household.

Food waste in general:

- What kind of food are you wasting? (What did you waste last, why?)
- Would you say you waste a lot of food or not so much?
- What makes you waste a lot or a little food?

- Do you have any strategies for wasting less food?
- What kind of food are you most reluctant to throw away? (what kind of food is "easier" to waste?)
- Do you have any thoughts on how you could waste less food?

- Has the amount or type of food being wasted changed over time?
- What would you say is inevitable food waste?
- If you have food waste sorting, does it make you more aware of how much food is being wasted? (If so, has this reduced your food waste?)

- How much do you think about the food you throw away?
- Do you feel relief when throwing away food?
- Do you feel bad when wasting food?

- Is food waste a problem? (for you, for society?)
- Do you have any other concerns about food waste?

Closing

Now we have been through quite a few topics related to food. Is there anything you had thought in advance that we should talk about, but which we have not addressed?

- Signature of consent declaration

- Delivery of gift certificate

Consent form

Request to participate in research project on food waste

Consumption Research Norway (SIFO) is currently conducting a study of people's habits and practices related to food and food waste in the home. The purpose of the study is to find solutions that can better accommodate consumers so that they can reduce their food waste. The study is funded by the Ministry of Children and Equality.

We wish to interview you in your home, and are looking to gain knowledge of your everyday food routines and considerations, such as food, preparation, meals, various family members' roles and habits in the household related to food, storage, food waste and hygiene. We would like to record the interview on tape, as well as take some pictures along the way. This could be, for example, of your kitchen related to storage, preparation and meals, as well as in the store while you shop. You do not have to be included in the pictures yourself, or if you are, you will be anonymized. You will also be anonymized in the interviews and will not be recognizable in later publications. Photo documentation and other data from the interviews will be treated confidentially, and only researchers on the project will have access to them. The project is expected to be completed in 2017, when the photo and audio material will be deleted and prints from the interviews will be stored in anonymous form.

Participation in the study is voluntary and you can withdraw your consent at any time without giving any reason. If you withdraw, all information about you will be anonymized. The study is reported to the Data Protection Ombudsman for Research, Norwegian Social Science Data Services AS.

Please sign the consent statement below if you wish to participate in the survey.
I have received information about the study and am willing to participate:

(To be signed by participant, date)

If you have any questions, or would like to be informed of the results of the research when available, please contact:

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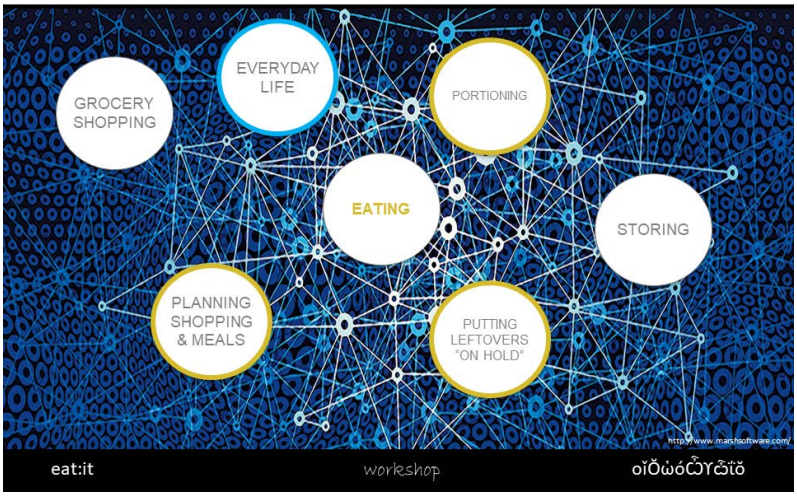
HØGSKOLEN I OSLO
OG AKERSHUS

A4 Workshop briefs

Below you will find excerpts from the design briefs that I presented to the participants in the three workshops. These briefs were part of a more extensive introduction about the food waste issue.

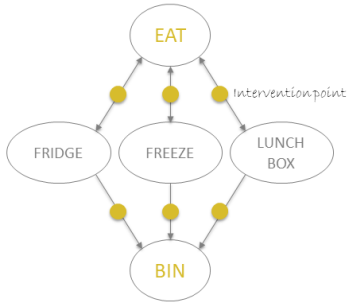
Design brief, Eat it workshop at OsloMet Product Design Kjeller 2016

