# Causes & Determinants of Consumers Food Waste

## A theoretical framework

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# Glossary

## Food waste

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|---|---|
| Consumer food waste | Edible food and drink fractions from products or meals that are acquired with the intention to be consumed by humans, but remain unconsumed and are discarded. This contrasts with food waste generated in the supply chain. Consumer food waste can be split into in-home and out-of-home – see below. |
| In-home consumer food waste | Food waste from food and drink products that are prepared and/or in part consumed in the household. |
| Out-of-home consumer food waste | Food waste from situations in which consumers obtained food products and drinks prepared by food services and which are eaten out of the home. |

## The stages in consumer food management

| | |
|---|---|
| Planning stage | Household planning generally before food enters the household and while food is in stock. This includes e.g. meal plans, shopping lists, storage checks. |
| Provisioning stage | Bringing food into the household. This can occur through e.g. in-store purchasing, online ordering, home growing, gift receiving. |
| Storing stage | Storing of food products and meals in the household, e.g. in fridge, freezer or cupboard. |
| Preparing stage | Handling of food products to enhance edibility. This includes cooking, removal of inedible parts (e.g. peel), and other types of preparation. |

| | |
|---|---|
| Consuming stage | Moments when food products or meals are being consumed and the handling of leftovers. |
| Ordering / Serving stage | Acquiring food products by the consumer, from a food service provider. |
| Disposal stage | Disposing of food products. This includes decisions of how to dispose of food: throwing it in the bin, giving it to animals, home composting, etc. |

## Main constructs in the consumer food waste model

| | |
|---|---|
| Motivation to prevent food waste | A person's willingness to perform actions that reduce the likelihood or amount of food waste being generated food waste. Relevant aspects of motivation are attitude, awareness, and social norms. |
| Ability to prevent food waste | A person's proficiency to solve the problems that he or she encounters when performing actions that help prevent food waste. Relevant aspects of ability are knowledge and skills. |
| Opportunity to prevent food waste | The availability and accessibility of materials and resources required to prevent food waste. Relevant aspects of opportunity are time and schedule, material and technologies, and infrastructure. |

# 1 Executive summary

This report presents a theoretical framework on consumer food waste behaviours. The framework is based on the current status quo of the literature and will form the basis for further research executed by the EU project REFRESH (Resourse Efficient Food and dRink for the Entire Supply cHain). The focus of the report is on the specific behaviours increasing the likelihood to waste as well as the drivers of these behaviours.

## 1.1 Definition of consumer food waste

For the definition of consumer food waste, we made use of the definitional framework of food waste developed within the EU FP7 project FUSIONS. After adjusting their definition to the consumer situation, we came to the following definition: consumer food waste is the edible food and drink fractions from products or meals that are acquired with the intention to be consumed by humans, but remain unconsumed and are discarded.

## 1.2 Different viewpoints

Consumer food waste has been investigated from two different viewpoints in prior literature. In the first, the individual is the centre of interest and lack of motivation and knowledge to prevent waste are considered to be the main drivers of food waste. In the second, the situational context is the centre of interest and the social and societal barriers to prevent food waste are considered to be the main drivers of food waste. After examining both perspectives, we conclude that both viewpoints need to be taken into consideration to fully capture the complexity of consumer food waste.

In our summary of prior research, we emphasize that consumers do not intend to waste food, but that they waste food as an unintended result of accumulated behaviours executed while managing food in the household. Additionally, we emphasize that at the moment of disposal, the opportunity to prevent food from becoming waste has already passed. Therefore, to prevent food from becoming waste, consumer food management must be understood.

## 1.3 Consumer food management

We have identified several stages of food management, both in-home and out-of-home. Within these stages, various behaviours have been linked to the generation of food waste. Although these stages are heavily intertwined, separating them provides an opportunity to get more detailed understanding on how food is managed in the household.

As a first stage, consumer food management in the home can include the *planning* of grocery shopping and creation of meal plans. The occurrence of food waste has been repeatedly linked to a lack of planning. In the stage of *provisioning* the household, behaviours that are argued to increase the likelihood to waste food are purchasing too much food due to impulse buying, purchasing pack sizes that are too large and buying discounted products. In the next stage, s*toring* of products, behaviours reducing the shelf-life of products are linked to food waste, such as bringing home products without a cool bag, storing them in a suboptimal way, or reducing the visibility of products due to a chaotic organisation of storage space. During the *preparing* of meals, behaviours that are linked to food waste are using products only partially, preparing too much or preparing it incorrectly resulting in sub-optimal taste and quality. In the stage of *consuming*, failure to store the plate and pan leftovers are behaviours linked to food waste. Finally, when is decided that food is waste, it can be discarded by throwing it in the bin, by given it to animals or by home composting

When eating out of home, consumers have less influence on the amount of waste being generated. Nonetheless, there are several behaviours related to food waste. When *ordering meals* or *serving* plates, overestimating how much food will be consumed has been linked to food waste. Moreover, after *consuming* the meals, not bringing home the leftovers in a 'doggy bag' results in food waste.

## 1.4 Consumer food waste framework

Prior research has identified various constructs that affect consumer food waste. We grouped these into four categories: motivation, ability, opportunity, and distal factors.

*Motivational constructs* that drive food waste are attitudes, awareness and social norms. Although a majority of consumers express negative attitudes towards food waste, only a minority agrees that their household is generating too much food waste. This lack of awareness has been reported repeatedly in several studies and is suggested to be a reflection of the fact that food waste is the result of a complex of behaviours. *Ability* refers to a person's proficiency to solve problems that he or she encounters when changing behaviour. Changing routines in household food management in order to pay increased attention to food waste prevention, requires skills and knowledge. The key challenge of managing the food supply and making sure that only low levels of food are being discarded seems to be connected to a large variety of personal and household aims. *Opportunity* refers to the availability and accessibility of materials and resources required to change behaviour. Relevant aspects as shown in prior literature are time and schedule, material and technologies, and infrastructure. *Distal factors* concern socio-demographic constructs, which likely have an indirect effect on household food management, through motivation, ability, and opportunity.

Motivation, ability, and opportunity affect the likelihood that consumers engage in waste preventing behaviours while managing food in their household. However, these categories cannot be seen independently from each other: as a lack of abilities and/or opportunities can be demotivating to consumers and a lack of motivation can prevent the acquisition of new knowledge. The resulting framework is flexible enough to deal with different types of variables, and further allows the identification of differences between consumers and cultures when applied empirically.

# 2 Introduction

This study is part of the EU research project REFRESH, which aims to contribute towards reducing food waste across Europe. The focus of the REFRESH project lies on the prevention of food waste across the food chain and the improvement of the valorisation of food resources. The project consists of eight work packages, each with a different focus. The current report is an output from work package 1, which focuses on consumer behaviour related to food waste. The outcome of all tasks within this work package will be used to design and develop interventions to reduce waste levels for consumers. This is input for EU policy recommendations regarding prevention and valorisation of food waste streams throughout the complete food chain.

## 2.1 Objective

This report is the deliverable of task 1.1. Its objective is to develop a theoretical framework on consumer food waste behaviours. The purpose of this theoretical framework is to improve the understanding of the drivers of consumer food waste generation. In addition, it aims to serve as a basis for future tasks to identify and test which of the drivers should be altered to offer the greatest potential for reducing consumer food waste levels. This model will be developed based on prior literature.

## 2.2 Definition of food waste

For the definition of food waste, the definitional framework developed within the EU FP7 project FUSIONS (Food Use for Social Innovation by Optimising Waste Prevention Strategies) is taken as a starting point. In its publication of July 2014 (Östergren et al. 2014), food waste is defined as follows:

"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)."

A main assumption within the definitional framework of FUSIONS is that food waste is related to the destination of removed food from the Food Supply Chain and it specifies the destinations that are considered waste. The non-waste destinations of food that is not eaten by humans are animal feed and bio based materials and biochemicals. These destination categories are considered as re-use and valorisation, and thus not waste.

