



Policies against consumer food waste

**Policy options for behaviour change including
public campaigns**

**Background report contributing to “REFRESH Policy
Brief: Reducing consumer food waste” (D3.4)**



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List of abbreviations

ADEME	Agence de l'environnement et de la maîtrise de l'énergie i.e. French Environment and Energy Agency
BMEL	Bundesministerium für Ernährung und Landwirtschaft i.e. Federal Ministry of Food and Agriculture Germany
BOGOF	buy-one-get-one free
DG Sante	Directorate-General for Health and Food Safety
EFSA	European Food Safety Authority
EPA	Environmental Protection Agency
EU	European Union
EU LIFE	L'Instrument Financier pour l'Environnement i.e. EU's financial instrument for the environment
FAO	Food and Agriculture Organization of the United Nations
FUSIONS	Food Use for Social Innovation by Optimising Waste Prevention Strategies
GPP	Green Public Procurement
ICT	Information and communications technology
JRC	Joint Research Centre
LFHW	Love Food Hate Waste
LWARB	London Waste and Recycling Board
MAVPC	Ministry of Agriculture, Viticulture and Consumer Protection
MS	Member states
NGO	Non-governmental organisation
OVAM	Openbare Afvalstoffenmaatschappij voor het Vlaams Gewest i.e. Public Waste Agency of Flanders
REFRESH	Resource Efficient Food and dRink for the Entire Supply cHain
TRiFOCAL	Transforming City FOod hAbits for Life
UK	United Kingdom

- UNEP** United Nations Environment Programme
- US** United States
- WRAP** Waste and Resources Action Programme

Executive summary

This report translates the findings of the REFRESH project on consumer behaviour into policy recommendations. It helps national and regional policy makers in designing and improving appropriate interventions against food waste.

We focus on policy instruments that aim to reduce consumer food waste including in-home and out-of-home consumption.

The **factors that cause consumers to waste food** are **complex**. Often food waste is a **result of conflicting goals**, such as convenience, taste, and saving money.

Consumer food waste behaviour is **determined by consumers' motivation** (including attitude, problem awareness, and social norms around wasting food), **opportunity** (including time availability, access to technologies, and having the quality and quantity of food), and **ability** (skills and knowledge) to control or change food waste-related behaviour. **Socio-demographic aspects** such as age, gender, income and household size are also **correlated with food waste** as they influence motivation, ability and/or opportunity, but do not play a causal role.

Policy instruments that exist to influence consumer food waste can be clustered into five categories:

- **Information** and awareness raising campaigns
- **Regulation**
- **Economic** instruments
- **Nudging**/change of consumer's choice architecture and
- **Voluntary agreements**.

Within the EU the **most often used instrument** so far is **public campaigns** that have been designed to provide information that **increases awareness** of the consequences of food waste. However, there are only very few studies that have evaluated to what extent these activities actually reduced or prevented food waste. Meta-analysis of pro-environmental behaviour experiments though have shown that **intervention strategies that only provide information belong to the least successful**. So the common assumption that providing information is sufficient to induce behavioural change is not supported by the evidence.

This is supported by REFRESH results of a survey in four countries with 3354 households. It shows that the **awareness of the consequences** was not correlated with food waste levels, i.e. did **not show a significant influence**. However, **social norms have a clear influence**, i.e. the more strongly consumers believe that others such as family members and friends waste food, the more food

Who should read this report

Policy recommendations are aimed at **public policy makers** on the local or national level, but also have relevance for EU policy making. Moreover, the insights of this report with regard to determinants of consumer food waste practices, information behaviour and key messages for campaigns are also of relevance for **retailers, NGOs, and marketing professionals**.

they waste themselves. Also, “**busy lifestyles**” and the prevalence of unforeseen events strongly influences food waste levels: Consumers who more often encounter unforeseen changes in their schedule tend to waste more food. It also shows that households with less waste tending to exhibit **five household food practices**: planning of food shopping and use, less impulse buying, maintaining overview of the food in stock, cooking precisely, and using leftovers.

Research suggests that it could be helpful to design, implement and test **campaigns that aim to influence social norms**. Social norm campaigns exploit the tendency of individuals to conform to what they perceive those around them think or do. Therefore, there is an opportunity to shape behaviour by giving people information about the behaviour or attitudes of others in the population, carefully selected to maximise adoption of positive behaviours. Similarly, the **provision of practical skills** should be stronger in the focus of policy interventions. These need to build on an **analysis of national particularities** (e.g. which food items are wasted most and why) and **key target groups** (e.g. young people), and **be tailored to existing knowledge and skills** to influence the most relevant household food management practices.

Most importantly, **interventions need to be monitored and evaluated** to gain insights about the effectiveness of campaigns and to adapt interventions accordingly. Monitoring and evaluation needs to be considered **early in the process**: i.e. developed at the same time as the planning for the intervention themselves.

Policy makers should **consider interventions based on regulation, economic instruments and nudging approaches**. Where necessary, these approaches should be supported by carefully designed campaigns drawing on the latest insights from research.

Finally, even if consumers are currently often in the focus of policy makers in their efforts to reduce food waste, food waste reduction needs to be addressed **all along the supply chain**. Other actors in the food chain, particularly **retail and hospitality** have significant **influence on consumer behaviour** and therefore need to be involved in public strategies addressing consumer food waste (e.g. through voluntary agreements).

A more **integrated policy approach** towards consumer food waste is also needed due to the conflicting goals that cause food waste and that are e.g. related to health policies, the economic framework, or resource efficiency policies. It is important to consider these aspects early in the planning of interventions and policies in order to **reduce existing conflict of targets, increase synergies** and increase **coherence of policy interventions**.

Trade-offs can exist between e.g. health and food waste, but synergies exist such as improved skills for (creative) cooking. Reduced packaging often is in conflict with increasing shelf life of perishable products. Fostering regional food production and consumption can reduce food losses during transport. Policies that increase consumers’ free time, such as part-time working models, may be able to provide opportunity for food waste preventing behaviour. Increasing food prices to internalise external costs could decrease waste, but impacts on social inequality would need to be considered.

Policies against food waste therefore look for synergies to achieve a more general **shift towards a more sustainable and resilient food system**.

This internal background report is part of the EU project REFRESH (Resource Efficient Food and dRink for the Entire Supply cHain), which aims to contribute towards reducing food waste across Europe.

1 Introduction and objectives

Reducing and preventing food waste is increasingly recognized as an impactful and important way to reduce the environmental footprint of the food system and to achieve a sustainable, resilient food system, contributing to global food and nutrition security.

For the EU, the research project FUSIONS has estimated that 88 million tonnes of food are wasted each year, equating to 173 kg of wasted food per person. The costs associated with this level of food waste are estimated to amount to around 143 billion EUR (Stenmarck et al. 2016). Besides high social and economic costs, food losses and food waste contribute to climate change and represent a waste of scarce resources such as land, energy and water.

With an estimated contribution of 53%, the **consumer is the primary contributor** to food waste across the food chain in higher income countries (Stenmarck et al. 2016). Considering that a large amount of this waste could be avoided, the urgent need to change consumer behaviour is evident.

Reducing consumer food waste and policy interventions to support this effort is therefore a key area¹ of the EU project **REFRESH** within which this report was developed. REFRESH (Resource Efficient dRink for the Entire Supply cHain) is a four year (2015-2019) Horizon 2020 EU research project taking action towards food waste reduction. This project's goal is to support the Sustainable Development Goal 12.3 of halving per capita food waste at the retail and consumer level, reducing food losses along production and supply chains and valorizing unavoidable food waste.

The role of consumers to prevent food waste has been analysed in different parts of the REFRESH project.² It is the objective of this report to **translate the findings of REFRESH work on consumer behaviour into policy recommendations** that will help national and regional policy makers in designing appropriate instruments against consumer food waste.

After a description of the methodological approach and scope of the report (chapter 2) we will provide an overview of the known influencing factors of consumer food waste based on REFRESH insights and other research publications (chapter 3) and

¹ Through the policy research carried out within the project, four policy areas stood out as main focuses to further research within policy briefs: use of surplus food as animal feed, building of voluntary alliances between business and policy actors, unfair trading practices, and behaviour change of consumers.

² See chapter 2 for an overview of consumer behaviour work within the REFRESH project

show why it is important to differentiate consumer food management practices (ranging from planning, to shopping, provisioning, storing, preparing, consuming to disposal). We then identify potential policy options to influence consumer behaviour (chapter 4). Chapter 5 gives an overview of some key public campaigns in the EU, illustrating that public awareness raising and information campaigns are the most commonly used interventions so far.

In chapter 6 we point to the difficulty of assessing the impact of interventions due to missing evaluation of interventions and draw first conclusions how this can be improved. Finally, chapter 7 draws conclusions, summarizing how policy responses can be improved. It also illustrates opportunities for an integrated policy perspective to improve the sustainability of food systems that goes beyond efforts to reduce consumer food waste.

2 Approach and scope of the report

The analysis of determinants of consumer food waste and possible policy interventions mainly builds on the results of the REFRESH work.

The **main REFRESH results** related to consumer behaviour and food waste (as of October 2018) are:

- A theoretical framework on consumer food waste behaviours (van Geffen, van Herpen, and van Trijp 2016).
- An overview of all factors that may influence household food waste based on prior research as well as focus group interviews throughout four European countries (van Geffen et al. 2016).
- A large scale survey in Germany, Hungary, Spain and the Netherlands that examined the extent to which the potential factors identified actually determine in-home household food waste (van Geffen, van Herpen, and van Trijp 2017).
- A survey (across the same four countries) that examined various formats of on-pack guidance information and compared different formulations and formats of date labelling, freezing advice, as well as storage advice (O'Brien and Leach 2018).
- A report about ICT tools for food management and waste prevention at the consumer level (Vogels et al. 2018).
- An examination how consumers respond to waste valorisation options (Rahmani et al. 2018).
- The report "Consumers behavioural economic interrelationships and typologies" (Grainger and Stewart 2016) that analyses datasets to define consumer behavioural typologies and develops a systems map to illustrate potential links between consumer behaviour and the creation/reduction of food waste.

In addition to this, various methods to measure household food waste were compared to develop the REFRESH best practice assessment of household food waste (van Herpen et al. 2016).

Besides REFRESH results we also include findings of a very dynamically growing base of literature that – particularly over the last 3 years – has focused increasingly on understanding consumer food waste. Moreover, we also use literature that deals more generally with consumer behaviour change and the impact of different interventions, as much of the food waste prevention interventions have not yet been evaluated in terms of effectiveness.