Consumer food practices



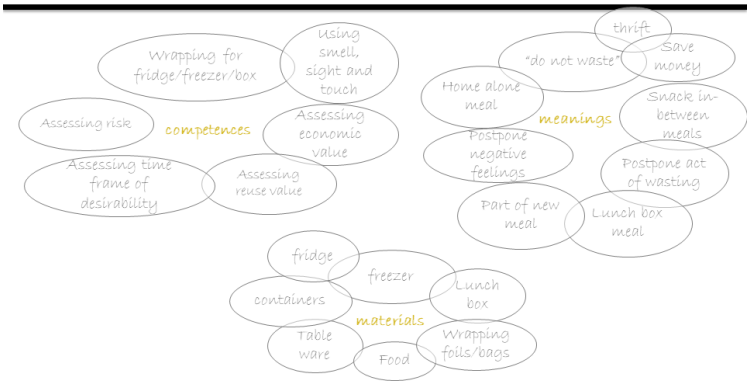
On hold

On hold

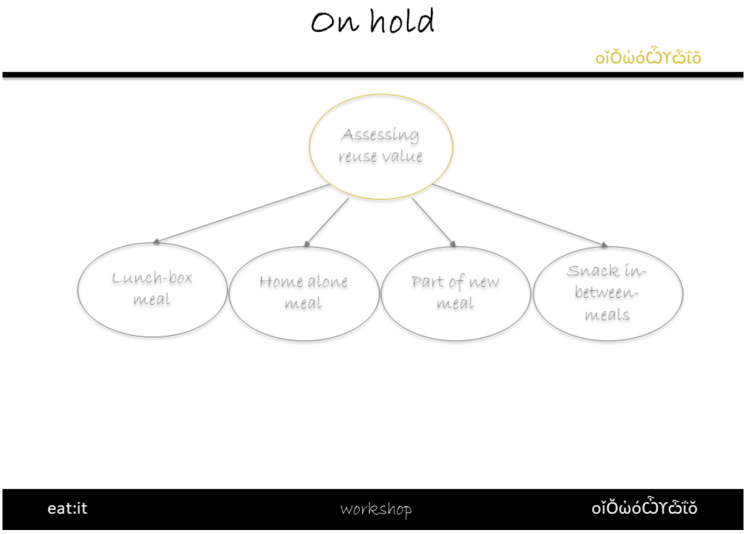


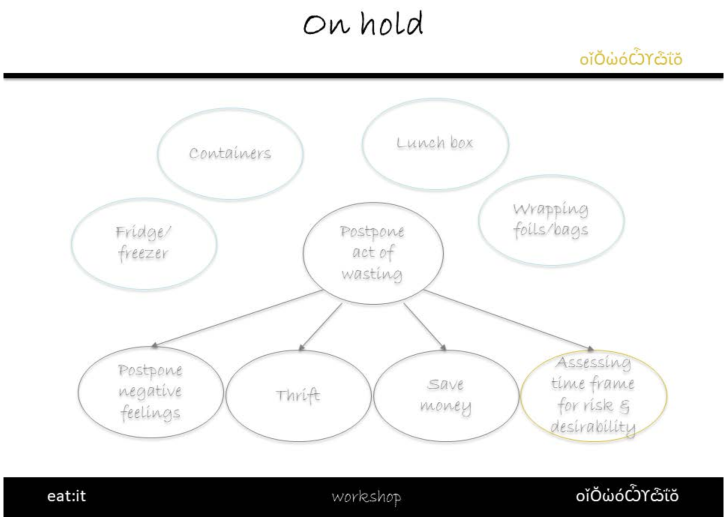
eat:it workshop

On hold



eat:it workshop


On hold
Assessing reuse value
Lunch-box meal
Home alone meal
Part of new meal
Snack in-between-meals
eat:it
workshop


On hold
Containers
Lunch box
Fridge/ freezer
Wrapping foils/bags
Postpone act of wasting
Postpone negative feelings
Thrift
Save money
Assessing time frame for risk & desirability
eat:it
workshop

Planning shopping and meals

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Portioning

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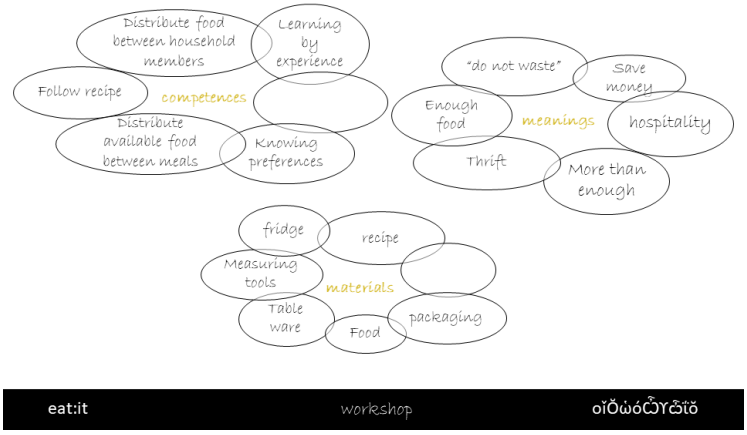