FUSIONS goes on to explain that food waste refers to food appropriate for and intended for human consumption being discarded, whether or not after it is kept beyond its expiry date or left to spoil.

The FUSIONS Definitional Framework was developed from a chain and resource efficiency perspective. The current research of REFRESH within WP1 focuses on the food wasted by consumers, in households and out-of-home. As consumers themselves are often not in control of the destination of the discarded food that leaves their home (or their out-of-home site), food waste is scoped here to involve the stages from provisioning through discarding within the household or out-of-home boundary. Food needs to be provisioned by the consumer or the household, which includes purchase, home growing, and gift receiving, and excludes food waste that occurs in retail or service outlets before a purchase has been made. Discarding can take many forms, for example, putting food in the bin (residual waste or organic waste), feeding it to household pets, or home-composting. Regardless of the manner of disposal, the fact that food, intended and appropriate for human consumption was not consumed by humans, is the starting point for the current study.

The FUSIONS definitional framework also includes both edible and inedible fractions of food into food waste categories. The major reason to do this is from a waste quantification and resource efficiency in the food supply chain perspective: the fact that throughout the food supply chain, there is too little data available to make a reliable estimation of only the edible food waste fraction, has led to this scope. However, the FUSIONS project emphasises that the definition could be reconsidered if and when the necessary data to distinguish the two fractions types of food in waste become available.

For the purpose of this research, the focus is on the edible food and drink fractions within consumer food discards, and this will be referred to as 'food waste' in the remainder of the study. Other scientific studies within the consumer behaviour body of literature also follow this scope (e.g. Stefan et al. 2013; Stancu, Haugaard, and Lähteenmäki 2016; Quested et al. 2013). Concluding, consumer food waste in this study is defined as: Edible food and drink fractions from products or meals that are acquired with the intention to be consumed by humans, but remain unconsumed and are discarded.

## 2.3 Difference between in-home and out-of-home

Consumer food waste can occur in two types of situations: in home as well as when eating out of the home.

We define *in-home consumer food waste* as food waste from products, drinks or meals that are prepared and/or in part consumed in the household. This includes situations in which food is wasted from meals prepared in-home but eaten elsewhere (packed lunch, picnics, etc.) as well as situations in which food is eaten in-home that was prepared elsewhere (ready-made convenience foods, take-away, home-ordering, etc.). These are all situations in which consumers have considerable control over important parts of the food provisioning process.

We define *out-of-home consumer food waste* as food waste from situations in which consumers derived food and drink products prepared by food services and which are eaten out of the home. This includes restaurants, snack bars, kiosks at train stations, canteens and as well institutions such as homes for the elderly and prisons.

## 2.4 Structure of the report

The remainder of the report is structured as follows: In section three we will discuss several consumer theories to position consumer food waste behaviours in the consumer literature. We will approach the problem from a psychological as well as a social practice perspective. In section four, we will describe the different stages in which food related behaviours take place. These stages refer to how food enters the household, is being stored, prepared and consumed, and the overall planning of these processes. By making use of prior literature, we will list the behaviours that increase the likelihood to generate food waste within each stage. In section five we will elaborate on the factors that influence these behaviours and introduce a framework on consumer food waste, based on Rothschild (1999) motivation, opportunities and abilities model. In the final section we will conclude our findings and elaborate on how this framework will be used in the next tasks of work package 1.

# 3 Food waste behaviours in a theoretical context

One-third of all food produced for human consumption is wasted across the food supply chain (Gustavsson, Cederberg, and Sonesson 2011; Stenmarck et al. 2016). The generation of food waste unnecessarily uses fresh water and fossil fuel during production, transportation and packaging of the products, increases methane due to landfill disposal and causes a loss of agricultural land that could have been used as forest to help off-set $CO_2$ emissions (USEP 2009; Forster et al. 2009). Apart from the environmental impact, it seems ethically unjustifiable to waste food in a world where one in nine people do not have sufficient access to nutrition (Marx 2015). Therefore, it is vital that food waste levels will be reduced.

With a contribution estimated at fifty-three percent, the consumer is the primary contributor to food waste across the food chain in higher income countries (Stenmarck et al. 2016) and it is for this reason that consumer food waste is gaining an increasing amount of scientific attention. So far, scholars have revealed several essential insights into consumer behaviours leading to food waste. First and foremost, they find that the opportunity for consumers to prevent food from becoming waste has often already passed at the moment of disposal (Quested et al. 2013). Food waste is generally the result of multiple behaviours that are performed over time and this complexity of behaviours at different time points increases the likelihood of waste (Quested et al. 2013). Secondly, such variety of behaviours takes place in each stage of the household management (Boyd and McConocha 1996). For instance, in response to point-of-purchase promotions (Wansink, Kent, and Hoch 1998) consumers might purchase a quantity of food which cannot be eaten by the household in time; in terms of storage consumers might misunderstand date labels (Milne 2012) or store products suboptimally (Terpstra et al. 2005); regarding preparing consumers might prepare or serve too much; or when saving leftovers consumers might store them suboptimally in terms of visibility or preserving its freshness. Each of these behaviours by themselves do not necessarily lead to waste. However, an accumulation of these behaviours often results in disposing decayed food. It is therefore that scholars are inclined to say that consumer food waste is the result of a complex set of behaviours and factors influencing those behaviours (Quested et al. 2013) rather than the result of a single action.

With respect to the factors that influence food related behaviours, and thus waste, scholars differ in opinion regarding which types of factors are most influential in driving consumer food waste. On the one hand there are scholars who assume that aspects such as consumer motivation to prevent waste and attitudes are key influential factors (Stefan et al. 2013). On the other hand, other scholars claim that the societal structure makes food waste virtually inevitable (Evans 2011). Still, there seems consensus that consumers do not intentionally *want* to waste food but do so due to trade-offs surrounding food waste prevention.

Scholars with an individual perspective mainly investigate motivational aspects or intentions of consumers to prevent food waste (Stefan et al. 2013; Neff, Spiker, and Truant 2015). They investigate the attitudes, thoughts and beliefs regarding food waste (Principato, Secondi, and Pratesi 2015; Abeliotis, Lasaridi, and Chroni 2014; Mallinson, Russell, and Barker 2016), perceived (social) norm among the consumer's peers (Graham-Rowe, Jessop, and Sparks 2015), as well as perceived control to avoid wasting food (Stancu, Haugaard, and Lähteenmäki 2016). Their aim is to create a conceptual framework of factors that predict household food waste levels (Schmidt 2016). A commonly used framework at this moment is the Theory of Planned Behaviour (Stefan et al. 2013; Graham-Rowe, Jessop, and Sparks 2015; Visschers, Wickli, and Siegrist 2016). This theory states that attitude, social norms, and perceived behavioural control predict the intention to perform a certain behaviour and thereby behaviour itself (Ajzen 2002). It has successfully been applied to a variety of single and accumulations of planned behaviours (Armitage and Conner 2001). Also in terms of food waste it has shown effective in (partly) explaining the variation in household food waste levels (Stefan et al. 2013; Graham-Rowe, Jessop, and Sparks 2015; Visschers, Wickli, and Siegrist 2016).

However, the theory of planned behaviour may not be the best suited model for predicting consumer food waste. Studies which have applied this theory to consumer food waste all have added additional constructs to improve the predictive value of the model. Although this in itself does not need to be an issue (Ajzen, 2002), the addition of knowledge (Visschers, Wickli, and Siegrist 2016) and routinized behaviours (Stefan et al. 2013) as relevant predictors points towards potential missing elements in the theory of planned behaviour. The theory of planned behaviour was developed to predict behaviour that is intended (planned) in advance. Yet, food waste is not a planned behaviour – it's not even a behaviour in itself – but the *result* of mostly routinized behaviour related to managing the household. The theory of planned behaviour appears less suited to predict unintended consequences of routinized behaviours, as discussed by Quested et al. (2013).