2.1 Consumer food waste definition

In developing policy recommendations we focus on consumer food waste. As in van Geffen, van Herpen, and van Trijp (2016) we **define consumer food waste** as “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”. We include both **in-home as well as out-of-home** consumer food waste in our analysis³

Interventions addressing **other parts of the food supply chain** - from agricultural production to waste recycling - are just as important as addressing consumer food waste, but are **outside of the scope** of this report.

2.2 Target audience of this report

Policy recommendations are aimed at **public policy makers** – be it on the local level (e.g., a municipality) or national level, but also have relevance for EU policy making. We focus on policy instruments that aim to change the behaviour of citizens with respect to food, in order to diminish food waste (see chapter 4). However, the insights of this report with regard to determinants of consumer food waste practices, information behaviour and key messages for campaigns are also of relevance for **retailers, NGOs and marketing professionals**.

The analysis and recommendations of this report will be input for the **expert workshop in Berlin, on November 19, 2018**. The results of this workshop will then be used to publish a **policy brief** on consumer behaviour change in January 2019.

³ Food waste in this definition taken from van Geffen, van Herpen, and van Trijp (2016) 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.). Out-of-home consumer food waste is food waste arising 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.

3 Understanding consumer food waste

3.1 Food management practices and competing goals

Often there is a **misperception of the reasons behind food waste on consumer level**, with a tendency in public opinion to regard current consumer culture as a 'throwaway society', and to take "current volumes of waste generation as incontrovertible evidence for the excessive, wanton nature of contemporary consumerism" (Evans 2012, 42). Yet, there is **growing empirical evidence pointing out that wasting is not a careless or carefree activity** for many consumers. Consumers express anxiety and concern about food waste, yet feel that they cannot adequately change this (e.g., Evans 2012). This is also evidenced in the REFRESH results from focus group discussions across four countries in the EU (Spain, Germany, Hungary and the Netherlands) that were undertaken in 2016 (van Geffen et al. 2016).

3.1.1 Food management practices

Food waste needs to be understood as a complex set of behaviours and food management practices, rather than a single behaviour and as the result of competing goals. **Food management practices that have an impact on food waste** include planning, shopping, storing, preparing, and consumption activities (see Figure 1 and Table 1).

1. **Planning and organisational practices:** Food management starts already when **stocks** are checked, **meals are planned**,⁴ and **(mental) shopping lists** are produced. **Accurate planning** reduces the chances of overstocking and hence reduces the likelihood for food waste. Planning has often been described as an effective strategy to reduce food waste (Stancu, Haugaard, and Lähteenmäki 2016; Jörissen, Priefer, and Bräutigam 2015).

2. **Shopping practices:** While most of the food is bought in supermarkets, shops and markets, or bought "to-go", it can also be home-grown or received as gifts. This is important as it influences the **level of control over quality and quantity** of food in the home. Low **frequencies of shopping** (e.g. monthly instead of daily) can be relevant as this influences the likelihood of perishable products to spoil (Stöckli, Niklaus, and Dorn 2018). People with a **tendency towards impulse buying** during shopping (i.e. spontaneous shopping decisions without reflection on the actual need of the product) tend to waste more food (Parizeau, von Massow, and Martin 2015; Stefan et al. 2013; Beatty and Ferrell 1998). A **less clear relation** to food waste has been shown for **price sensitivity** of consumers and **attraction to special offers** (Roodhuyzen et al. 2017): Some studies suggest that low prices stimulate overbuying and lead consumers to be less worried if the food is spoiled, thus enhancing food waste. Other authors show that consumers who are interested in discounted food are price sensitive and less likely to discard food.

⁴ See e.g. Romani et al. (2018) about how a simple organization of a weekly menu contributes to food waste reduction.

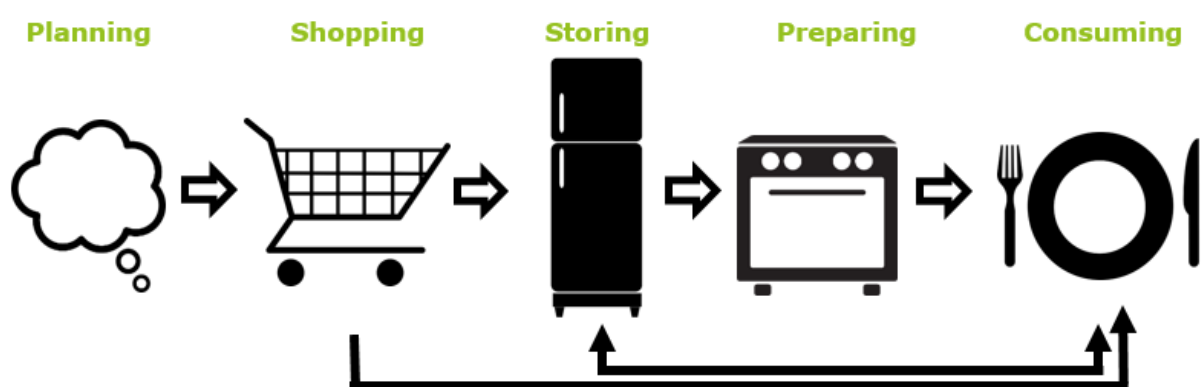
3. **Storage practices:** Correct storage influences shelf life of products. Correct storage relates to the **right temperature** and **light intensity** as well as a **good structure and organisation** that make it less likely that food products are forgotten or overseen. In the REFRESH survey (van Geffen, van Herpen, and van Trijp 2017) people with a better overview of what they have in stock reported less food waste. On pack information about suitable storage and interpretation of best-before and use-by dates play a relevant role in food waste reduction in this stage.

4. **Preparation and serving practices:** Preparing and serving practices relate to the preparation (e.g. cutting vegetables, trimming, cooking) of food. **Cooking precise** amounts, e.g. with the assistance of measuring cups, reduces the chance of leftovers. **Creative cooking** allows to deal with unusual amounts and ingredients and reuse of leftovers. **General cooking skills** are needed to avoid wrong handling of food (e.g. avoid burning).

5. **Consumption practices:** Food waste relevant practices at the consumption stage relates to the use of leftovers. These can be **eaten directly, transformed into a new meal** or **discarded**. They can also be stored as leftovers. To reuse leftovers correct storage matters as well as using one's senses to identify if food is still fit for consumption (rather than discarding it solely if it has reached its date or was stored for a specific time).

The REFRESH survey (van Geffen, van Herpen, and van Trijp 2017) found out that **planning of food shopping and use, impulse buying, overview of the food in stock, cooking precisely, and using leftovers** are the practices that **account for a large part (22%) of the variance in household food waste**.

Figure 1: Overview of food management practices



These behaviours directly and indirectly influence the level of consumer food waste. It is important to note though, that **not all food management behaviour are relevant at all times**. For example when buying food "to go"/within the out of home food sector, food is bought and directly consumed. In other occasions food is moved back in the stages of food management practices, e.g. when leftovers are stored. Also, some people may be particularly skilled in relation to one of the mentioned behaviours (e.g. creative cooking) but less in others (knowing what is in stock).

Table 1 Overview of food management practices and influencing factors leading to food waste

Planning	Shopping	Storing	Preparing	Consuming
Mental shopping list	Impulse buying	Temperature setting	Creative cooking skills	Save and store leftovers
Know what is in stock	Sensitivity to price discounts	Overview of food in stock	Cooking precise amounts	Reuse leftovers
Meal planning	Different ways of purchasing (Super-) market, home grown, take-away, gift etc.: influences control over quality and quantity	(Mis-) understanding of on pack information	Unnecessary trimming	Discarding food without using one's senses
	Frequency of shopping		Basic cooking skills (prevent burning etc.)	
	Out of home: ordering half portions and second helpings			
	Preferences for packages and sizes			

3.1.2 Competing goals impact food consumption behaviour

During the performance of food management practices, consumers attempt to obtain multiple and sometimes **competing goals, such as convenience, tastiness, freshness, variety, healthfulness, and quantity of food**, so wasting food is more a “**collateral damage**” of conflicting goals. Examples include the problem of providing enough and good food for guests while at the same time trying to reduce food waste. Some of the competing goals and preferences have been **tested in the REFRESH survey**: It showed that **people who attach more importance to having sufficient food and having tasty food have more household food waste**. The importance attached to **healthy food however, is not related** to food waste according to the survey (van Geffen, van Herpen, and van Trijp 2017). As the social and environmental benefits of saving food are abstract, food waste prevention faces the dilemma of many other pro-environmental behaviours. It creates limited personal and direct effects except for acting upon moral issues and saving some amount of money. These goals compete with direct personal benefits such as saving time and food enjoyment.

As the accumulation of diverse practices, during which multiple goals are relevant, leads to food waste, **prevention of household food waste is a complex issue.**

Understanding food management behaviours and the occurrence of food waste better as well as understanding and influencing competing goals is an important step for a targeted policy response.

Figure 2: Competing goals to food waste reduction



3.2 Influencing factors: Motivation, opportunity, and ability

To better understand consumer food waste drivers, the **REFRESH project set up a general framework of factors that influence household practices** and thereby the amount of household food waste (van Geffen et al. 2016). Based on prior research (Rothschild 1999), a **distinction was made between three groups of influencing factors: consumer motivation, opportunity, and ability.** This framework incorporates both individual and situational factors that can lead to food waste, and is more encompassing than the theories used in many prior studies (e.g., theory of planned behaviour, which focuses mainly on individual factors). Motivation, opportunity, and ability are all relevant for household food waste, and need to be considered jointly in policy interventions.

3.2.1 Motivation

Motivation to prevent food waste equates to a person's willingness to perform actions that avoid generating food waste. The factors which seem to be most influential are **attitude, awareness and social norms.**

1. Attitude

Attitude includes the feelings and related thoughts, beliefs and ideas that are brought to the surface by disposing food. Visschers, Wickli, and Siegrist (2016) found that people with positive attitudes towards reducing food waste have higher intentions to reduce wasteful behaviours. According to the REFRESH survey, people's thoughts and feelings towards wasting food are related to household food waste in the way that people who feel bad about disposing food report lower waste levels (van Geffen, van Herpen, and van Trijp 2017). Negative feelings towards food waste result from moral, environmental and monetary concerns (van Geffen et al. 2016).