Session 1

oïÕώóÕϒÕïõ

- ✓ Choose a target practice
- ✓ Discuss the practice, its elements and the links between them
- ✓ Add more elements that come up
- ✓ Generate ideas for how to reconfigure the practice in order to reduce food waste
- ✓ Categorize ideas by putting ideas that are similar on the same poster (A3) with a headline describing the category (Photograph these posters)
- ✓ Choose the 6 best ideas that you can derive from your categories

eat:it workshop oïÕώóÕϒÕïõ

No limits

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eat:it workshop oïÕώóÕϒÕïõ

All levels

groups

Letter of consent

Screening questions

- ✓ Work with one idea at the time (start with the most interesting)
- ✓ Discuss the screening questions in relation to each idea
- ✓ Choose a secretary who will write down your answers on a poster (A3). A short description of the idea should be written on top.

1. How does this idea change the target practice?
2. What is the trigger?
3. What "jobs to done" does it help the consumer with?
4. Who are the relevant stakeholders for implementation?

Session 3

oïÕώóČƳĉšŏ

- ✓ Choose three of your best ideas
- ✓ Make visual and textual presentations of them
- ✓ Pitch the best one!

Presentation format

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- ✓ Digital format (e.g. InDesign) handed in as PDF
- ✓ Contain: Drawings, images and text that explain your idea and how it answers to the screening questions
- ✓ The composition of the presentation should enhance understanding of the idea and be compelling

Design brief, Eat it workshop at NTNU Design Trondheim 2016

Colliding ideals

Being healthy	>	not wasting food
Diversity & novelty	>	not wasting food
Togetherness & hospitality	>	not wasting food
Planning vs spontaneity	>	not wasting food

How may design thinking address these colliding ideals
and reduce the food waste caused by them?

eat:it workshop

Brainstorming session

- ✓ Form groups of 4-6 people
- ✓ Choose a facilitator and a secretary
- ✓ Take 5-10 minutes to generate ideas on your own
- ✓ Proceed to generate ideas together
- ✓ Sort the ideas in an affinity diagram

eat:it workshop

The facilitator

The facilitator makes sure:

- ✓ to encourage any ideas (not just the "realistic" ones)
- ✓ everybody gets to voice their ideas
- ✓ to focus on quantity
- ✓ to stop criticism (yes, and… not no, but)
- ✓ not to steer the direction of ideas

eat:it workshop

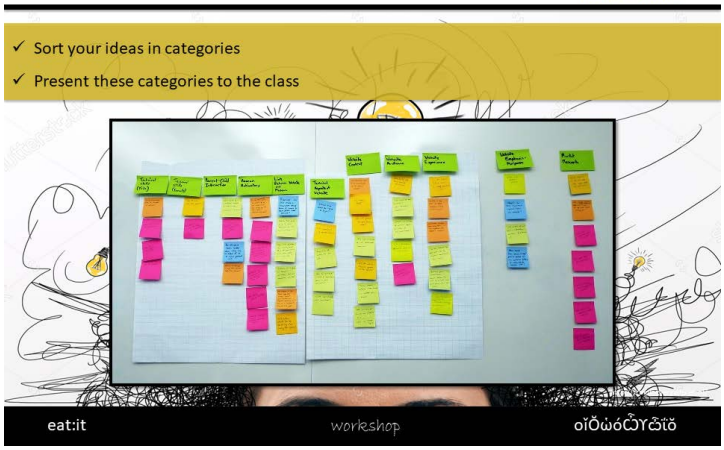
The secretary

The secretary makes sure:

- ✓ all ideas are noted on post-its and mounted on the poster
- ✓ a summary of categories is made before presentation (written if enough time)

eat:it workshop

Affinity diagram



Ideas are welcome on all levels

Ideas are welcome on all levels

- ✓ Challenge yourselves to think new thoughts – outside convention/status quo
- ✓ Do not limit yourselves to what seems realistic
- ✓ "Crazy" ideas are welcome – they could be triggering other ideas!

eat:it workshop

Letter of consent

eat:it workshop

Design brief, Food Fiction workshop at OsloMet SIFO, 2019

This brief has been translated from Norwegian to English by the author.