Scholars with a sociological perspective (Shove 2010) find that a focus on motivational and intentional aspects is too narrow. The pioneer in this field is Evans (2011; 2012). He has shown, in a series of qualitative studies as in-home observations and interviews, that several situational aspects can cause food waste in the household. He claims that the (imposed) busy life of consumers, with substantial working hours and demanding leisure schemes, results in limited time for consumers to spend on managing food in the household. Also, he shows that consumers often encounter varying and complex household dynamics in terms of taste, preferences, shared responsibilities or varied number of guests who will join for dinner, which makes managing the food supply even more difficult. Additionally, the supermarkets' infrastructure can make it difficult to buy a quantity of food that can be used in time. For instance, packages can be too big, the quality can be suboptimal, or the supermarkets can be difficult to reach which influences frequency of shopping trips. Therefore, even if consumers are

motivated to prevent food from becoming waste, situational factors can create barriers that cause consumers to be unable to actually act upon this aim.

Our position is that an interaction between individual and societal factors drives consumer food waste. Motivation to prevent food waste is needed. However, additionally, the ability and opportunity to perform waste preventing behaviours are required. Before going into more detail on motivation, ability, and opportunity as key aspects in consumer food management and food waste, the next section will first discuss the different stages of consumer food management.

# 4 Consumer food management and food waste

To manage the food supply in the household, sets of behaviours needs to be executed. The household needs to be provisioned, and this supply needs to be stored, prepared into meals and consumed. As mentioned in the previous section, consumers tend to develop routines to integrate a variety of priorities into their daily practices. In an ideal situation the household is managed in such a way that the amount of food that enters the household equals the amount that is consumed. However, in reality there is a discrepancy between the amount that is acquired and the amount that is consumed, resulting in food waste on a consumer level. Before further discussing why consumers might perform behaviours which result in food waste, we will first describe the behaviours themselves. We will focus on how food is being managed in the household and when eating out-of-home in different stages. It is important to emphasize upfront that the routines developed to manage food in-home or out-of-home should not be considered as decisions made by individual consumers, but as routines developed in the context of a household.

## 4.1 In-home consumer food management

Prior research has aimed to categorise food waste behaviours into several stages (Quested et al. 2013; Williams et al. 2012; Graham-Rowe, Jessop, and Sparks 2014). These relate to the consumer model of the household management of goods, developed by Boyd and McConocha (1996). Based on this model, the following stages can be distinguished: planning,

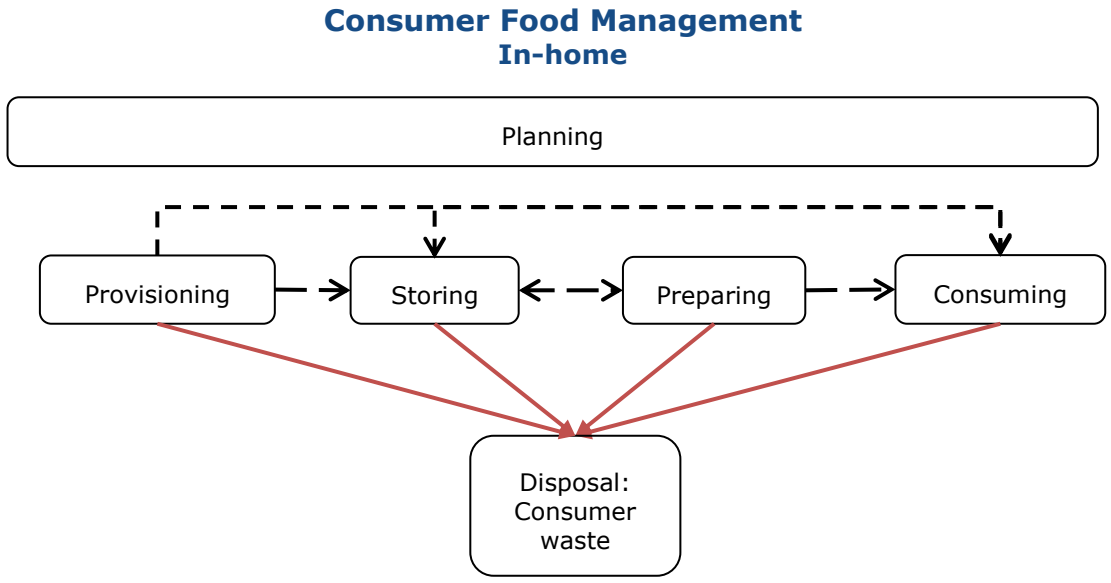


**Figure 1: Consumer Food Management.** Food is being moved from provisioning to consumption passing (all) intermediate stages. Black dashed arrows represent movement. Red lines indicate waste.

provisioning, storing, preparing, consuming, and disposal. Figure 1 provides a graphical display of these stages and indicates how food moves from one stage to another. We will discuss each stage in turn.

### 4.1.1 Planning

Planning refers both to the planning before food enters the household and when the food is in stock. To manage the food in the household consumers can prepare meal plans in which they decide which meals will be eaten during the period the plan covers (e.g., a week) and with how many persons these meals will likely be eaten. Additionally, consumers can prepare shopping trips by making lists with food products that should be bought and in which quantities. Consumers can as well check storage spaces when making these plans or lists, to update their knowledge on which products are already in stock and what their shelf-life is.

Behaviours in the planning stage can indirectly result in food waste, for instance due to incorrect or lack of planning. A lack of planning can lead to purchasing too many products. This increases the likelihood that not all products can be eaten before becoming spoiled. Therefore, lack of planning increases the likelihood of spoilage (Quested et al. 2013; Schmidt 2016).

### 4.1.2 Provisioning

Provisioning refers to all ways in which food can enter the household. The majority of food products enter the household through purchases in retail outlets such as supermarkets, greengrocers or butchers, or through purchases at farmers' markets. Yet, other ways of provisioning exist as well. Food products can be ordered online and home-delivered. Also food can be home grown, foraged, received as gifts, or purchased as take-aways from restaurants. When leftover food from out-of-home consumption is brought into the home, this is also part of provisioning.

When purchasing food products in a store, several behaviours increase the likelihood of food waste. This includes impulse buying, in which consumers experience a sudden and strong urge to buy (Beatty and Ferrell 1998). The resulting purchase occurs spontaneously and without much reflection. People who have a greater tendency to make impulsive purchases waste more food (Stefan et al. 2013; Parizeau, von Massow, and Martin 2015).

Additionally, a behaviour that has been shown to increase the likelihood to waste is buying packaged food that contains too much of a certain product. Consumers report a relationship between large package sizes and food waste (Williams et al. 2012; Koivupuro et al. 2012; Evans 2011). Consumers report to continue to buy them because the larger package size is often cheaper than the smaller packages of the same product, or because it is the only package size offered.

Another behaviour that is mentioned by consumers to lead to food waste, is buying discounted food products (Graham-Rowe, Jessop, and Sparks 2014). The temporary low price of the products makes it tempting to buy more

food products than actually needed. However, it is not clear if this indeed leads to waste, since in Finnish and UK households buying discounted products was related to less food waste (Koivupuro et al. 2012) or did not show any relation (Cox and Downing 2007). In an UK study, results indicated that people who buy less of other items when purchasing special offers generated less waste, and thus special offers may not increase food waste when consumers adjust their purchasing in other categories accordingly (WRAP, 2014).

### 4.1.3 Storing

Storing refers to the storing of food, either as single items or as a combination of foods (e.g. leftovers from a meal). In many cases, correct storage can prolong the shelf life of the products. Storing can take the form of stocking food in fridge, freezer, cupboards or other forms of storage.

Several behaviours related to food storing can increase the likelihood to waste food. First, whether frozen and chilled products are brought into the household with or without a cool bag influences their shelf-life after purchasing (Quested et al. 2011). Second, the shelf-life can be influenced by how the products are stored. Consumer often store products suboptimally, meaning that the shelf-life is not prolonged to its full extent (Quested et al. 2011). Some consumers do this consciously, for instance they use a fruit bowl to stimulate children to eat healthy instead of placing the fruits in the fridge (Evans 2012). However, a large majority seems to store products suboptimally due to a lack of correct knowledge on how to prolong products shelf-life (Aschemann-Witzel et al. 2015; Graham-Rowe, Jessop, and Sparks 2015; Cox and Downing 2007).