The findings that persons who feel guilty when wasting food waste should however not be translated in arousing guilt within campaigns. According to Russell et al. (2017) arousing negative emotions in individuals could have counterproductive effects, as this might increase the intention to reduce food waste but does not encourage actual decreases in food waste behaviour. Similarly, Birau and Faure (2018) found that **messages that blame consumers for waste tend to have backfiring effects** that can lead to less negative attitudes towards food waste and the feeling of being less able to engage in food waste reducing behaviours. In order to avoid this, the authors suggest that lowering the level of perceived task difficulty can help to avoid backfiring effects (i.e. increasing consumers' feeling that not wasting food is easy). Wonneberger (2017) investigated the role of guilt arousal in environmental campaigns, and found that guilt arousal is less effective among people who have no prior concern about the topic compared to people already aware and concerned. **Evoking guilt through a campaign's messages therefore is likely to be only effective for consumers already aware and concerned about food waste.**

2. Awareness

Problem awareness about wasting food and **awareness of the consequences** can influence attitudes and intentions to reduce food waste. In a Eurobarometer survey in 2013 only a minority of consumers agreed that their household is generating too much food waste (Eurobarometer 2014). This lack of awareness has been reported by several studies, even though with the growing number of awareness campaigns in the past years it can be assumed that awareness for food waste in the household has grown. However, both the REFRESH survey as well as the results from the focus groups show that **awareness of the environmental and moral consequences of food waste does not directly impact the amount of reported household food waste** (van Geffen et al. 2016; van Geffen, van Herpen, and van Trijp 2017).

3. Social norms

Social norms are generally defined as shared rules of conduct that are partly sustained by approval and disapproval of society or relevant social groups. Social norms can be distinguished into injunctive and descriptive norms. Injunctive norms describe what most people approve of doing (Farrow, Grolleau, and Ibanez 2017). They reflect the **extent to which consumers perceive wasting food as a behaviour that is disapproved of by others** who are important to them, like

friends and family. Descriptive norms reflect the **extent to which consumers think others prevent food waste**.

The REFRESH survey showed that **when people think that others waste food, they are more likely to waste more themselves** (and vice versa). The extent to which people think that others disapprove of them wasting food, however, does not significantly affect household food waste.

3.2.2 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 are **time and schedule, technologies and infrastructure** (van Geffen, van Herpen, and van Trijp 2016).

1. Time and dynamic lifestyles

Dynamic lifestyles play a role, as **people often lack time to perform food waste preventing behaviours** and feel pressure to balance conflicting goals both related and unrelated to food. **Planning can become inaccurate by unpredictabilities** such as changing presence of family members, fluctuating appetite of children and unforeseen work or leisure activities. As a result, even motivated and skilled persons may not properly implement food waste preventing behaviours. The REFRESH survey showed that “busy lifestyles” and the prevalence of unforeseen events strongly influences the amount of food waste (van Geffen, van Herpen, and van Trijp 2017).

2. Technologies/storage equipment

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, making it difficult to prolong the shelf-life of products (Canali et al. 2014).

It may also occur that people with **more storage space** may be **likely to stock too many** food products. These effects may cancel each other out, which would account for reported non-significant effects in the REFRESH survey (van Geffen, van Herpen, and van Trijp 2017).

3. Infrastructure: Accessibility of stores and available food supply

The **density and distance of shops** around the household in combination with their opening hours, may influence food waste levels. Households without easy access to stores have been argued to be more likely to waste as they need to buy larger quantities at one time, increasing the likelihood to buy more than needed (Abeliotis et al. 2013). This effect, however, could not be related to the amount of household food waste with the REFRESH survey. What can be shown though is that the **offered supply in stores** matters as well: When people can buy the **quality and quantity** that their household needs at the time they need it, food waste is less (van Geffen, van Herpen, and van Trijp 2017).

Roodhuyzen et al. (2017) adds that **package properties**⁵ (too large, difficult to empty, unsuitable or broken material) **and food properties** (poor quality, perishability, use of pre-cut food) can increase food waste as well.

3.2.3 Ability

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, align their food-related goals, change routines or counter the arguments of peers. A general feeling of having the ability to change behaviour has been examined under the related terms **self-efficacy and perceived behavioural control**. According to the Social Cognitive Theory (Bandura 2002) the belief of personal efficacy belongs to the most central mechanisms of human agency as it reflects the core belief that one has the power to produce desired effects by one's own actions. Stancu, Haugaard, and Lähteenmäki (2016) found perceived behavioural control to have a strong direct effect on self-reported food waste behaviour. In addition to this general feeling of control, other studies have examined specific abilities related to food waste in more detail.

1. Knowledge

Knowledge for example is needed to know **how products are stored correctly**, e.g. if in light and at what temperature. 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. Many products have on-package storage guidelines, but these are often misunderstood by consumers (Plumb and Downing 2013). Studies have also found that consumers tend to **misunderstand the differences between the use-by and best-before date labels** (European Commission 2018).

2. Skills

Next to the correct knowledge, consumers additionally need the skills to integrate this knowledge into their routines and food management behaviours, for example 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.

The REFRESH survey showed that consumers who have good skills to **plan accurately, to cook creatively with leftovers, and who know how to prolong shelf life of products**, have less household food waste. Difficulties in assessing food safety were not related to amount of household food waste (van Geffen, van Herpen, and van Trijp 2017).

⁵ According to (Wilson et al. 2017) consumers are more willing to waste when package size is large.

3.3 Influence of socio-demographics

Additionally to the factors described above, literature points towards several **socio-economic and demographic aspects of consumers** which are associated with certain consumer behaviours and consumers' engagement in preventing food waste. The most influential named in literature appear to be age, household size and composition, gender, education level, and income.

The factors do **not directly cause food waste**, but most likely **influence motivation, ability or opportunity**. They **do not play a causal role but are merely correlated with food waste**. This differentiation is important as many studies do not explicitly distinguish between (assumed) causal factors and merely correlated factors (Roodhuyzen et al. 2017).

The example of the influence of age is described below to emphasize this: The REFRESH survey results as well as REFRESH analysis of data sets using multiple regression models showed that older people report less household food waste than younger people. This is in line with other studies that observed that older age is associated with less food waste (Quested et al. 2013; Stefan et al. 2013). However, other studies have suggested a positive relationship between age and waste (Jörissen, Priefer, and Bräutigam 2015), i.e. more waste with increasing age. Possible explanations for finding a lower level of food waste are related to the fact that older generations are more likely to have experienced food austerity during or after the Second World War, or have had education in cooking and food management (Roodhuyzen et al. 2017; Quested et al. 2013). A negative relationship may be explained by the fact that retired people are more likely to live in small households, which in turn is found to be related to higher food waste (Jörissen, Priefer, and Bräutigam 2015).

This example makes clear that a variety of factors are potentially associated with consumer food waste and that correlated factors do not necessarily play a causal role and shows the need to invest more research in the influencing mechanisms of the underlying causal factors and to understand the multiple routes of influence.⁶

More than measuring correlations between factors and food waste, there is a **need to understand the background behind these correlations**. More explanatory research is urgently needed to avoid addressing correlated but causally irrelevant factors. Policymakers responsible for campaigns and other consumer-focused interventions and experts assisting them should therefore strive to **identify causal**

⁶ Household size can be used to illustrate why socio-economic and demographic factors alone cannot be used to predict household food waste. For example, living in a single household might promote food waste as food packages often cater for multiple consumers (e.g. Jörissen, Priefer, and Bräutigam 2015). However, it might also be possible that singles are more likely to be more often away from home or to have a dynamic lifestyle, thereby increasing the likelihood that food is not consumed in time (see Evans 2012; Roodhuyzen et al. 2017). In this example, both product attributes and personal characteristics play a role and show that household size is only a correlated factor.

evidence when developing, implementing, and evaluating anti-consumer-food-waste interventions (Roodhuyzen et al. 2017; Stöckli, Niklaus, and Dorn 2018).

4 Policy options to influence consumer food waste

4.1 Categories of public policy instruments

There are various ways how policy makers can influence food waste relevant consumer behaviour. One of the most often used categorization of public policy instruments⁷ in general is provided by Vedung (1998). He differentiates between **regulations, economic means, and information**. These three types of instruments are divided based on the authoritative force of government involved in governance efforts (Vedung 1998).

While scholars still refer to these categories for policy instruments, views on policy instruments have nevertheless broadened in recent years due to changing views regarding the role of the government and society in policy implementation (Bouwman et al. 2012, p. 19). They have also been specified according to the policy area described and vary in theoretical perspective and by country (Christopher Hood 2007; Howlett 2005).

In order to optimally describe the policy area of food waste we therefore include two additional categories of policy instruments: **Nudges and organisation of choice architecture** and **voluntary agreements, strategies & guidelines**.

Voluntary agreements belong to the so-called second generation of policy instruments. Instead of directing, the government is often steering and facilitating indirectly or from a distance (van Nispen 2011). Public-private partnerships and covenants also fall under this category. Similarly, strategies and guidelines provide a framework for action, though without being binding.

Public policy makers can modify and direct choices through interventions of the choice architecture or even the built environment⁸, called nudging. **Nudging** is a concept in behavioural science and political theory which proposes to influence behaviour without coercion, and has become a widely known concept since the publication of the book "Nudge: Improving Decisions about Health, Wealth, and Happiness" (Sunstein and Thaler 2008). A nudge makes it more likely that an individual will behave in a particular way, by altering the environment so that automatic cognitive processes are used in favour of the desired outcome. In the area of food and food waste examples refer to altering the **choice architecture** when placing food or food serving plates/trays (e.g. on eye level, sized of plates, availability and characteristics of trays and bins, etc.) but also relate to the density

⁷ Vedung describes public policy instruments as "a set of techniques by which governmental authorities wield their power in attempting to ensure support and effect social change" (Vedung 1998, p. 21).

⁸ For example, Hood (2007) argues that some basic aspects of control and surveillance that include the physical shaping or structuring of the environment (such as street lighting, speed bumps or a software architecture) are not easily classified under the categorization information, regulation and economic incentives. In his own typology set out in his book "The Tools of Government", Hood calls this category "organization".

and accessibility of supermarkets, farmers' markets, availability of food sharing platforms, etc.

The five categories of public policy instruments cannot be strictly separated and have some overlap⁹. We will define the categories and how they can be specified in the field of consumer food waste in the following subchapters.

4.2 Information

Information covers **all attempts by public policy makers to influence people through the transfer of knowledge, education and counselling**. It includes everything based on argumentation and persuasion. Thus, it covers information and awareness campaigns, social norm campaigns, educational efforts and skill training, prompts and labelling, feedback, self commitment and ICT tools as crosscutting category. It is important to understand that this information category covers not only objective and correct knowledge, but also judgements and normative appeals and recommendations about how citizens should act and behave (Vedung 1998, p. 33).