AGENDA

17:30 - Hei og hopp + mat

18:00 - Introduksjon

18:30 - Idéfase

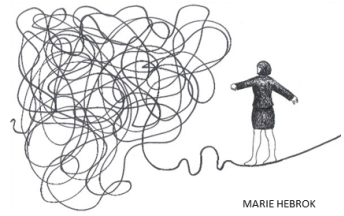
19:30 - Pause med snacks

19:45 - Visualiseringsfase

20:45 - Presentasjon og diskusjon

21:30 - Ut for noen øl?

OSLOMET



OSLOMET

FOOD FICTION

What do we do?

- we make/ sketch **prototypes** of something (anything)
> that exists in a specific context we describe
> at a specific time in the future

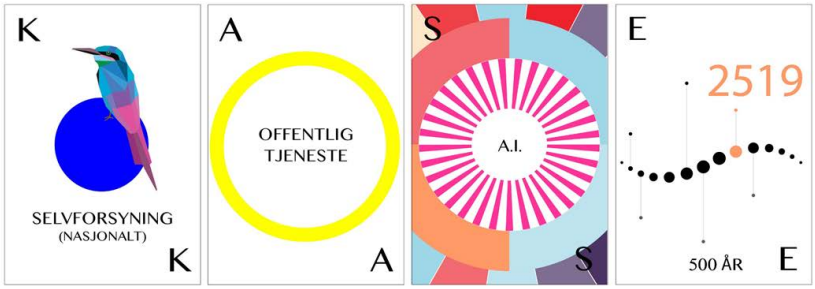
Why do we do it?

- To challenge the status quo!
> norms, culture and systems tied to food
- To think more radically about food and sustainability
- To create discussion and expand the imaginable solutions space

How might food consumption look in the future?

MARIE HEBROK

OSLOMET



KONTEKST ARTEFAKT SIGNAL EPOKE

MARIE HEBROK

Scenarios used for illustration during the workshop:

2050: A classic totalitarian dystopia

The food system has been deconstructed and reconstructed in a radically new way. In order to eliminate food waste and distribute food equally amongst the population, the food supply is now governed by the authorities from farm to fork. Food producers are forced to deliver their produce to food hubs that process the food into a variety of meals that are distributed amongst the population. The meals are skimp in quantities in order to avoid waste and obesity. The meals are composed in a way that preserves the cultural and hedonistic values of eating. However, choices are restricted. Food theft is punished harshly by the law. This new food system has restored the value of food as perceived by the people, as an effect of scarcity. Furthermore, it has spurred a massive increase in kitchen vegetable gardens and food sharing networks. Selling food outside the official food system is prohibited and punished harshly by the law. Meat production is reduced drastically, and killing animals for food is prohibited (Animal population sizes are governed by natural selection?). There is no food import, all countries must be self-reliant.

A semi-commercial 2050s food system

As a result of digital food purchasing platforms driving conventional retail out of business, a rearrangement of the food system has developed. What were collective everyday practices related to food such as planning, purchasing, preparation, and storage have dissolved. These practices have been absorbed and streamlined by professionalized food systems. Domestic kitchens are down-sized to kitchenettes or excluded all together. Apartment buildings contain food units with staff preparing food on demand. Residents purchase subscriptions to various food plans. Neighborhoods with less density, such as those comprised of single-family houses, two-four family houses, and row houses, share local freestanding food units with staff. Food units are financed by a combination of paid subscriptions and subsidies. Work places, kindergartens and schools serve breakfast, lunch and dinner. These meals are billed or deducted from the pay-check. People wanting to eat at home with the family use their food subscription from the food unit in their building. People being of less fortune, and the work disabled, can apply for free subscriptions or reduced fees.
Inspired by *The Kitchen-less house*: https://www.archdaily.com/793370/the-kitchenless-house-a-concept-for-the-21st-century

A5 List of dissemination

Below you will find a list of various channels of dissemination of the research presented in this dissertation; citations from interviews, references to research, interviews on radio and podcast, essays published in newspapers, presentations at conferences and various events.

Interviews and references to the research in newspapers

1. Hebrok, Marie; Tor, Sandberg (2016). Kjøper i blinde- Nær hver tiende nordmann skriver aldri handleliste før turen til matbutikken, viser ny undersøkelse.[*New study shows that every 10th Norwegian never brings a shoppinglist to the grocery store*] https://www.dagsavisen.no/nyheter/innenriks/kjoper-i-blinde-1.775674

2. Hebrok, Marie; Heidenstrøm, Nina Vatvedt (2017). Ikke gi mat i gave. [*Don´t bring food as a gift*] https://www.dn.no/smak/matindustri/sifo/mat/forskning/-ikke-gi-mat-i-gave/2-1-169036