How the storage is organized also has an influence on how much food is wasted, since a cluttered or chaotic storage space increases the risk of forgetting products, whereas an organised storage seems to prevent this type of spoilage (Evans 2012; Farr-Wharton, Foth, and Choi 2014). A study which used colour coding to increase the organization and so the visibility of available products in the fridge, has shown to be effective in preventing spoilage (Farr-Wharton, Foth, and Choi 2012). Further, the habit of undertaking extensive cleanings of the storage spaces, fridges and freezers has been shown to lead to food waste (Cox and Downing 2007).

The ways in which consumers estimate food edibility has been related to food waste. Consumers use different methods to determine the edibility of food products. Elderly persons often make use of their senses, while younger individuals tend to make more use of date labels or the number of days it has been stored for (Terpstra et al. 2005). The strategy of using your senses has been related to less food waste (Terpstra et al. 2005). Additionally, it has been found that the more different methods used, the more food is being discarded by household (Parizeau, von Massow, and Martin 2015).

### 4.1.4 Preparing

Preparing relates to the handling (cooking or preparation in other ways) of food products to enhance edibility. Many food products are handled before being eaten by household members. Most obvious are the preparation of the main meals – breakfast, lunch and dinner – but the peeling of fruit products or baking of cookies also falls in this phase.

A behaviour that has found to increase the likelihood of waste is using products only partially (e.g., when half an onion is used in a recipe). This increases the likelihood to waste since consumers need to communicate within their household about which products are partially left (Farr-Wharton, Foth, and Choi 2014) and additionally need to find a recipe and the time to use these products (Evans 2012).

Another influential behaviour is the amount of food prepared. Consumers tend to estimate portion sizes incorrectly and prepare too much food (Williams et al. 2012). In some cases this is intentional, for instance when consumers want to show their hospitality to guests or to make sure that their household members have a meal that matches their wishes (Evans 2012), but it also happens unintentionally.

Food is more likely to be discarded when it tastes bad, which in some cases is the result of suboptimal cooking skills. Extreme examples are when the food is burned during preparation (Evans 2011).

### 4.1.5 Consuming

Consuming refers to the moments when the food products or meals are being consumed and leftovers are being handled.

Food waste occurs if consumers do not store the plate and pan leftovers for later usage, or when they do store the leftovers but end up not eating them. Consumers can be unwilling to eat leftover food in general (Porpino, Wansink, and Parente 2016), but more often forget that the leftovers are in the storage (Evans 2012). This, combined with the fact that consumers often find it difficult to estimate edibility and want to avoid foodborne diseases, makes the consumers decide to discard the leftovers (Watson and Meah 2012).

### 4.1.6 Disposal

As shown in Figure 2, food can be moved from the provisioning, storing, preparing and consuming stages into the disposal stage. At that point, food becomes waste, and consumers make decisions about how to dispose of the food. They can decide to throw it out in the bin, but also to give it to pets or other animals, or to engage in home composting.

## 4.2 Out-of-home consumer food management

Food waste is also generated in out of home settings such as restaurants, canteens, catering services, prisons and homes for the elderly. In these settings, most of the above mentioned behaviours are performed by the employees of the food services. Therefore, the influence of consumers to prevent food waste in these settings is limited. However, there are two stages in which consumers have direct control over the amount of food waste generated, and this is what the current report focuses on. We will discuss these stages one by one. For a graphical display see figure 2.

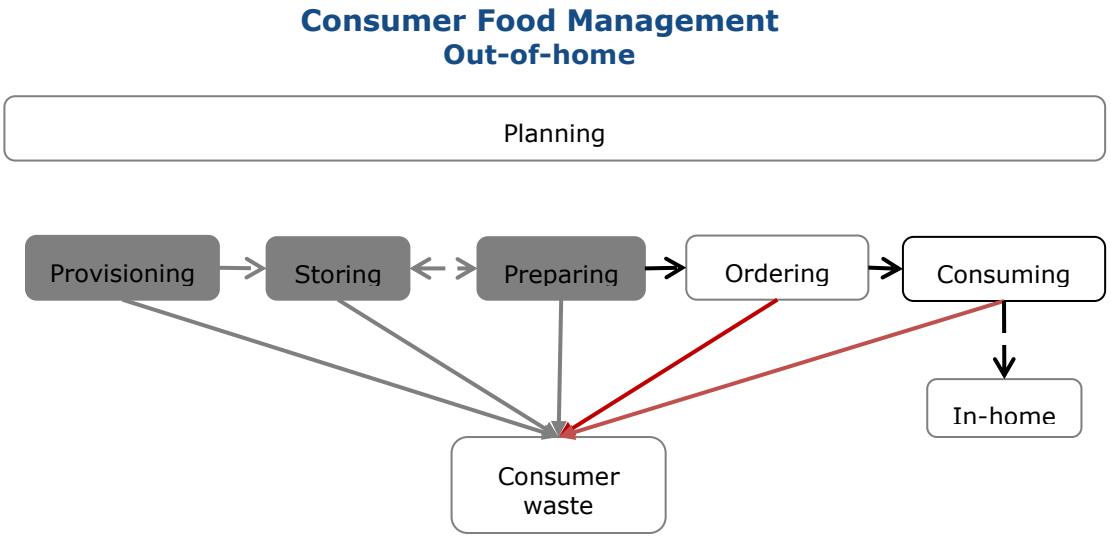


**Figure 2: Consumer Food Management out-of-home.** Food is being moved from provisioning to consumption passing (all) intermediate stages. Black dashed arrows represent movement. Red lines indicate waste.

### 4.2.1 Ordering / Serving

Ordering / serving relates to how consumers receive the food by the food service, in which the most common forms are ordering 'a la carte' or filling a plate buffet-style, or a mix of the two. Within these two types several variations exist. For instance, in some food services starters or side-dishes are standard included, in others they are not. Similarly, in some food services plates can be refilled without limits (e.g., all-you-can-eat restaurants), in others they cannot. Also the size of the meals can differ between food services, for instance some offer standardized multi-course menus and others small dishes to share like tapas or sushi.

Consumer behaviours that increase the likelihood to waste refer to how much food ends up on the consumers' plate. More food increases the likelihood of surplus food, as the consumers might be unable or unwilling to finish it all. It is not clear which type of serving causes more plate waste.

However, there is an indication that buffet-style restaurants create more plate waste than 'a la carte' orderings (Adams et al. 2005).

Several interventions are found to influence the amount of waste. Smaller plate size (Kallbekken and Sælen 2013; Wansink, van Ittersum, and Painter 2006) and offering smaller portion size in all-you-can-eat restaurants reduce plate waste (Freedman and Brochado 2010). As well as, having a tray-less system (i.e., not using trays in a self-service restaurant) are found to create less waste (Thiagarajah and Getty 2013). Further, a general message to motivate consumers to avoid food waste in a canteen study, was found to be effective (Whitehair, Shanklin, and Brannon 2013). Just as presenting consumers with social cues claiming that it is better to dish multiple times at a buffet-style serving than to waste, have been found to result in less plate waste (Kallbekken and Sælen 2013). However, an educative warning on the dangers of choosing a too large plate size, on the other hand, has shown to be ineffective (Wansink, van Ittersum, and Painter 2006).

### 4.2.2 Consuming

The only option of consumers to prevent plate leftovers from being wasted is to take it home in a resource pack, also known as the doggy bag. This topic has not been thoroughly studied yet. However, a series of studies performed in the UK has revealed some interesting insights (WRAP 2013).

Consumers report that they do not want to worry about food waste when eating out. Also, they mention that portion size offered is the major cause for food waste. They perceive that serving size is out of their control and therefore do not feel ownership over the leftovers nor will ask for adjustments in serving size. Further, consumers report to feel embarrassed to ask for a doggy bag, but are more likely to use one when the use of doggy bags is proactively offered by the food service employee (WRAP 2013).