4.2.1 Information and awareness raising campaigns

Public campaigns that intend to increase knowledge and awareness about food waste are one of the most often used tools that government officials use in order to provide knowledge, shape public values, attitudes or behaviours and shift consumption patterns towards more sustainable food practices (Schanes, Dobernig, and Gözet 2018; Vilariño, Franco, and Quarrington 2017). These campaigns include different elements, and the most often used ones include "informational interventions" that aim to increase awareness, knowledge and skills (Stöckli, Niklaus, and Dorn 2018; Osbaldiston and Schott 2012)).

However, research has shown that intervention strategies that only provide information are likely to belong to the least successful, as shown in a meta-analysis of pro-environmental behaviour experiments (Osbaldiston and Schott 2012). So the common assumption that providing information is sufficient to induce behavioural change is not supported by the evidence. A large body of scientific work refutes the simplistic economic, rational view of decision making which is often relied upon (Umpfenbach 2014). Evidence shows that intention is only partly realised in behaviour - the so called "intention-behaviour gap". Results from meta-analyses showed that targeting intention has negligible effects on behaviour (Michie 2009; Stöckli, Niklaus, and Dorn 2018). The provision of more information often reduces consumers' ability to make satisfying choices due to the limited capacity and/or willingness to understand and interpret the available information (Umpfenbach 2014). This finding is also reflected in the REFRESH survey results that show that awareness of consequences of food waste was not found to have a

⁹ For example, prompts (e.g. a sign inviting for second helpings in a canteen) can be interpreted as an informational intervention or a nudge or even be required through regulation (on pack stickers with storage tips). A voluntary agreement can develop a number of business standards e.g. in the retail sector that could also be counted as information, when developed into policy guidelines.

significant influence on food waste levels (van Geffen, van Herpen, and van Trijp 2017).

A small number of reviewed academic studies on informational interventions against consumer food waste show an impact of these informational campaigns on actual food waste. Among them was a study by Young et al. (2018) that showed that an e-newsletter used by a UK retailer resulted in 19% reduction in self-reported food waste in the home. Another (small scale) intervention study (Schmidt 2016) to promote household food waste-prevention was conducted in 217 German households. It consisted of providing action knowledge (e.g. planning grocery shopping in advance), using a public commitment- and a goal setting-technique, so was not a purely informational intervention. It resulted in a 12% perceived (self-reported) reduction in food waste in the home.

Still, informational interventions are commonly recommended within the academic food waste literature, without discussing the evidence that informational interventions are often not sufficient to change behaviour (Stöckli, Niklaus, and Dorn 2018). Even consumers themselves recommend them to fight consumer food waste, as shown in the REFRESH focus groups (van Geffen et al. 2016). It is therefore important to increase efforts to evaluate the effectiveness of interventions (see chapter 6 on evaluation and monitoring). A second consequence is that campaigns should not only build on awareness and information campaigns but also test and use other intervention strategies, as presented in the following.

4.2.2 Social norm campaigns

Campaigns that aim to **influence social norms** exploit the tendency of individuals to conform to the majority, shaping behaviour by giving them information about the behaviour or attitudes of the majority of their reference group (Burchell, Rettie, and Patel 2013). This can be done through **modelling**. Modelling refers to establishing new norms surrounding a behaviour such as food waste, e.g. promoting taking leftovers to lunch at work or a waiter always proactively offering doggy bags in restaurants. It can also **demonstrate a desired target behaviour**, e.g. in a video portraying certain practices (how to peel vegetables efficiently, how to store food etc.) or through **giving comparative feedback**.

People follow social norms **out of needs for belonging and status**. People with weaker bonds to social circles, and those with weaker senses of self are more likely to follow the perceived broad societal norms. This is important to understand when tailoring campaigns to target groups (Umpfenbach 2014).

Various campaigns and interventions that aim to **promote health-related or pro-environmental behaviours** through the use of social norms **showed great success**. For example, Goldstein, Cialdini, and Griskevicius (2008) observed a 44% increase in towel re-use in a hotel among their social norm group compared to a control group when giving participants the information that the majority of people that stayed in this hotel room before did reuse their towels.

Regarding **food waste behaviour**, the REFRESH survey showed that descriptive social norms (i.e., what other people do) have a **big influence on reported food waste levels** (van Geffen, van Herpen, and van Trijp 2017). The often used social marketing technique of warning people by emphasizing the great extent of the

socially undesirable behaviour prevalent in society is therefore likely to have contrary effects by actually making this behaviour seem to be more socially accepted (Burchell et al. 2013). Regarding the development of a campaign, it is therefore important to not only focus on the large amount of food waste occurring in households¹⁰ as this might lead to unintended effects¹¹.

Moreover, Nomura, John, and Cotterill (2011) found that appeals to the collective norm could promote food waste recycling. They tested whether giving people **feedback about the rate of recycling behaviour** in the street they live in compared to others could create a sense of collective identity and thereby could foster recycling behaviour. The idea behind the feedback approach used in their study is that most people over-estimate the amount of undesired behaviours among their peers and then use those estimates of descriptive norms as a standard against which to judge themselves.

Campaigns that employ social norms as a means to change individual behaviour seek to **correct people's misperceptions about the prevalence of the undesired behaviour** (Schultz et al. 2007). This approach should also be applicable to foster the reduction of food waste in general in individual households. A factor to be considered when using this method is the so-called **boomerang effect**, which can lead to an increase of the undesired behaviour, as people who receive feedback that they, for example, consume less energy (or waste less food) than the average tend to increase their consumption (or waste) during the intervention (Schultz et al. 2007). Nomura et al. (2011) avoided the boomerang effect by including an **injunctive norm** (perceptions of what is commonly approved or disapproved within society) by adding a smiley face on the feedback card provided to people who recycled more than the average to encourage and motivate them to continue with that behaviour.

The strong influence of social norms suggests a need to **work with existing social groups or social influencers** that practice and/or support certain desired behaviours, to create new norms or to portray the existence (or transformation) of a social norm. Law also serves as an influential instrument for policy to shift social norms as a major element shaping social practices (Umpfenbach 2014). A relevant topic for future research could be e.g. whether the French decision to prohibit supermarkets to dispose of edible food might have had an influence on social norms.

The various (experimental) demonstrations using social norms motivate the **further testing of social norm interventions** against consumer food waste. Potential applications could be normative appeals in restaurants to take home leftovers, or order smaller portions, testing and influencing consumer acceptance

¹⁰ For example, in 2012 a short campaign produced by the European Commission was running in form of a short video clip (European Union 2012). The video showed various situations in which consumers produced an exaggerated amount of food waste in their households. While this might raise individuals' awareness of the food waste issue in general, it may also set wrong standards to which consumers compare their own behaviour.

¹¹ See also chapter 3.2 about the "backfiring effect" due to negative emotions towards guilt arousal

when products/dishes are sold out (to prevent overstocking), normative appeals in supermarkets to not over-serve guests at dinner parties, etc.

4.2.3 Education/ Skill training

Interventions can aim at increasing people's **abilities and skills** that are necessary to engage in FWP practices. The REFRESH survey showed that 4 practices seem to have a particularly strong influence on food waste: planning of food shopping and use, impulse buying, getting an overview of the food in stock, cooking precisely, and using leftovers (van Geffen, van Herpen, and van Trijp 2017). These practices might therefore be particularly relevant for skill training (tips and tricks on how to plan a meal, skill training how to pro-long self-life and estimate food safety, how to increase inventory overview or cook creatively, use of measurement devices).

To change consumer behaviour **schools can also play an important role**. Of the few examples tested and assessed a 2016 study showed promising results: Changing how schools and students were taught about food waste in a Portuguese school resulted in a 33% waste reduction from main dishes (Liz Martins et al. 2016).

Education interventions can also be set out **via regulation**, be it for schools, university curricula or job training (e.g. curricula for cook's education). Both the Italian food waste law (Law 166/2016)¹² and the French food waste law (Law 2016-138)¹³ include a section on education and campaigns. Article 9 of the Italian so-called "Gadda law" requires food waste education on public media, through ministry activities, and in school and university curricula. It also enables regions and cities to run campaigns about food waste. The French Law (Art 3) amends the education law requiring that food waste education be provided in schools.

4.2.4 Prompts

Another aspect to consider is that Stöckli et al. (2018) found in a review of food waste interventions that **prompts were relatively more effective in changing behaviour compared to informational interventions**. Prompts are verbal or written messages designed to remind people to perform a target behaviour (Osbaldiston and Schott 2012); e.g. small labels on cupboards or fridge that remind the consumer to use up stocks or leftovers, or icons on packaging that remind consumers where to store this product best.

Prompts work best when they are worded politely, when they address an easy to perform behaviour and when they are placed at the location where the behaviour takes place (Stöckli, Niklaus, and Dorn 2018).

¹² Legge No. 166/2016 (2016) Law No 166/2016 on the donation and distribution of food and pharmaceutical products. Gazzetta Ufficiale della Repubblica Italiana. <http://www.gazzettaufficiale.it/eli/id/2016/08/30/16G00179/sg> Accessed 22.03.2018

¹³ Loi No. 2016-138 (2016) LAW n ° 2016-138 of February 11, 2016 relating to the fight against food waste. Journal officiel de la République française. <https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000032036289&categorieLien=id> Accessed 22.03.2018

Academic examinations of prompts against consumer food waste so far are limited to those in public spaces. Two examples are illustrated in Stöckli, Niklaus, and Dorn (2018): One includes a field experiment testing a print message ('All Taste No Waste - Eat What You Take, Don't Waste Food') addressing students in a university dining facility, that showed 15% reduction in food waste (Whitehair, Shanklin, and Brannon 2013). A second field experiment by Kallbekken and Sælen (2013) placed a sign at a buffet encouraging restaurant guests to help themselves more than once ('Welcome back! Again! And again! Visit our buffet many times. That's better than taking a lot once.') showed 20% reduction in food waste. Both examples seem to be effective, though more testing is needed.

4.2.5 Feedback

Feedback refers to providing information about the frequency and/or consequences of a target behaviour, in this case the amount of food wasted. Feedback can be individual (e.g. a printed sheet of one weeks food waste amount per household) or done in comparison to others (see subchapter on social norm campaigns). Using feedback mechanisms is known from the energy sector through smartmeters. First experiments to use this concept through "smart bins" or a "grumpy bin" taking pictures of the food thrown away **showed mixed results and no lasting effect** (Stöckli, Niklaus, and Dorn 2018). Feedback can also be given including rewards (praise or special privileges) or penalties (negative consequences for a target behaviour, e.g., financial penalties).