3. Hebrok, Marie; Heidenstrøm, Nina Vatvedt (2017). Storinnkjøp en gang i uka gir mer matsvinn. [*Large purchases once a week causes more food waste*] https://forskning.no/forbruk-mat-oslomet/storinnkjop-en-gang-i-uka-gir-mer-matsvinn/321696

4. Hebrok, Marie; Heidenstrøm, Nina Vatvedt (2017). Datomerking trigger matsvinn. [*Date labelling triggers food waste*] http://www.matindustrien.no/emballasje/datomerking-trigger-matsvinn/

5. Hebrok, Marie Cathrine; Heidenstrøm, Nina (2018). Våre mat- og plastkastevaner. [*Our food and plastic wasting habits*] https://www.grontpunkt.no/nyhet/vaare-mat-og-plastkastevaner/

6. Hebrok, Marie Cathrine (2017). Så mye spiser og drikker du antakeligvis for i julen. [*This is how much you spend on food and drink at Christmas*] https://www.godt.no/artikkel/24209807/saa-mye-spiser-og-drikker-du-antakeligvis-for-i-julen

7. Hebrok, Marie Cathrine; Heidenstrøm, Nina Vatvedt (2017). Forsker: Derfor bør du unngå spiselige julegaver. [*Researcher: why you should avoid edible Christmas presents*] https://www.dagbladet.no/mat/forsker-derfor-bor-du-unnga-spiselige-julegaver/69018259

8. Hebrok, Marie Cathrine (2017). Unngå matsvinn - slik bruker du opp julematrestene. [*Avoid food waste – how to use Christmas leftovers*] https://www.godt.no/artikkel/24210978/unngaa-matsvinn-slik-bruker-du-opp-julematrestene

9. Hebrok, Marie (2017). Kutt matsvinn med fiskeskinn. [*Cut food waste with fish skin*] https://www.nito.no/fagmiljo/mat-og-drikke/matsvinn/
10. Hebrok, Marie Cathrine (2018). Food waste: raising awareness is important, but not decisive. https://urbanfoodfutures.com/2018/05/10/food-waste/

11. Heidenstrøm, Nina; Hebrok, Marie Cathrine (2018). Tips til optimering av emballasje i forebygging av matsvinn. [*Tips for optimizing packaging in food waste prevention*] https://www.grontpunkt.no/nyhet/tips-til-optimering-av-emballasje-i-forebygging-av-matsvinn/

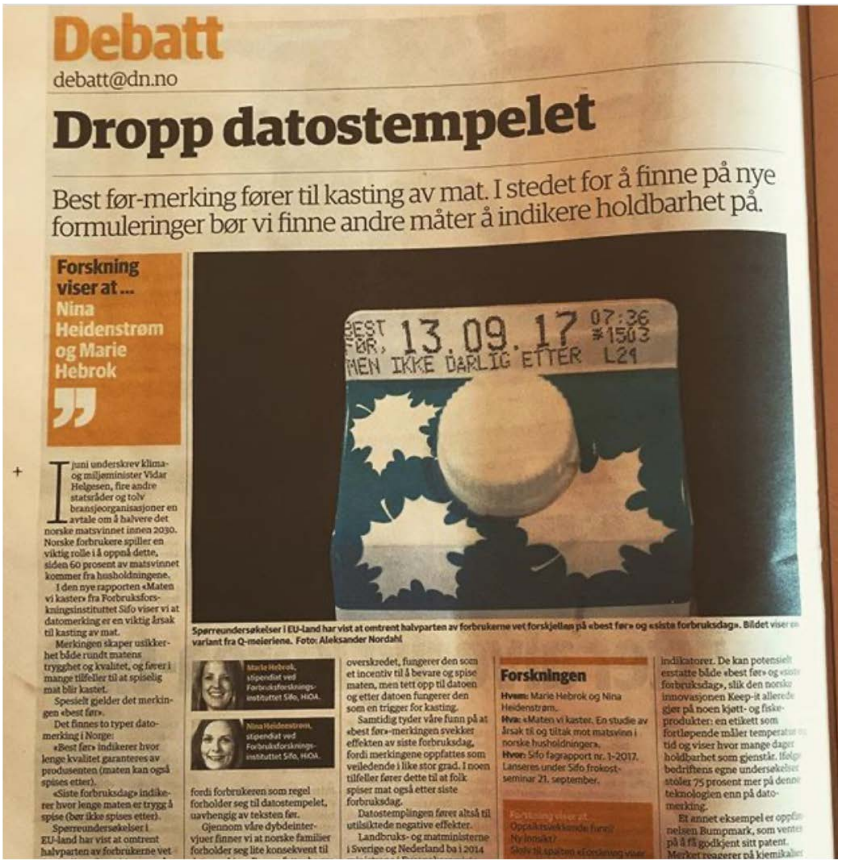
12. Lassen, Kjersti; Hebrok, Marie Cathrine; Steinnes, Kamilla Knutsen; Heidenstrøm, Nina (2019). Vi lar maten bli til søppel før vi kaster den. [*We let food become waste before we throw it out*] https://forskning.no/forbruk-mat-og-helse-oslomet/vi-lar-maten-bli-til-soppel-for-vi-kaster-den/1287598