## 4.3 Use of the consumer food management model

Viewing consumer food waste behaviours from this management point of view makes it possible to account for multiple behaviours increasing the likelihood of wasting food. Each stage covers different sets of behaviours while managing food in the household. However, it is important to note that these stages are heavily linked. For instance, preparing too much food or bringing home leftovers can displace existing meal plans, meaning that other food items may get wasted.

The advantage of separating between stages is that it provides an opportunity to get a more detailed look into the motivational, social (household members, family, friends), knowledge-based, and societal factors (time to spend on the food management), that affect the flow of food though these stages. In the next section we will describe in more detail which constructs and factors have found to influence these behaviours.

# 5 A model of consumer food waste

To induce behavioural change it is important to understand what causes consumers to waste food. Therefore, we introduce a conceptual model (see figure 3) which addresses drivers on the individual, social and societal level. We group them according to the framework of Rothschild ((1999); based on Macinnis et al. (1991)) namely in motivations, abilities and opportunities. This approach has been advocated especially when the aim is to address the appropriateness of interventions (Andreasen 2002). Motivational drivers refer to the attitudes and awareness of consumers towards food waste levels as well as social norms surrounding food waste and food in general. Further attention is given to the ability of the consumer to prevent food from becoming waste in terms of skills and knowledge. Lastly, we include the lack of opportunity to prevent food waste due to the influence of technologic developments, the food infrastructure, as well as work and leisure schedules.

For an overview of the literature on factors that influence the amount of consumer food waste, see appendix 1. Papers and reports included in this appendix contain statistical tests on factors that influence food waste, and the appendix thus provides an overview of factors that have been empirically shown to affect household food waste. Both survey studies and intervention studies are included in the appendix.

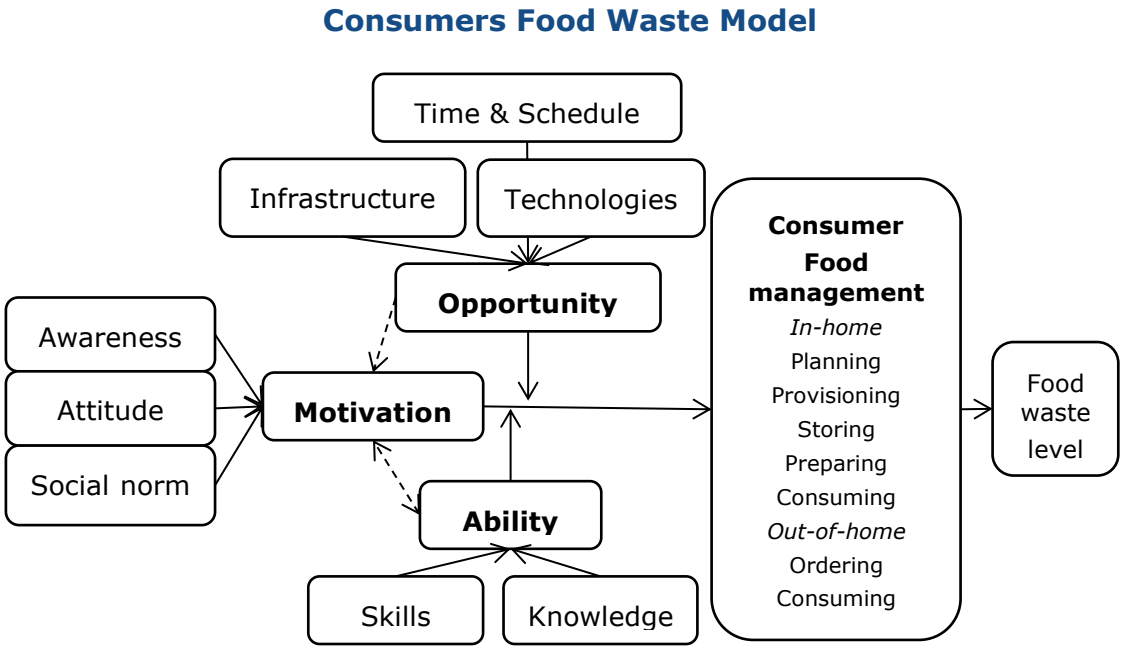


**Figure 3: Consumer Food Waste Model.** Motivation, ability and opportunity to engage in food waste prevention predicts the amount of consumer food waste generated. Black and dashed lines indicate influence on.

## 5.1 Motivation

Motivation to prevent food waste equates to a person's willingness to perform actions that avoid generating food waste. With a few exceptions, all prior studies that attempted to explain the level of food waste made use of motivational constructs (see Appendix 1 for an overview). The ones which seem to be most influential are awareness, attitude and social norm, and will be discussed in turn.

### 5.1.1 Attitude

Attitude refers to a persons' appraisal of the act of disposing food (Ajzen 2002). It includes the feelings or emotions and related thoughts, beliefs and ideas that are brought to the surface by disposing food.

The majority of consumers express negative attitudes towards food waste in general (Abeliotis, Lasaridi, and Chroni 2014; Graham-Rowe, Jessop, and Sparks 2014) and a feeling of guilt while discarding food (Stancu, Haugaard, and Lähteenmäki 2016; Neff, Spiker, and Truant 2015; Abeliotis, Lasaridi, and Chroni 2014; Graham-Rowe, Jessop, and Sparks 2014). The most common reported reason for consumers to experience this negative affect, is that they consider food waste to be an unnecessary loss of money (Abeliotis, Lasaridi, and Chroni 2014; Neff, Spiker, and Truant 2015; Rispo, Williams, and Shaw 2015). Additionally, to a lesser extent consumers find wasting food a negative behavior due its environmental impact (Principato, Secondi, and Pratesi 2015), or due to the social consequences of wasting food (referring to the fact that food is being wasted while others are undernourished) (Stefan et al. 2013). This negative attitude predicts food waste levels (Stefan et al. 2013; Stancu, Haugaard, and Lähteenmäki 2016), in which a more negative attitude towards food waste is related to lower food waste levels.

Some consumers are (to some extent) unwilling to engage in food waste preventing behaviours, due to the belief that it will increase the risk of foodborne disease (Principato, Secondi, and Pratesi 2015). They feel that preventing food waste equals eating products that are already overdue. This could be in part the consequence of governmental campaigns that focus on reducing the amount of consumers that suffer from foodborne disease (Principato, Secondi, and Pratesi 2015; Cox and Downing 2007). Regardless of its cause, it seems to be mostly present among households with young families (Evans 2012). The fear for foodborne disease is likely to be related to the consumers' perceived ability to correctly estimate food edibility.

Some consumers have reported discarding food due to personal preferences, such as a dislike of its taste (Evans 2012; Graham-Rowe, Jessop, and Sparks 2014a; Cox and Downing 2007), a dislike of eating leftovers (Porpino, Wansink, and Parente 2016; Aschemann-Witzel et al. 2015) or a dislike of eating items that need using up first rather than eating what is fancied at that moment (Cox and Downing 2007). Some consumers consider food waste not to be a problem due to the misconception that it is inevitable (Graham-Rowe, Jessop, and Sparks 2014), or not harming the

environment since it is recycled (Graham-Rowe, Jessop, and Sparks 2014) and biodegradable (Cox and Downing 2007).

### 5.1.2 Awareness

Although the majority of consumers express negative attitudes towards food waste (Stancu, Haugaard, and Lähteenmäki 2016; Stefan et al. 2013; Abeliotis, Lasaridi, and Chroni 2014; Graham-Rowe, Jessop, and Sparks 2014), only a minority of consumers agree that their household is generating too much food waste (Eurobarometer 2014). This lack of awareness has been reported repeatedly in several studies (Stefan et al. 2013; Cox and Downing 2007) and is suggested to be a reflection of the fact that food waste is the result of a complex of behaviours, rather than being an intentional behaviour (Evans 2012). Food waste often occurs unnoticed.