4.2.6 Commitment

In general, commitment is giving a pledge to change behaviour, asking people to agree to perform a target behaviour. Signing pledges or promise cards increases the likelihood of a person performing the behaviour to which they have committed and can be linked back to people's desire to behave, and appear to behave, consistently. There have been some examples¹⁴ in the form of an online pledge to reduce food waste, though yet without an evaluation (Stöckli, Niklaus, and Dorn 2018). General literature from pro-environmental behaviour change experiments suggest that **commitment is an intervention type with moderate effectiveness, though still higher than informational interventions** (Osbaldiston and Schott, 2012). General consumer behaviour literature also suggests that **commitment works best when public (e.g. pledges posted online), specific, and when people are already motivated to perform the target behaviour** (Stöckli, Niklaus, and Dorn 2018).

4.2.7 Crosscutting: Apps and ICT tools

A special case for information instruments are **apps**: These are partly also used in public campaigns (e.g. providing recipes for leftover food, providing information about food discounts). Apps can target motivation, opportunities, and ability. Their effectiveness is still not well analyzed. A literature review and selected testing in focus groups within REFRESH showed that there is little evidence about the

¹⁴ by the NGO "feedback" and as part of the Australian "FoodWise" campaign

effectivity of apps. It showed that many lack **user-friendliness**, which was key to the users involved. **Incentives for positive behaviours** and an **added value in everyday life** (e.g. apps provided by retailers about discounted items that almost reach their 'Best before date', apps to order food/takeaway meals from local stores that would otherwise go to waste) were a clear success factor for the apps analysed (Vogels et al. 2018).

Apps can also be a tool for gamification, which is a promoting strategy for behavioural change according to (Hamari et al. 2014).

Other ICT applications that have been tested, though with no robust evidence about their success are **fridge cameras, smart bins** or **bin cameras** (Ganglbauer et al. 2013). The FridgeCam aims to improve supply and location knowledge by means of taking photos from the fridge interior and making them electronically available to household members through an app (Ganglbauer et al. 2013). The BinCam takes pictures of items thrown away and makes them visible to the BinCam community on Facebook. A gamification element of increasing (or decreasing) gold bars (depending on one's behaviour) constitutes rewards and penalties. Evaluation results of the BinCam are mixed and show that that motivational effects can be achieved but that these effects do not necessarily persist over time (Farr-Wharton et al. 2014; Comber and Thieme 2013).

4.3 Regulation

According to Vedung, regulations are "measures undertaken by governmental units to influence people by means of formulated rules and directives" (Vedung, 1998, p. 31). The relationship between government and addressees is authoritative, meaning the addressees are obligated to act in the way stated by the government.

With regard to food waste, regulation offers the opportunity to influence consumer food waste behaviour through regulation on **date marking, requirements for packaging, or prohibition for certain practices** (e.g. potential bans on "Buy one get one free" promotions) as well as regulation on **consumer education** (see chapter 4.2.3).

4.3.1 Regulation on date marking

Date labelling influences the selection of food at the point of purchase and its subsequent consumption and decision of what to eat or throw away. Measures on date marking and potential changes are currently discussed by the EU Commission and the EU Platform on Food Losses and Food Waste/Subgroup on Date Marking - including regulatory and non-regulatory measures.

Changes to existing requirements are under consideration after the Commission study on date marking practices. The study published in 2018 showed that there are significant differences among Member States in the use of "use by" and "best before" date marks and that date marking is used differently by food business operators and control authorities (European Commission 2018). Particularly in cases where food labels used "use by" on foods that should be labelled with "best before" (yoghurts etc.) this leads to consumer confusion and possibly more food waste.

Regulatory initiatives under discussion are a potential change of the EU Regulation No 1169/2011 on the provision of food information to consumers, e.g. with regard to an extension of the **list of foods included in Annex X which are not required to bear a "best before" date**. Other possible regulatory initiatives include

- Improvement of **format, presentation and terminology of date marking** rules to better differentiate "use by" from "best before" concepts and facilitate consumer understanding and potential modification of format for "best before" dates for foods with shelf life of more than 3 months.
- Proposition of mandatory **graphical/visual presentation highlighting the different meaning** of "Best Before" and "Use By" signs

Possible non-regulatory initiatives discussed by the Commission with regard to date marking include:

- scientific and technical guidance to ensure more consistent date marking practices;
- inter-sectoral cooperation to reduce food waste generation linked to date marking in the food supply chain;
- an EU Action Plan on communication activities for date marking¹⁵.

4.3.2 Promotions, product presentation and packaging

Some activities by food retailers contribute to consumer food waste. These include promotions that encourage overbuying (e.g. buy-one-get-one (BOGO) offers) (UK House of Lords 2014) lack of offer or lack of visibility of products packaged in appropriate portions (van Geffen et al. 2017), and lack of offer or lack of visibility of products from surplus food. It is possible to address these issues through voluntary agreements (see chapter 4.6) or directly regulate these activities. Options include banning **BOGOF promotions**, mandating the inclusion of self-serve/**bulk store sections** instead of sale in pre-packaged portions, or mandating **shelf space for surplus food products**.

Another possibility is to integrate mandatory requirements *or* voluntary agreements about these interventions in **zoning** and spatial planning for (super-) markets. Here, nudging approaches to increase healthy food consumption¹⁶ offer sources of inspiration and lessons learned.

¹⁵ Information according to Shungham EU Issue Tracker, information retrieved: October 5, 2018, <https://signedin.euissuetracker.com/Pages/default.aspx>

¹⁶ Especially in the United States, initiatives in a number of cities have been implemented that amend zoning and spatial planning to require the inclusion of supermarkets and stores with space for fresh produce in new developments, or to offer financial incentives for their inclusion (subsidies or tax breaks). The goal of these initiatives is to increase the availability of healthy food in urban environments. The initiatives have shown mixed results. The FRESH programme in New York City showed a positive impact on healthy eating behaviour among residents near developments which included markets with fresh produce (NYCEDC 2015).

4.3.3 Influencing consumer behaviour through regulation targeted towards other actors

Besides regulation that is directly relevant to consumer behaviour and food waste on consumer level such as date marking there are also other areas for regulation that do not directly target consumers but can indirectly reduce consumer food waste and/or which depend on changed consumer behaviour. This includes the following 5 options¹⁷:

1. Relaxing marketing standards

In interviews with food industry stakeholders, marketing standards about size, colour, shape etc. of fruits and vegetables were highlighted as the main source of food waste for fresh produce (Göbel et al. 2015). Evidence on the amounts of waste and savings potential associated with marketing standards is difficult to quantify and mostly anecdotal (Parfitt, Barthel, and Macnaughton 2010).

Marketing standards can also lead to product rejection (Aschemann-Witzel et al. 2015). Where fresh produce is sold by unit and not weight, **consumers are less likely to choose smaller/misshapen produce** because it's less value for money (Halloran et al. 2014).

Calls for relaxation or reduction of marketing standards have been a central feature of past anti-food waste activities and campaigns. In fact, these activities were already successful. EU regulatory marketing standards already have been reduced – however, producers continue to operate with them (Göbel et al 2015).

However, according to Göbel et al. (2015), it is not (only) the marketing standard regulations that are the issue, but **retailers' own internal standards and the belief and experience that consumers will not buy cosmetically irregular produce** (Göbel et al. 2015). Voluntary agreements to relax internal standards and further encouraging consumers to purchase irregular produce may therefore be an even more efficient approach.

Relaxing marketing standards does not contribute to a reduction on consumer food waste. However, it is an intervention that may reduce food waste in the value chain (as cosmetically less optimal would also be sold and e.g. not be ploughed back into the soil) and depends on consumers and their acceptance.

2. Increasing availability of new products from surplus food

One barrier to consumption of products made from surplus food and secondary resources is low supply due to the administrative burden of **bringing novel food products to market** (e.g. soda from coffee cherries or products made from insects fed on food waste). Since 2018 the new Novel Foods Regulation (Regulation (EU) 2015/2283) addresses this problem to some degree. Applications are now processed centrally for the whole EU, and are granted for a food product and not

¹⁷ A sixth option - though not explained here in further detail – could be relaxing of donation policies, as long as these help to keep food in the food value chain. Food donation policies have in all case only an indirect impact on consumer food waste.

to a single producer of the product. The process for proving the safety of traditional food products from third countries is also simplified. Safety assessments are carried out by the EFSA, and there are now timeline requirements for the application procedure to give more clarity and efficiency about the timeline for applicants. This reduces the **administrative burden and associated cost** with putting a novel food on the market. This is likely to increase the supply of novel products made from surplus food, which is the first step to increasing their consumption.

Similarly to relaxing marketing standards this instrument does not contribute to a reduction on consumer food waste but may reduce food waste in the value chain or move it higher up the food hierarchy and depends on consumers and their acceptance.

3. Prohibition for supermarkets to waste edible food

A ban for supermarkets to throw away edible food has been intensively debated in the media after France established The National Pact against Food Waste in 2016, outlining several measures to achieve a food waste reduction of 50% by 2025 (Mourad 2015) including a ban¹⁸ for grocery stores from throwing away edible food. An evaluation of the effectiveness of this measure has not (yet) been carried out. However, even though it was a regulatory measure it is possible that this step as well as the media attention surrounding it has influenced social norms around food waste. It does not help though to reduce food waste on consumer directly but is a measure with indirect effects on consumers (availability of discounted food, which may however have a shorter shelf life etc.).

4. Requirements within public procurement regulation

The set-up of (green) public procurement rules, for food provision in e.g. hospitals, school, and public canteens, can be influenced by public policy and thereby reduce food waste.

Through **progressive public procurement rules**, public bodies and governments can **act as powerful role model** (as well as stimulating other parties). They can set standards that for example relate to **size portions, staff training¹⁹ or availability of dishes during daytime** – all having an impact on food waste and providing consumers with the opportunity to reduce food waste.