13. Hebrok, Marie Cathrine (2018). Vil droppe hele datostempelet. [*Drop the date labelling*] Dagligvarehandelen. https://www.buyandread.com/pub/Medier%20og%20Ledelse-publisher_medierogledelse/Dagligvarehandelen-dagligvarehandelen/Dagligvarehandelen-dagligvarehandelen/2018-01-09-20180109/Side%201-1/Dagligvarehandelen%2009.01.18%20side%201.htm

14. Hebrok, Marie Cathrine; Heidenstrøm, Nina Vatvedt (2017). De som handler mye og sjelden, kaster mer mat. [*Those who do large purchases once a week waste more food*] NTB. The NTB story was purchased by at least 23 newspapers: Aftenposten, Nationen, NA24, Finansavisen, Adresseavisen, Laagendalsposten, Nynorsk Pressekontor, Rix, Sør-Varanger Avis, ABC Nyheter, Altaposten, Avisa Møre, Avisen Agder, Dagen, Firda Tidend, Folkebladet, Fosna-Folket, Framtid i Nord, Harstad Tidende, Romsdals Budstikke, Sunnmøringen, Sunnmørsposten and iTromsø.

Feature stories

15. Heidenstrøm, Nina Vatvedt; Hebrok, Marie (2017). Dropp datostempelet. [*Drop date labelling*]. Dagens næringsliv. https://www.dn.no/forskning-viser-at-/mat/miljo/matsvinn/dropp-datostempelet/2-1-163334



Debatt

debatt@dn.no

Dropp datostempelet

Best før-merking fører til kasting av mat. I stedet for å finne på nye formuleringer bør vi finne andre måter å indikere holdbarhet på.

Forskning viser at ... Nina Heidenstrøm og Marie Hebrok

I juni underskrev klima- og miljøminister Vidar Helgesen, fire andre statsråder og tolv bransjeorganisasjoner en avtale om å halvere det norske matsvinnet innen 2030. Norske forbrukere spiller en viktig rolle i å oppnå dette, siden 60 prosent av matsvinnet kommer fra husholdningene.

I den nye rapporten «Maten vi kaster» fra Forbruksforskningsinstituttet Sifo viser vi at datomerking er en viktig årsak til kasting av mat.

Merkingen skaper usikkerhet både rundt matens trygghet og kvalitet, og fører i mange tilfeller til at spiselig mat blir kastet.

Spesielt gjelder det merkingen «best før».

Det finnes to typer datomerking i Norge:

«Best før» indikerer hvor lenge kvalitet garanteres av produsenten (maten kan også spises etter).

«Siste forbruksdag» indikerer hvor lenge maten er trygg å spise (bør ikke spises etter).

Spørreundersøkelser i EU-land har vist at omtrent halvparten av forbrukerne vet fordi forbrukeren som regel forholder seg til datostempelet, uavhengig av teksten før.

Gjennom våre dybdeintervjuer finner vi at norske familier forholder seg lite konsekvent til overskredet, fungerer den som et incentiv til å bevare og spise maten, men tett opp til datoen og etter datoen fungerer den som en trigger for kasting.

Samtidig tyder våre funn på at «best før»-merkingen svekker effekten av siste forbruksdag, fordi merkingene oppfattes som veiledende i like stor grad. I noen tilfeller fører dette til at folk spiser mat også etter siste forbruksdag.

Datostemplingen fører altså til utilsiktede negative effekter.

Landbruks- og matministerne i Sverige og Nederland ba i 2014

Spørreundersøkelser i EU-land har vist at omtrent halvparten av forbrukerne vet forskjellen på «best før» og «siste forbruksdag». Bildet viser en variant fra Q-meieriene. Foto: Aleksander Nordahl

Marie Hebrok, stipendiat ved Forbruksforskningsinstituttet Sifo, HiOA.

Nina Heidenstrøm, stipendiat ved Forbruksforskningsinstituttet Sifo, HiOA.

Forskningen

Hvem: Marie Hebrok og Nina Heidenstrøm.