Increasing the awareness of consumers about their own food waste levels and the consequences of food waste has shown to be effective in reducing food waste levels (Parizeau, von Massow, and Martin 2015; Farr-Wharton, Foth, and Choi 2012; Quested et al. 2011). It has also been using in a recent UK campaign, were consumers were confronted with messages such as *"You could save up to £50 per month by throwing away less food"* by means of radio, digital and print advertising, along with supporting PR activities, events and community engagements (Quested and Ingle 2013). This campaign is built on the notion that most consumers dislike food waste due to its economical consequences.

### 5.1.3 Social norms

Prior studies have investigated the effect of social norms on disposing food. Social norms can be distinguished into injunctive and descriptive norms, of which the first reflects the extent to which consumers perceive wasting food as a behaviour that is disapproved of by others who are important to them (Lapinski and Rimal 2005) and the latter to the extent to which consumers think others prevent food waste (Cialdini, Kallgren, and Reno 1991).

Although not studied extensively, conflicting results have been reported regarding the social norms surrounding consumer food waste. On the one hand, there are studies that show that consumers find wasting food an accepted behaviour due to the perception that it is inevitable (Graham-Rowe, Jessop, and Sparks 2014), whereas on the other hand, studies show that consumers perceive it as an unacceptable behaviour (Graham-Rowe, Jessop, and Sparks 2015). Also, the results on how predictive social norm is on the intention to reduce food waste are mixed. Some studies show no effect (Stefan et al. 2013), whereas others do (Graham-Rowe, Jessop, and Sparks 2015; Visschers, Wickli, and Siegrist 2016; Stancu, Haugaard, and Lähteenmäki 2016). The mixed results might be because wasting food is a private, in-home affair, with little social interference. Alternatively, it might be a consequence of the focus of the studies, as they looked at social norms on the result of multiple behaviours (i.e., wasting food) rather than actual actions (e.g., list making).

Importantly, there are other social norms which have found to be related to wasting food in the household. These norms refer to the aim of being a good provider. Being a good provider is often reported by consumers as a reason that food ends up being spoiled. It refers to making sure that a wide variety of healthy and tasty foods are available for household members and guests (Graham-Rowe, Jessop, and Sparks 2014; Evans 2011; Aschemann-Witzel et al. 2015). Consumers report that living up to this norm is important to them, even if this can lead to food waste (Tokareva 2014).

## 5.2 Ability

Ability refers to a person's proficiency to solve the problems that he or she encounters when changing behaviour, including breaking well-formed habits and routines or countering the arguments of peers (Rothschild 1999). Preventing food waste is not the main priority for many consumers while managing their household. Instead, factors such as family relations, quality of meals, taste, diets or food safety play a role, which all lead to an increased likelihood to waste (Evans 2012). For instance, the aim to eat healthily can lead to the purchase of food products with a short shelf-life such as fresh fruit and also to the disposal of stored foods to eliminate the risk of foodborne disease. Individuals develop routines to integrate diverse priorities in their day-to-day life. Changing these routines in order to pay increased attention to food waste prevention requires skills and knowledge (Stancu, Haugaard, and Lähteenmäki 2016). In other words, even when individuals are motivated to reduce food waste, they need knowledge and skills to be able to integrate this aim within their current lifestyle.

### 5.2.1 Knowledge

Although consumers predominately feel confident about their storing abilities, they often store products incorrectly (Plumb and Downing 2013). This leads to limited shelf-life of products (Quested et al. 2011). As an example, consumers tend to maintain the temperature of their refrigerator too high (Aschemann-Witzel et al. 2015) and often do not know that product packaging can prolong a product's shelf-life in-home (Plumb and Downing 2013). Many products have on package storage guidelines, but these are often misunderstood by consumers (Plumb and Downing 2013).

Some studies found that consumers tend to misunderstand the differences between the use-by and best-before date labels (Graham-Rowe, Jessop and Sparks 2014; Terpstra et al. 2005). Moreover, research conducted in the UK shows that consumers who understand date labels still may not act upon them because they have their own routines in estimating food edibility. Date labels tend to be used more often in-store to check the quality of food items and in-home in case of high risk food as meat or diary. The use of these date labels has been associated with consumers' level of risk averseness regarding food borne disease (Brook-Lyndhurst 2011).

Consumers' confidence in estimating food edibility is rather low (Brook-Lyndhurst 2011), which is in accordance with studies that found that consumers tend to lack knowledge on how to correctly estimate food edibility (Tsiros and Heilman 2005; Evans 2011; Farr-Wharton, Foth, and Choi 2014).

Further, consumers often lack the knowledge to create meals from leftovers, which increases the likelihood to waste (Aschemann-Witzel et al. 2015). Knowledge to create taste meals from leftovers can limit the level of food waste. Therefore, correct knowledge on food management is needed to lower the levels of in-home food waste.

### 5.2.2 Skills

Next to the correct knowledge, consumers additionally need the skills to integrate this knowledge into their daily life in order to integrate the prevention of food waste into their current food management behaviours. The key challenge of managing the food supply and making sure that no food is being discarded seems to be acting upon a large variety of personal and household aims. Skills enable consumers to waste less by being able to handle food correctly in a greater range of situations. For instance, skills can enable consumers to waste less when the following routines are incorporated into their day-to-day life: creating shopping lists, planning meals, preparing foods that are about to go off into tasty meals, creating new dishes from leftovers and prolonging shelf-life of food products that otherwise will not be eaten in time (Cox and Downing, 2007).

## 5.3 Opportunity

Opportunity refers to the availability and accessibility of materials and resources required to change behaviour (Shwom and Lorenzen 2012). In the case of food waste, relevant aspects based on prior literature are time and schedule, technologies and infrastructure (Darnton and Evans 2013). Empirical evidence of their influence from quantitative studies is relatively scarce, as indicated in Appendix 1.

### 5.3.1 Time and schedule

Although consumers might realize that some behaviours increase the likelihood to waste, they can still decide to perform these behaviours to alleviate the risk of other negative effects. For instance, consumers mention buying surplus food to alleviate the risk of running out (Evans 2011) or to give the household the opportunity to choose a preferred dish every day (Evans 2011). Additionally, consumers can decide to order a take-away meal instead of preparing a meal with already bought products to save time (Quested 2013), regardless of the fact that they might be limited in opportunities to prevent spoilage of these products at a later date.

On one hand, these trade-offs are influenced by the consumer's motivation to prevent food waste. On the other hand, they are influenced by the day-to-day schedule of consumers. Many consumers report experiencing a busy schedule due to demanding working hours, leisure activities, children, or other factors. This demanding lifestyle limits the time available to spend on food management (Evans 2012). In addition, unexpected events, such as unexpected work or social appointments or the fluctuating appetite of children, can limit the ability of the consumer to estimate the quantity of food products needed (Evans 2012; Quested and Luzecka 2014). This means that the consumer is limited in the time and opportunity to prevent food waste. Therefore, a motivated and skilled consumer can still end up wasting food, due to a lack of time to integrate behaviours that will prevent food waste into his or her lifestyle.

### 5.3.2 Material and technologies

Consumers can also be limited to prevent food waste by improper equipment in home, such as too little storage space or a low quality of fridge or freezer. Being limited in storage quality makes it difficult for the consumer to prolong the shelf-life of products (Canali, Östergren, and Amani 2014). This means that they have less time to consume the products before becoming spoiled, increasing the likelihood of waste. Also, new interventions can potentially help consumers to lower their food waste levels. In previous studies, the use of cameras in the fridge and smart bins have been tested with no clear results yet (Ganglbauer, Fitzpatrick, and Comber 2013).

### 5.3.3 Infrastructure

Several factors concerning the products offered in retail outlets and the accessibility of stores can lead to an increase in the chance that food will be discarded. One of these factors is the quality of the products bought. A bad or unpredictable quality results in an inability of consumers to correctly predict the shelf-life and therefore its use according to a meal plan (Evans 2011). Additionally, some retail outlets only offer large package size (e.g. bulk packaging) of certain products. This increases the likelihood of having partially used products and thus the chance to waste (Quested et al., 2013).