On EU level, it is now expected that the development of non-binding Green Public Procurement (GPP) criteria for food and catering services is completed towards the

¹⁸ Loi No. 2016-138 (2016) LAW n ° 2016-138 of February 11, 2016 relating to the fight against food waste. Journal officiel de la République française. <https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000032036289&categorieLien=id> Accessed 22.03.2018

¹⁹ Also, issues like influencing the curricula for e.g. cooks' education and putting food waste on this agenda are options for Member States to pursue. This may improve e.g. the abilities of chefs to use create tasty dishes using all parts of a food product, even those that are so far often still discarded. This may reduce food waste in the value chain, and is related to consumer acceptance.

end of 2018. The Commission's Communication on Green Public Procurement (GPP) sets voluntary criteria for the **basis of voluntary EU-wide targets**²⁰.

5. Regulation about waste collection and recycling

Waste regulation, requirements for separate waste collection, potentially combined with fees ("pay as you throw")²¹ and recycling of (organic waste) has an influence on how much consumers waste and what happens to consumer food waste.

Collection schemes for food waste can be mandated as part of waste management regulations. Regulation can also mandate the provision of bins and bags to consumers, as this increases participation in separate food waste collection (Gibbs and Hogg 2008). Requirements on separate collection bins facilitate the recycling of food waste, and hence have an indirect impact on consumer food waste.

There is also some evidence that the act of waste collection could increase awareness of food waste, and increased awareness leads to lower food waste. However, the literature is not conclusive on this. There is some evidence that this effect may occur at least in the short term in the context of behaviour change experiments, but in the long-term and in everyday situations there is not yet conclusive evidence (WRAP 2011).

4.4 Economic Instruments

Economic instruments do not oblige addressees to take the measures involved. Instead, they choose by themselves whether to take action or not. However, economic instruments such as fees, taxes or subsidies make it cheaper or more expensive in terms of money, time, effort, and other resources to pursue certain actions (Vedung, 1998). Economic instruments in general are a **tool to shift consumption patterns** towards more sustainable food practices (Reisch et al. 2013; Schanes, Dobernig, and Gözet 2018).

However, only few public approaches are known in which **fees and taxes** are used to reduce food waste (e.g. **incentives for donating food** in Italy, **penalties for supermarkets** wasting food in France) and research about their impact is lacking (Shanes, Dobernig, and Gözet 2018). In the private sector examples are known where restaurants **charge consumers for leftovers**. Making waste more expensive – e.g. through **Pay-as-you-throw schemes** that charge households for personally generated waste – is another option. Evaluations from the United States, Sweden, Canada, Japan, Taiwan, Korea, Thailand, Vietnam and China, where this scheme is used show that this is an effective measure to reduce food waste (Chalak et al. 2016; Schanes, Dobernig, and Gözet 2018).

Providing financial resources for research projects can also be considered as an economic instrument. Overall, the **price of food** and its share in household income plays a role for food waste behaviour in general. Results of the REFRESH focus groups illustrated that in Germany for example, low prices for food in relation to

²⁰ In cooperation with Member States the Communication sets the minimum levels required and provides legal guidance to Member States.

²¹ See (Wunder et al. 2018) for a discussion how waste regulation can effect food waste.

income are seen as a reason for overconsumption and food waste. At the same time a large body of research²² has illustrated that if the real cost of natural resource use and the costs of food waste for the society is reflected in prices (i.e. **internalize external costs**), food prices would need to grow. This would in turn provide economic incentives for food waste prevention.

However, as behavioural research has shown, consumers do not act according to models of economic rationality, and economic motivations are only one factor that influence consumer decisions (see chapter 3.1). There therefore may not be a direct, proportional relationship between increasing the economic costs of food waste for consumers and a reduction in waste, particularly not if economic instruments only have a minor effect on prices.

4.5 Nudges and organization of choice architecture

The **modification of choice architecture** - also called “nudging” - in selecting, processing and disposing (food) waste can be used as a strategy by business and public policy makers to reduce food waste. **Nudging** is a concept in behavioural science and political theory which proposes to influence behaviour without coercion (Sunstein and Thaler 2008). It **uses automatic cognitive processes** (“mental shortcuts”) in favour of the desired outcome, i.e. they are “gently pushing” consumers in the favoured direction without forcing them. This strategy is therefore not working through regulation, economic instruments or information and forms a separate category of policy instruments.

Nudges are a response to the so called “intention-behaviour gap”, described in chapter 4.2.1 and the limitations of awareness raising campaigns and result from behavioural economics as they work without influence on intentions but rather with “automatic” changes in behaviour. The insights about the “mental shortcuts” people use without knowing it to make complex choices are relevant because they can explain **biases in people’s decisions**, and show ways in which the framing of a choice influences decision outcomes and why people often do not behave rationally. The most important **biases in decision-making** with regard to food waste are the following (Umpfenbach 2014):

- **Habits and routines:** Most of our behaviours are habits, including many with significant environmental impacts: travel, food, heating and water use. They are less susceptible to ‘rational’ change. This implies that policy to change habitual behaviours needs to consider the strength of habits, the difficulty to establish new ones and break existing ones. Establishment of new habits might include helping people who intentionally want to break the habit, e.g. through information prompts (Umpfenbach 2014). Also, Russell et al. 2017 highlights the strong influence of habits in food waste behaviours and identifies them as fruitful targets in interventions and campaigns. A good timing for intervention is when people change contexts (job, home, family) as habits are then reformed.
- **Salience of information:** The extent to which information is at the front of someone’s mind and the relative importance given to it, matters for

²² For a recent compilation of all relevant studies see (TEEBAgriFood 2018).

decision making. It varies greatly between pieces of information and can be influenced by timing and presentation. This is important to consider with all on-pack information that is intended to reduce food waste.

- **Complexity** can lead consumers to avoid making a decision (and so stick with current practices). This means that too much choice or information overwhelms consumers and can lead to less satisfying choices.
- Consumers place greater value on the immediate future and heavily **discount future costs or savings**. This bias explains why e.g. future environmental costs or personal costs, are not a regular consideration when wasting food.

In the **area of food** examples for nudges refer to altering the choice architecture when placing food (e.g. on eye level, size of plates and trays) but also relate to the availability of waste collection and separation, the density and the accessibility of (super-) markets and food sharing platforms, etc.

Within the domain of **consumer food waste** the application of nudges has just started (Stöckli, Niklaus, and Dorn 2018). Nudges such as changes to **plate type and size as well as portion size have led to reduced food waste** (Kallbekken and Sælen 2013; Williamson, Block, and Keller 2016).

Learnings from healthy food nudges can be used for decisions about **placing surplus food products in more visible and salient places** (Reisch and Zhao 2017). The availability of **smaller size/compartments of shopping carts** may help as big carts “invite” to buy more than needed.

Nudging can be particularly powerful to reduce out-of home food waste and is therefore relevant for canteens, caterers, restaurants etc. As public policy makers also shape the food **procurement** of hospitals, schools, prisons etc. nudging is an important element to be considered.

4.6 Voluntary agreements, strategies and guidelines

As shown in chapter 4.1 the often used categorization of policy instruments into information, regulation and economic instruments has been challenged by some as it undervalues the role of public policy makers within voluntary approaches that should be considered as a separate category (C. Hood 2007; van Nispen 2011).

Particularly within the area of food waste, collaboration across the supply chain to achieve beneficial change can play a big role. The starting point is that interactions across the food supply chain are generally based on contracts, not on cooperation, and food waste prevention is rarely considered in such contracts. Addressing this requires a different approach, and voluntary cooperation may be one option for doing so. A large part of the REFRESH project has focused on facilitating²³ and analysing voluntary agreements (Burgos et al. 2019; Piras et al. 2018; Osoro and

²³ As part of the project REFRESH has set up so called “National Platforms” against food waste in the Netherlands, Germany, Hungary and Spain to facilitate and promote voluntary agreements against food waste. For more information see www.eu-refresh.org

Bygrave 2016). Voluntary agreements include self-regulations, developed by the industry and/or other stakeholders to implement or complement public policies.

Voluntary agreements may be created by businesses without an external stimulus (for example, Codes of Practice developed by trade associations to raise the standards of their members), but they can also be created in order to respond to developments in policy. For example, in the UK the Courtauld Commitment (originally set up as a voluntary agreement between WRAP and the UK retail sector in 2005) was created in response to the UK Government's 2002 strategy document 'Waste Not, Want Not' (UK Government 2002), which called for a focus on waste prevention by the retail sector in order to help the UK achieve new targets arising from the EU Landfill Directive (1999/31/EC).

The role that governments can play in helping voluntary agreements/alliances to succeed is an issue of current interest to many countries. In October 2016 the REFRESH project published the report 'Inventory and Evaluation of Effectiveness of existing approaches to voluntary alliances' (REFRESH 2016). This summarised the different approaches taken in various existing voluntary alliances focused on food waste across Europe, evaluated their effectiveness, and identified the success factors underlying those that worked best. The report states that **'one of the main success factors is having government backing, including but not limited to financial support.** (...) In fact a lack of political backing and involvement was mentioned by several lead organisations as a factor hindering the success of the alliance.' It also states that **government involvement in the setting up process can be critical.** In some cases government holds the evidence for action, it often **has the power to bring organisations together**, it can provide impartial support and guidance, and it has the power to introduce new policy when evidence suggests it might be beneficial. It can also provide real motivation by imposing new, **normative regulation if no voluntary action is taken, or if the voluntary approach is not successful.**²⁴

A similarly non-binding approach is the **development of guidelines** and the **development of strategies** (within a sector or region). These are also often (but not always) developed within a multi stakeholder approach, can have implications for consumer food waste, and provide a framework for action. Examples include the EU guidelines for food donation.²⁵ Even school dietary guidelines can influence food waste levels. Two examples from the US; where dietary guidelines were changed to increase healthy eating and more consumption of fruit and vegetables resulted in a 28% (Schwartz et al. 2015) and 14.5% (Cohen et al. 2014) vegetable waste reduction.

Many of the aforementioned issues that cannot be directly influenced by consumers but essentially affect consumers (availability of surplus products, relaxed marketing standards, on pack information, requirements for high diversity in bread shelves,

²⁴ See also [Wunder et al. 2018 \(p.91ff\)](#) for a discussion on Voluntary Agreements as part of the REFRESH EU Policy screening.

²⁵ Commission Notice: EU guidelines on food donation (2017/C 361/01)

reduction/ban on BOGOF promotions, food donation) can therefore be subject for agreements between actors in the food supply chain.

4.7 Combination of measures

The review of policy instruments examined the potential of various policy measures designed to influence household behaviour directly or indirectly. Overall, the international evidence suggests that **food waste prevention benefits will be derived from a combination of measures** (Cox et al. 2010).