Hva: «Maten vi kaster. En studie av årsak til og tiltak mot matsvinn i norske husholdninger».

Hvor: Sifo fagrapport nr. 1-2017. Lanseres under Sifo frokostseminar 21. september.

indikatorer. De kan potensielt erstatte både «best før» og «siste forbruksdag», slik den norske innovasjonen Keep-it allerede gjør på noen kjøtt- og fiskeprodukter: en etikett som fortløpende måler temperatur og tid og viser hvor mange dager holdbarhet som gjenstår. Ifølge bedriftens egne undersøkelser stoler 75 prosent mer på denne teknologien enn på datomerking.

Et annet eksempel er oppfinnelsen Rumpmark, som ventes på å få godkjent sitt patent.

16. Hebrok, Marie; Heidenstrøm, Nina (2018). Hvorfor kaster vi mat, og hva kan skolen bidra med i arbeidet mot matsvinn? [*Why do we waste food and how can schools contribute to the work against food waste*?]. **Mat og helse i skolen**. [*Food and Health in School*] Vol. 1. (

17. Hebrok, Marie; Heidenstrøm, Nina (2018). Tiltak for mindre matsvinn. Norske forbrukere vet at matsvinn er et stort klimaproblem, men det er fortsatt langt fra holdning til handling. [*Measures against food waste. Norwegian consumers know that food waste is a major climate problem, but it is still far between attitudes and actions*]. Nationen. https://www.nationen.no/kronikk/tiltak-for-mindre-matsvinn/?fbclid=IwAR1rIAf8YNjQCdjbi8ibmdO_7Nv3i8JXk5s2yqthWAMYt9t5i91OjHzSTh8

18. Hebrok, Marie Cathrine; Heidenstrøm, Nina (2019). Klimavennlig mat kan ikke lenger bare være den enkeltes ansvar. [Sustainable food consumption cannot be framed as the responsibility of the individual]. Dagens næringsliv. https://www.dn.no/innlegg/mat/klima/landbruk/klimavennlig-mat-kan-ikke-lenger-bare-vare-den-enkeltes-ansvar/2-1-660876?fbclid=IwAR288VFY3BAIoI4mn-NIoYvNjiXril1Oyifz9hVViiS-tGDjHN7lfSQp3PU

Klimavennlig mat kan ikke lenger bare være den enkeltes ansvar

Artikkelforfatterne har blant annet forsket på hvorfor folk kaster så mye mat hjemme, og funnet at matens lave verdi har stor betydning. Foto: Gorm K. Gaare

Ansvaret for bærekraftig matforbruk kan ikke lenger bare hvile på forbrukernes valg i butikk og hjem. Myndigheter og næringsliv må legge til rette praktisk og strukturelt for endringene som må til.

Marie Hebrok og Nina Heidenstrøm, forskere ved Forbruksforskningsinstituttet Sifo, Oslomet

↑ Nina Heidenstrøm.

↑ Marie Hebrok.

● Å satse på at klimamerking og best-før-men-ikke-dårlig-ettermerking av matvarer, samt moraliserende kunnskapskampanjer skal endre hva vi handler og hvor mye vi kaster, er et blindspor hvis målet er store og raske endringer i matforbruket. Vi kan ikke vente på at etisk og bærekraftig forbruk skal bli mainstream.

Politikere og næringsliv må intensivere arbeidet med å legge praktisk til rette for det matforbruket som gagner oss og kloden.

Den vanligste responsen fra politikere og matbransjen er at det er opp til forbrukerne å gjøre de miljøvennlige valgene i butikken. Det forutsettes at ved å øke kunnskapen hos forbrukerne om hvilken mat som er mest klimavennlig, og hvordan vi kan bruke matrester og handle smartere, vil skuta etter hvert dreie i riktig retning. For etterspørsel dikterer tilbudet. Og hvis vi bare får nok informasjon vil vi endre våre dårlige vaner.

Vår forskning viser at dette kan ta lang tid – tid vi kanskje ikke har. Forbrukerne er nemlig ikke så uopplyste på dette området som politikere og matbransje later til å tro. Det er den totale mengden hensyn å ta