Not only are the quality and size of products that are sold important, but also the accessibility of the stores themselves. This refers to opening hours as well as geographical density of food shops. A lack of accessibility of food stores combined with a limited available time of consumers increases the likelihood to waste. Consumers need to buy larger quantities of food in one go, which increases the chance of buying surplus food (Evans 2011; Abeliotis et al., 2014).

## 5.4 Interactions between motivation, ability, and opportunity

The willingness of consumers to learn and use skills and knowledge is most likely influenced by the level of motivation consumers have to engage in accurate household food management and (consequently) prevent food waste. There may be various reasons why consumers may be motivated to engage in accurate household food management, the motivation to reduce food waste is one of these however it as well can be another reason as not spending too much money. Regardless of the reason, motivation is needed to instil routines in the household that will minimize food waste. If the motivation is lacking, consumers can be resistant in incorporating new behaviours into their daily routines. A (repeated) inability to prevent food from becoming waste due to lack of skills or knowledge, is likely to reduce the willingness or motivation of consumers to prevent food waste, as it becomes frustrating to not succeed. A lack of opportunity can as well decrease the motivation of consumers to prevent waste. When a consumer fails to prevent food waste due to factors which are out of their control, this can lead to the feeling that food waste is inevitable or at least is paired with many inconveniences. This in turn most likely reduces the motivation to engage in preventing food waste.

In summary, a lack of motivation results in a resistance, whereas the lack of ability or opportunity results in an inability to engage in waste preventing behaviours and in turn affects motivation. Therefore, it is best if all three factors are present for a consumer to successfully reduce waste levels.

Figure 3 provides the resulting conceptual model of consumer food waste. The model shows how motivation, opportunity, and ability jointly determine food management within the household. The resulting food management behaviours subsequently affect the amount of food waste that is generated by the household.

## 5.5 Distal factors

Additionally to the factors described above, prior literature points towards several distal factors which seem to shape consumer behaviours and their engagement in preventing food waste. In contrast to the factors described above, distal factors are factors which have an indirect influence on behaviour. Thus, instead of viewing the various consumer characteristics as independent from each other in their influence on behaviour, these factors can be placed on a distal/proximal influence axis (e.g., Mittal 1994).

The distal factors related to food waste have in common that they refer to socio-demographics aspects of consumers that cannot be changed by interventions directly. The factors do not directly cause food waste, but most likely influence motivation, ability or opportunity. They thereby affect food waste through these constructs and the consumer food management process. The table in appendix 1 identifies several distal factors, of which

age, gender, education level, household size and composition, and income appear to be the most common and influential. We will discuss each in turn.

### 5.5.1 Age

Age has been found to influence how much waste is being generated and the attitude of the consumers towards waste, in which elderly consumers are found to waste less and to have a more negative attitude towards wasting food than younger consumers (Eurobarometer 2014). This might be related to the social and cultural background and thus the upbringing of these consumer, as elderly consumers have experienced periods of food scarcity whereas young consumers have not. Upbringing has been related to the consumer perceptions and habits towards food management (Aschemann-Witzel et al. 2015). Furthermore, elderly consumers may waste less because they often have more time and are more skilled to prevent food waste (Quested and Luzecka 2014).

### 5.5.2 Gender

Gender is also found to have an influence on how much food is being wasted. Some studies find that males waste more than females (Secondi, Principato, and Laureti 2015; Visschers, Wickli, and Siegrist 2016), but the opposite has also been reported (Koivupuro et al. 2012). Additionally, females tend to have more positive intentions to reduce fruit and vegetable waste (Graham-Rowe et al., 2015) and to be more aware of food waste (Secondi, Principato, and Laureti 2015). However, since food waste emanates from a household, which is a collective of individuals who share food management tasks, it is difficult to pinpoint who is responsible for which piece of food waste.

### 5.5.3 Education

A higher level of education has been related to a higher self-reported amount of food waste (Visschers, Wickli, and Siegrist 2016; Secondi, Principato, and Laureti 2015). From these studies, it is not clear why education is related to food waste levels.

### 5.5.4 Household size and composition

Household size and composition has also been related to food waste levels, in which larger households waste more than smaller households (Quested et al., 2013). However, when corrected for the amount of persons living in the household, larger households appear to waste less per capita (Parizeau, von Massow, and Martin 2015). An exception seems to be households with children, who tend to waste more than all-adults households of equal size. UK data indicates that due to the fussy eating of children and the fact that their parents pay more attention to food safety, they are more likely to throw away food. At the same time, they are also found to make more use of meal planning and freezers (Quested and Luzecka 2014).

### 5.5.5 Income

The results on the effect of income on food waste levels are unclear. Some studies indicate that lower income is related to more food waste (Cox and Downing 2007; Stancu, Haugaard, and Lähteenmäki 2016), but the opposite has also been reported (Stefan et al., 2013). Additionally, there are studies who found no relation between food waste and income (Koivupuro et al. 2012; Wenlock et al. 1980; Williams et al. 2012). Further, some preliminary findings suggest that lower wages or higher food prices are related to less food waste (Britton et al. 2014).

## 5.6 The overall framework

The resulting overall framework on consumer food waste is presented in Figure 4. The figure indicates that distal factors affect the motivation, ability, and opportunity that consumers experience in their attempts to manage food in the household. Their food management behaviours affect the level of food waste that is generated. This in turn affects how much food waste is generated.

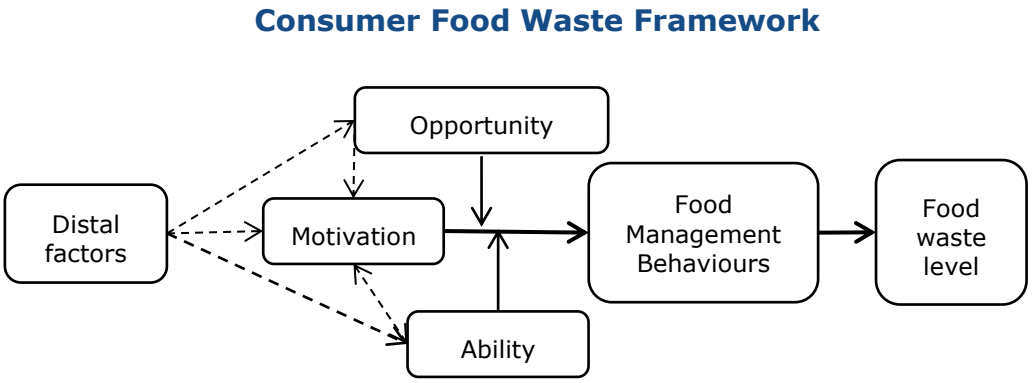


**Figure 4: Consumer Food Waste Framework.** Distal factors influence food waste via their influence on motivation, ability and opportunity. These three constructs in turn affect food management behaviours and the level of food waste being generated. Black and dashed lines indicate influence on.

# 6 Conclusions

Consumer food waste is not the consequence of discarding waste, but of the accumulation of behaviours performed earlier in time. This report has described and interlinked the behaviours leading to waste and the factors influencing them. It has integrated prior research into one theoretical framework in which the focus lies on the motivation, the abilities and the opportunities of consumers to prevent food waste while managing food in the household.

## 6.1 Integrating viewpoints on consumer food waste

Household food waste has been studied from different disciplines, each with its own perspective on potential drivers of food waste. Two conflicting views were discussed: the individual perspective, in which food waste is mainly seen as a consequence of lack of motivation and knowledge, and the sociological perspective, in which food waste is mainly seen as a result of situational aspects.

To understand the complexity of behaviours surrounding consumer food waste, both viewpoints need to be combined. Consumer motivation and intentions to reduce food waste appear to be sufficient to prevent food waste insofar as situational factors (busy schedules, improper equipment, and infrastructural challenges) enable consumers to make the required changes. Our proposed theoretical framework therefore combines both individual (motivation and ability) as well as situational factors (opportunity).