Which policy instrument is actually used very much depends on an analysis of challenges and opportunities in the specific regional context and can mix different instruments (in parallel or in subsequent steps). For example, if it turns out that in a given country date marking is confusing because “use by” marking is frequently used on a product that should be better labelled with a “best before” mark and if that confusion significantly contributes to waste, then one could choose different types of measures. The portfolio may include education campaigns on how to interpret date labelling, or school trainings on how to use senses to detect if a food product is still good to eat. In parallel, policy makers may also want to negotiate for a voluntary agreement with the relevant actors, aiming for a change of date marking. If this is not successful, a change of regulations might be considered.

5 Overview of public campaigns

In the following section, we will give an overview of already existing public campaigns within the field of consumer food waste prevention in Europe to illustrate the diversity of what national policies already do to reduce consumer food waste.

Table 2 includes information about the name and regional coverage of the campaign, the institution responsible for execution, the sponsoring body as well as the campaign’s objectives, concept, and methods/interventions, and the target groups. We include only those with relevance for consumer behaviour, as some of the campaigns have a broader approach. It also shows if the campaign assessed food waste reductions on consumer level.

Beyond the core target to reduce food waste, the review shows that most campaigns aim to do this through **raising awareness** of the topic of food waste and by **providing knowledge** and information about what individuals can do to minimize waste in their own households.

While they have **similar objectives**, the specific actions they take vary. Most of the big public campaigns have **created websites as their main tool of communication. These provide information and facts** about food waste as well as **planning and cooking tips** to actively reduce individual food waste. **They also use different messages**, e.g. cost reduction potential for saved food and positive impacts for the environment.

The majority of the campaigns mentioned aim to educate consumers about possibilities to reduce food waste by **storing** food properly, **using leftovers creatively** and **planning their shopping**. They are mostly targeted at the **broad**

population. Few campaigns focus on specific target groups. Only some assess actual food waste reductions.

The 14 campaigns reviewed here are **acting on a national level**, with the exception of UNEP's Think.Eat.Save as the key global campaign and TRiFOCAL's campaign Small Change Big Difference that takes place in London and can build on over a decade's learnings on UK food waste prevention initiatives.

It needs to be noted though that the overview is neither complete, nor can it provide up to date information for all of the presented campaigns that are under dynamic further development. It is rather intended to highlight what many campaigns have in common and where they are different.

There is an **increasing amount of regional and urban examples for public food waste reduction campaigns** and interventions. Particularly, since the Milan Urban Food Policy Pact (including four recommended actions against food waste²⁶) was launched during the Expo in 2015, the number of cities that have become active against food waste is ever growing²⁷. Also, examples from the retail and hospitality sector are not listed here, even though some of the (informational) interventions can also provide interesting learnings for policy makers.

²⁶ Including recommended action number 35 "Raise awareness of food loss and waste through targeted events and campaigns; identify focal points such as educational institutions, community markets, company shops and other solidarity or circular economy initiative".

²⁷ As of October 2018, 178 cities have signed the MUFPP, representing a total of 450 million citizens (see Website of the MUFPP, <http://www.milanurbanfoodpolicypact.org/>, last access: October 19, 2018)

Table 2: Main Public Campaigns

Campaign	Location	Period	Responsible Institution/Sponsoring Body	Objectives	Concept, Methods, Interventions	Assessment undertaken
Love Food Hate Waste	UK	Launched in 2007; ongoing	WRAP	<p>Raise awareness</p> <p>Help consumers take action: providing information and skills</p> <p>Community engagement</p>	<p>Website</p> <p>Poster campaign</p> <p>Local events and activities</p> <p>Cooking classes</p> <p>Cooperation with celebrities and chefs</p> <p>Guides for businesses</p> <p>Recipe and storage tips</p> <p>Social media</p> <p>Newsletter</p>	Yes (Assessment since 2007)

Campaign	Location	Period	Responsible Institution/Sponsoring Body	Objectives	Concept, Methods, Interventions	Assessment undertaken
Stop Spild af Mad (Stop Wasting Food)	Denmark	Launched in 2008; ongoing	Stop Spild af Mad – non-profit consumer movement collaboration with government and retailers	Raise awareness	<ul style="list-style-type: none"> Educational campaigns in schools Food donation and other events Support from celebrities and public figures Online knowledge centre Cooperation with supply chain actors Certification label for food service sector Doggy bag campaign Cookbook Articles in popular media Social media 	Yes (assessment over 6 years)

Campaign	Location	Period	Responsible Institution/Sponsoring Body	Objectives	Concept, Methods, Interventions	Assessment undertaken
Zu gut für die Tonne (engl: Too Good For the Bin)	Germany	Launched in 2012; ongoing	Federal Ministry of Food and Agriculture Germany (BMEL)	<ul style="list-style-type: none"> Raise awareness Help consumers take action: providing information and skills Support innovative business models 	<ul style="list-style-type: none"> Website App that provides tips on shopping, storage and recycling of food Education in schools Events and Days of Action Yearly Federal Award/Contest Newsletter Brochures and print material Leftover box campaign Cooperation with supply chain actors 	Monitoring of public outreach ²⁸
Lebensmittel sind Kostbar (Food is Precious)	Austria	Launched in 2012; ongoing	Ministry of Sustainability and Tourism	<ul style="list-style-type: none"> Raise awareness Support innovative business practices 	<ul style="list-style-type: none"> Website Posters Education in schools Annual Award (until 2016) Collaboration with supply chain actors (voluntary agreement) 	Partly – assessment of food waste reduction among voluntary agreement members ²⁹

²⁸ Critical review of monitoring gaps in the preparation and implementation of the campaign by the German Federal Court of Auditors (Bundesrechnungshof 2016)

²⁹ https://www.bmnt.gv.at/land/lebensmittel/kostbare_lebensmittel/Bericht-Lebensmittelpakt.html

Campaign	Location	Period	Responsible Institution/Sponsoring Body	Objectives	Concept, Methods, Interventions	Assessment undertaken
Think.Eat.Save	Global	Launched in 2013; ongoing	United Nations Environment Programme (UNEP), Food and Agriculture Organization (FAO), Save Food Initiative	Raise awareness Provide knowledge and information	Website, resource portal Tips for storage, planning, eating habits Student challenge	No (partly monitoring of outreach)
Ça suffit le gâchis! (engl: "Enough of the waste")	France	Since 2014; ongoing	L'ADEME (Agence de l'environnement et de la maîtrise de l'énergie), Ministère de l'environnement	Awareness raising Information and education	Website Posters Education in schools TV-Spots and Videos	No

Campaign	Location	Period	Responsible Institution/Sponsoring Body	Objectives	Concept, Methods, Interventions	Assessment undertaken
Small Change Big Difference	UK, London	2016 - 2019	Part of the TRiFOCAL project, led by WRAP, LWARB, Groundwork London Funded by the EU LIFE programme	Changing and improving planning, shopping, storage and meal preparation behaviours, Promotion of healthy and sustainable eating by changing purchasing and preparation practices Recycling of unavoidable food waste	Website Posters Media coverage incl. social media Localized activities/events Collaboration with chefs Two key target groups: young "aspirational discoverers" and spontaneous creatives	Yes (results available in 2019)

Campaign	Location	Period	Responsible Institution/ Sponsoring Body	Objectives	Concept, Methods, Interventions	Assessment undertaken
Wasteless	Hungary	2016 - 2020	National Food Chain Safety Office of Hungary Funded by EU LIFE programme	Raising awareness Collecting good practices	Website Social media Interviews in TV and radio Short videos Magazine articles Best practice guides for catering, retail, processing, and communities School educational material School pupil contest Target groups: youth, general public, businesses	Assessment of online and print media outreach (e.g. video views)
"Más alimento, menos desperdicio" (More food, less waste)	Spain	Launched in 2013 (initially until 2016, now until 2020)	Ministerio de Agricultura, Alimentación y Medio Ambiente	Raise awareness Enable action Enable cooperation	Social media Events Three food waste reduction weeks Monthly newsletter Publication of best practice guides Collaboration/ network building	Yes (for 2014-2016)

Campaign	Location	Period	Responsible Institution/Sponsoring Body	Objectives	Concept, Methods, Interventions	Assessment undertaken
Together against food waste	Luxembourg	Launched in 2016, ongoing	Ministry of Agriculture, Viticulture and Consumer Protection (MAVPC)	Raising awareness Knowledge and skills for behaviour change	<ul style="list-style-type: none"> Various events and action weeks Collaboration with restaurants Media campaign explaining expiry dates Education for children Booklet that provides practical advice regarding shopping, food preservation, leftover use, expiry dates Solidarity pact among municipalities Television programmes 	<ul style="list-style-type: none"> Assessments undertaken for some individual actions (e.g. for awareness raising weeks) Municipalities in the solidarity pact are invited to monitor locally
Samen tegen Voedselverspilling (engl. "United against food waste")	The Netherlands	Launched in 2018	<ul style="list-style-type: none"> Taskforce Circular Economy (Dutch national platform of REFRESH) Funded by Dutch Ministry of Agriculture 	<ul style="list-style-type: none"> Awareness raising about sustainable food choices Facilitating behaviour change 	<ul style="list-style-type: none"> Website Social Media Voluntary agreement Pilots, e.g. supermarket aisle with surplus products Video Tips for buying, preparing and storing food 	No

Campaign	Location	Period	Responsible Institution/Sponsoring Body	Objectives	Concept, Methods, Interventions	Assessment undertaken
Stop Food Waste	Ireland	Since 2009	Funded under the EPA National Waste Prevention Programme and managed by The Clean Technology Centre.	Providing support to communities Knowledge and skills for behaviour change	Website Support of local initiatives Tips for planning, shopping, storage and reuse Newsletter Social Media Public Commitment (Charter) Video Brochures and print material Promoting home composting	No
Stop food waste ("Stoppa Matsvinnet")	Sweden	2013 - 2015	Swedish Food Administration, the Swedish Environmental Protection Agency and the Swedish Board of Agriculture	Awareness raising Cooperation in the supply chain	Website Competition Waste saving tips	No

Campaign	Location	Period	Responsible Institution/Sponsoring Body	Objectives	Concept, Methods, Interventions	Assessment undertaken
No Waste	Belgium	2018- Ongoing	OVAM (public waste agency) together with private actors F.E.E. and waste management company Recupel	Awareness raising Knowledge and skills for behaviour change	Website Videos Quiz Magazine Blog Collaboration with well-known bloggers Tips for preparation and storage (focus: fridge) Coaching via Email	No

6 Evaluating impact of interventions

Though there have been many interventions, including campaigns addressing consumer food waste, there are only very few studies that have evaluated to what extent these activities actually reduced or prevented food waste. A recent review by Reynolds et al. (in press) identified only 17 applied interventions³⁰ that claim to have achieved food waste reductions. Of these, 13 quantified food waste reductions (Reynolds et al. in press). Also Stöckli et al. (2018) recently synthesized practical and academic evidence on anti-consumer-food-waste interventions. Their review shows that informational interventions are the most commonly used intervention type even though evidence indicates that this intervention type is relatively ineffective.