ikke hatt noen store dokumenterba
ter.
I tillegg har den økonomiske ve
mat og andre forbruksvaret sunket
i takt med utviklingen av stadig r
tive produksjonssystemer. Vi b
svært mye mindre andel av innt
på mat enn vi gjorde for 50 år sid
Vi har blant annet forsket på hv
kaster så mye mat hjemme, og
matens lave verdi har stor betyd
Vi finner også at selv om vi
skal bli veiledet til å ta de mest b
og etiske valgene gjennom ulik
ninger, oppleves det å sette sej
altfor krevende i hverdagen.
stort sett på rutine.
Derfor kan vi ikke lenger red
ret for et bærekraftig matforbr
kernes valg i butikk og hjem
begynne å legge til rette prak
turelt for de endringene i ma
og forbruk som bør komme.
Ifølge FNs klimapanel v
matforbruket vårt uansett t
ettersom matproduksjonen
følge av klimaendringene.
være i forkant ved å gjøre de
tidligere i verdikjeden; i hv
res, importeres og present
kerne.
Hvis vi må kutte i kjøtt
logisk nok også kutte i kjø
uten å vente på at etterspø
ker hos forbrukerne.
Både myndigheter
næringsliv må våge å tenk
nye løsninger for matforl
Bør vi for eksempel v
tive løsninger, som kan
system gjennom å utny
lene som følger med m
kjøkken?

Vi kan ikke ven
bærekraftig fo

Radio & podcast

19. Heidenstrøm, Nina Vatvedt; Hebrok, Marie (2017). De som planlegger kaster mest mat. [*Those who plan waste more food*]. P4: https://www.p4.no/nyheter/de-som-planlegger-kaster-mest-mat/artikkel/711641/

20. Hebrok, Marie; Heidenstrøm, Nina Vatvedt (2017). Storhandel hjelper ikke mot matsvinn viser ny forskning. [*Buying big does not help against food waste new research shows*]. Nrk radio Østlandssendingen: https://radio.nrk.no/serie/distriktsprogram-oestlandssendingen/DKOA02018917/21-09-2017#t=2h6m48s

21. Heidenstrøm, Nina Vatvedt; Hebrok, Marie Cathrine; Lavold, Hallvard (2017). Hva har du i kjøleskapet?. [*What is in your fridge?]*. Viten og Snakkis podcast OsloMet: https://vitenogsnakkis.oslomet.no/2017/10/12/matsvinn/

Conferences, workshops & events

22. Hebrok, Marie (2016). *Eat:it workshop - an introduction to Practice Oriented Design. Case: Consumer food waste. Can Design Thinking change food waste practices?*. Conducted at OsloMet Department of Design.

23. Hebrok, Marie (2016). Eat:it workshop - Colliding Ideals - Can design intervention *reduce consumer food waste?*. Eat:it workshop. Conducted at NTNU Department of Design.

24. Nielsen, Brita Fladvad; Hebrok, Marie (2016). *The Unconference - Food Waste and Need in Trondheim and how Design Thinking can contribute*. The Unconference - Food Waste and Need in Trondheim. Brita Fladvad Nielsen NTNU. www.designthinking.wordpress.com

25. Hebrok, Marie (2017). *Living up to the Ideal - Ideal practices as barriers to the reduction of household food waste*. 13th Conference of the European Sociological Association (ESA). ESA.

26. Hebrok, Marie; Heidenstrøm, Nina Vatvedt (2017). *Contextual measures to reduce household food waste*. The 18th conference of the European Roundtable for Sustainable Consumption and Production Society.

27. Hebrok, Marie; Heidenstrøm, Nina Vatvedt (2017). *Maten vi kaster*. [The food we waste]. SIFO´s breakfast seminar. Hotel Bristol, Oslo.

28. Hebrok, Marie (2017). *Hvorfor kaster vi mat, og hva kan gjøres for å redusere matsvinn i husholdningene?*. [*Why do we waste food, and what can be done about* it?] Network meeting at Kostforum. National Association for Public Health.

29. Hebrok, Marie (2018). *Matsvinn i norske husholdninger. Hvorfor kaster vi så mye mat?*. [*Food waste in Norwegian households. Why do we waste so much food*?] Meeting at the Norwegian Ministry of Children and Families.

30. Hebrok, Marie; Heidenstrøm, Nina (2018). *Fridge Studies - Looking into the fridge to understand food waste*. PLATEFORMS inception meeting. SIFO, OsloMet.

31. Hebrok, Marie (2018). *Et forbrukerperspektiv på matemballasje og matsvinn - med fokus på frukt og grønt.* [*A consumer perspective on food packaging and food waste - with a focus on fruits and vegetables*], Project meeting for the project NYBE - Ny Bærekraftig Emballasje for Økofrukt [*New sustainable packaging for Økofrukt*]. NOFIMA.

32. Hebrok, Marie Cathrine; Heidenstrøm, Nina Vatvedt (2017). *Hvorfor kaster vi mat, og hva kan gjøres for å redusere matsvinn i husholdningene? [Why do we waste food, and what can be done about it?]*. Avfallsforum. Renovasjonsetaten, Oslo kommune.

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