## 6.2 Consumer food management

In our summary of prior research, we have emphasized that consumers do not buy food with the intention of wasting it. Food waste is the unintended result of managing food in the household. Therefore, to understand food waste generation, consumer food management must be examined.

We have identified relevant food management stages, both in-home and out-of-home in which various behaviours contribute to the generation of food waste. Although these stages are intertwined, separating them provides an opportunity to get a detailed understanding of how food management behaviours are linked to food waste and additionally an understanding of which behaviours might be successful targets to reduce consumer food waste levels.

## 6.3 Consumer food waste framework

Prior research has identified many different constructs that influence food waste. We have grouped these into four broad categories: motivation, ability, opportunity, and distal factors. The distal factors concern socio-demographic constructs, which are likely to have an indirect effect on consumer food management. Their influence is thought to operate through

one of three main factors of motivation, ability, and opportunity. For example, the effect of age on food waste, which was found in prior studies, is likely to be present due to differences in motivations and ability between age groups.

Motivation, ability, and opportunity affect the likelihood that consumers engage in behaviours that prevent food waste in their household. They do not operate independently: a lack of abilities and/or opportunities can be demotivating to consumers, and a lack of motivation can prevent the acquisition of new abilities.

By making use of the existing literature, we identified the several relevant constructs of motivation, ability, and opportunity. For motivation these are attitudes, awareness, and social norms. For ability these are knowledge and skills. For opportunity these are time & schedule, material & technology, and infrastructure. The resulting framework is flexible in the sense that if new constructs are found to drive food waste they can easily be adopted into the framework, regardless of the nature of the construct. The framework also allows for the identification of differences between consumers and cultures when applied empirically.

## 6.4 Future REFRESH research in this work package

The current report forms the basis for future research within work package 1 of REFRESH. Most relevant in this respect are tasks 1.2 and 1.4. In task 1.2., focus groups are conducted across four European countries (Hungary, Germany, Spain, and the Netherlands) to assess qualitatively how consumers think about food waste. The focus groups will be used to investigate whether the stages, behaviours, and constructs that drive food waste, identified in this report, are also reflected in the consumers' own viewpoints on food waste. In task 1.4, a survey is conducted in the same four countries, to quantitatively test our conceptual framework.

Later tasks in this work package examine potential intervention strategies, related to ICT-based tools (task 1.5), on-pack guidance (task 1.6), and waste valorisation (task 1.7).

Additionally, the framework will be used as input in work package 2 and 4. Work package 2 will use the framework to design and develop interventions to reduce consumer food waste levels. Work package 4 will use the framework to design the consumer interaction with the overall food chain within an inclusive model on food waste generation.

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# 8 Appendix 1

| Article | Method | Motivation | Abilities | Opportunities | Behaviours | Distal factors |
|---|---|---|---|---|---|---|
| Cox & Downing, 2007 | 1862 individuals. Correlational study | | | | | • Age<br>• Household composition<br>• Occupation<br>• Social class |
| Freedman and Brochado, 2010 | 1475 individuals in canteen | | | | • Smaller portion size | |
| Graham-Rowe, Jessop, & Sparks, 2015 | 204 individuals Predictive model testing | • Attitude<br>• Subjective norm<br>• Perceived behavioural control<br>• Self-identity<br>• Anticipated regret<br>• Descriptive norm (ns) | | | • Responsibility for household food shopping (ns)<br>• Responsibility for household food cooking and preparation (ns) | • Gender<br>• Age (ns)<br>• Marital status (ns)<br>• Household composition (ns) |
| Kallbekken & Saelen, 2013 | 52 hotels Intervention study | • Social cue that is it accepted to serve more than once | | • Plate size | | |
| Koivupuro et al., 2012 | 380 individuals Correlational study | • Attitude towards leftovers<br>• Price concerns | • Knowledge on date labelling | • Package size<br>• Discount actions | • Frequency of purchasing | • Household composition<br>• Household size<br>• Income (ns)<br>• Area of residence (ns)<br>• Gender |
| Mallinson et al., 2016 | 928 individuals Segmentation study | • Included in the segmentation are factors as attitudes | | | | • Age<br>• Gender<br>• Income |

| | | | | | |
|---|---|---|---|---|---|
| | | towards convenience foods | | | • Household composition<br>• Occupation<br>• Education<br>• Area of living<br>• Body-mass index |
| Parizeau, von Massow, & Martin, 2015 | 68 households Correlational study | | • Amount of strategies used to identify food waste | • Money spend on groceries<br>• Frequency of eating out<br>• Reliance on convenience food | • Household composition |
| Principato, Secondi, & Pratesi, 2015 | 230 individuals Predictive model testing | • Awareness<br>• Concerns on monetary and environmental impact<br>• Concerns on food safety | • Knowledge on estimating food edibility<br>• Knowledge on expiration dates<br>• Create meal from leftovers | • Creating shopping lists<br>• Preparing too much | • Income |
| Quested et al, 2011 | Combination of studies | • Awareness | • Knowledge on date labels | • Meal planning<br>• Shopping lists<br>• Checking storage before shop | • Age<br>• Household composition |
| Secondi, Principato, & Laureti, 2015 | 388 individuals Predictive model testing | • Intention | | • Sorting kitchen waste | • Area of living<br>• Education<br>• Age<br>• Gender |
| Stancu, Haugaard, & Lähteenmäki, | 1062 individuals Predictive model | • Attitudes<br>• Injunctive norm<br>• Moral norm (ns) | | • Shopping routines<br>• Leftover reuse routines | • Age<br>• Household size<br>• Income |

| | | | | | |
|---|---|---|---|---|---|
| 2015 | testing | • Perceived behavioural control<br>• Intention<br>• Awareness of environmental and social impacts<br>• Awareness of economic impacts | | • Planning routines<br>• Household skills | |
| Stefan, van Herpen, Tudoran, & Lähteenmäki, 2013 | 244 individuals Predictive model testing | • Intention ns<br>• Moral attitude<br>• Lack of concern<br>• Subjective norm (ns)<br>• Perceived behavioural control<br>• Awareness | | • Planning of meals and grocery shopping<br>• Frequency of shopping trips<br>• Impulse buying<br>• Buying too much | • Age<br>• Income<br>• Involvement with food |
| Thiagarajah and Getty 2013 | 5000 meals | | | • Using a tray less system | |
| Visschers et al., 2016 | 796 individuals Predictive model testing | • Personal attitude (ns)<br>• Financial attitude<br>• Perceived health risks (ns)<br>• Personal norm<br>• Subjective norm (ns)<br>• Intention<br>• Perceived behavioural control<br>• Good provider identity | • Use-by date knowledge (ns)<br>• Food storage knowledge (ns) | • Household planning habits (ns)<br>• Use of bio-waste container (ns) | • Age<br>• Gender<br>• Education (ns)<br>• Household composition |

| | | | | | | |
|---|---|---|---|---|---|---|
| Wansink, van Ittersum, and Painter, 2006 | 85 individuals | | | | • Smaller plate size | |
| Wenlock, Buss, Derry 1980 | 1000 households Correlation study | | | • Season | | • Household size<br>• Age<br>• Income (ns)<br>• Geographical region (ns) |
| Whitehair, Shanklin, and Brannon 2013 | 540 individuals in canteen Intervention Study | • Beliefs about environmental impact of food waste<br>• Motivational prompts | | | | |
| Williams, et al., 2012 | 61 households Correlational study | • Environmental awareness<br>• Negative attitude towards food waste<br>• Price awareness | • Best before date | • Package size<br>• Functionality of packaging | • Prepared too much food<br>• How often food is bough | • Household composition<br>• Income (ns) |

**NOTE:** Overview of the literature on factors that influence the amount of household food waste. Papers and reports included contain statistical tests on factors that influence food waste. Both survey studies and intervention studies are included in the appendix. The abbreviation 'ns' stands for non-significant result.