Both reviews conclude that there is a lack of research surrounding food waste reduction interventions and a lack of evidence that would allow to draw conclusions about the effectiveness, transferability and scaling up of interventions. This is worrying as researchers as well as policy makers continue to propose, fund and implement approaches to reduce food waste, although there is hardly any reproducible quantified evidence to assure success or long-term effectiveness. Also the few examples follow different assessment methodologies, so their results are not comparable.

Future research and resources are needed to test and evaluate interventions with accurate measurement methods. In doing so many aspects need to be considered. Some that are often mentioned in literature are the following:

1. Set objectives and indicators for monitoring

To monitor the impact of an intervention, it is necessary to set specific objectives and key performance indicators prior to starting the campaign in order to be able to measure results and success. In their best practice guidance on waste reduction campaigns WRAP distinguishes between 'input objectives', such as created opportunities for target population to be exposed to the messages or the amount of leaflets and materials that are to be distributed, and 'outcome objectives' that describe the change that should happen as a result of the campaign, such as an increased awareness among participants about the campaigns' goals or residents' satisfaction with waste collection services before and after the campaign (WRAP 2010, 2013b). Finally, 'impact objectives' specify the ultimate desired results of the campaign, such as a specified reduced amount of food waste in the target area. Monitoring those three objectives helps to keep track of the effort put into the communications, which helps to evaluate the campaign's progress, to detect what changes happen as a direct result of the inputs and how effective the campaign has been in achieving the desired aims.

³⁰ The areas of study for the seventeen applied downstream food waste reduction interventions are focused on households and the community (n=6), hospitality and hotels (n=5), and educational establishments (n=6) (Reynolds et al. in press).

2. Interventions should be evaluated in a systematic manner using comparable methods

That is, by using a framework with standardized definitions and measurement methods (Stöckli, Niklaus, and Dorn 2018). This starts with the definition of waste (e.g. avoidable versus unavoidable food waste, scope: waste that is not ending up in the bin but disposed in the sink, or out-of-home) but also includes how figures are presented (relative to total food production, relative to total food waste etc.) (Roodhuyzen et al. 2017). Also, Sharp et al. (2010a) and Cox et al. (2010) came to the conclusion that there are various limitations to the available data used in campaign evaluation, such as unspecific definition of concepts, differences in the wording of questions and sometimes no differentiation between recycling and actually reducing waste, so that a comparison between the different interventions' outcomes is not possible. The ongoing development of a "Food waste prevention actions assessment framework" by the EU Commission's Joint Research Centre (JRC) can be an important contribution to improve evaluation efforts. It was started in 2018. Meanwhile the JRC has collected and analysed over 80 descriptions of actions from practitioners all over Europe through questionnaires and conducted a literature review. The examples include research projects, public campaigns, initiatives by retailers and others. After discussions with members of the EU's Food Loss and Waste Platform, the assessment framework is likely to be finalized in early 2019.

Also, the REFRESH methodological framework and survey design to understand consumer food waste behaviour could build a useful foundation for future surveys and has already been successfully applied in five EU countries (van Geffen, van Herpen, and van Trijp 2017). The survey methodology allows the identification of the types of food wasted, and what motivations, opportunities, and abilities support or hinder food waste prevention. A preliminary survey could be conducted among the target audience of an intervention to provide input for the design phase and a baselining. After the intervention, the survey could be repeated to see if any changes to food waste levels, types, and/or motivations, opportunities, and abilities can be observed. To use the methodology for evaluating interventions, it would be important to add elements to the survey methodology that allow to accurately identify causalities between changes and the intervention.

3. Measuring Food Waste

Often campaigns are compared according to the assumed reduction of food waste. However, the methods with which these effects have been calculated differ strongly in their reliability, and therefore need to be carefully chosen and communicated and can often not be compared directly. Many assessments rely on self-reported measurements, either survey-based, or using a diary or feedback sheets. Others use visual analysis or pictures. Some do weight-based waste measurements. The methods mentioned above all have different advantages and disadvantages, as was recently analysed by van Herpen et al. (2016), who aimed to scientifically develop and validate a practical measurement approach for the amount of in-home food waste within the REFRESH project. The diary method, for example, was seen as quite effortful and can only be conducted with rather small samples. Also, keeping a daily diary on food waste raises participants' awareness of the amount they waste and might therefore already lead to a change in behaviour. Self-report surveys are

easy to distribute across larger samples, but might not be as objective and valid, since they draw on people's memory which might lead them to give biased or more socially accepted estimates. Using photographic coding, kitchen caddies, and appropriately designed surveys showed promise as useful ways to measure food waste for small scale assessments – methodologies are provided in (van Herpen et al. 2016)

4. Identification of short-term and long-term effects

Most interventions that were evaluated assessed the effectiveness once and within a short time interval. The long-term effects are therefore not known. General intervention research suggests that many interventions lead to behavioural change in the short term, but are unable to establish change in the long term. It is therefore important to collect follow-up data (Stöckli, Niklaus, and Dorn 2018).

5. Consideration of competing influences and secondary effects

Another methodological problem is that it is in most cases very difficult to distinguish between the effect of a campaign as a whole and the effects of single interventions (Stöckli, Niklaus, and Dorn 2018). Similarly, it is also difficult to distinguish between the impact of a campaign and parallel influences in the society (e.g. increase of costs for food). For example, during a food waste prevention campaign aimed at London households in 2012/2013, a 15% reduction in household food waste could be reported, building on a waste compositional analysis. However, the authors noted that some of this reduction could have been the result of the research itself and the participating in a detailed survey (WRAP 2013a).

Also, in the evaluation of the "Love Food Hate Waste" campaign WRAP identified that avoidable food waste in the UK has been cut by 21% between the campaign's launch in 2007 and the evaluation in 2012. However, a follow-up study in 2015 showed no significant changes in the amount of household food waste between 2012 and 2015. WRAP argues that this might be due to food deflation and an increase in earnings since 2014 that might have reduced the incentive for individuals to avoid wasting food (WRAP 2017).

While it will remain to be difficult to isolate the effect of different interventions through the evaluation methodology, it may help to run experimental trials of single interventions in order to isolate impacts of certain campaign elements. In parallel this step can also be used for pretesting messages with representative samples of the target audience to be sure they are appropriate and effective, before scaling up in a bigger campaign.

6. Understanding causal mechanisms and unintended consequences

As discussed in chapter 3.3, many studies identify determinants for food waste (gender, age etc.) that are not causal but rather correlative. This leads to wrong conclusions about the real causal mechanisms that are responsible for food waste. Using and further developing theories as a conceptual foundation to public interventions is therefore crucial. Understanding causal mechanisms of consumer behaviour also helps to identify unintended side effects, such as "rebound effects", that may offset beneficial effects of food waste reduction. Rebound effects occur if

the money saved for buying food is e.g. invested in environmentally harmful activities such as flights. Unintended consequences can also mean that food waste reduction data can be flawed, if not seen in the overall context of consumption and waste behaviour. For example, if a school campaign measures less food waste for vegetables after a health campaign, this can be due to shifts in the types of foods consumed and wasted.

7. Understanding cost effectiveness and synergies to other food related goals

So far there is no discussion or data yet available about the cost-effectivity of interventions. This will be an important area for future research. In doing so the evaluation should include the assessment of other benefits or tradeoffs (e.g. healthy diets, social interactions, job creation etc., see chapter 7.2.3).

Further aspects and steps that are of relevance for the future assessment of food waste interventions are provided by Reynolds et al. as well as Stöckli et al. (2018).

7 Conclusions for improved policy responses

7.1 Improving public campaigns

The chapters above show that there is already a good understanding about consumer behaviour and the combined influence of motivation, opportunity, and ability. Only if all three factors are addressed in parallel, are policy interventions likely to have an impact. We also see that interventions should specifically address food waste practices. Needed skills and opportunities though differ between planning, shopping, storing, preparing and finally consuming but also differ per target group. Policy makers can influence them with a wide range of policy instruments, which differ in their efficiency, though little data is available from past interventions to specify this. First insights suggest that the most widely used interventions to address consumer behaviour are awareness and information campaigns, though these not the most effective. Building on these insights we can draw the following conclusions to improve public campaigns to reduce consumer food waste.

7.1.1 Understanding national particularities and key leverages

To tailor interventions it is necessary to first assess the particularities of the specific region or country, i.e. to **measure food waste** and **analyse** what is wasted in which part of the food chain, through which household **food management practices** most consumer food waste is created, and what **motivations, opportunities, and abilities** contribute to wasting or waste prevention behaviour. The share of consumer food waste in the overall amount of food waste will differ between countries, as well as the products wasted most: While analysis in the UK for example identified that a large part of food waste is toast (which resulted in some specific actions in the campaign "Love Food Hate Waste"), the REFRESH research in Hungary for example showed that soup made up a considerable share

of waste (van Geffen, van Herpen, and van Trijp 2017). Policymakers should investigate the current status of the motivations, opportunities, and abilities that support or prevent consumers in avoiding food waste, to identify effective starting points for interventions.

7.1.2 Identify target groups, key messages and information channels

Consumers differ in their waste behaviour and need **to be addressed differently in terms of key messages and channels**³¹. Segmenting the audience into meaningful subgroups and using a message design approach that directly addresses this target group is therefore helpful. The messages should be **adapted to the motivations relevant for the segment**. As described in chapter 3.2.1, motivation is built around attitude, problem awareness and social norms.

While there is little research on particular motivations to reduce food waste, research has found that pro-environmental behaviours correlate with stronger intrinsic values linked to the well-being of others, and that environmental concerns are rarely the primary driver for behaviours (Natural Scotland 2013). It might therefore be more effective to foster food waste prevention behaviour by appealing to potentially **stronger drivers for action like social justice, health, or children's wellbeing** (Umpfenbach 2014). Consumers also don't just decide on functional need but use consumption to make statements about themselves (e.g. buying innovative surplus products). The **impact of different narratives** and key messages **should be tested** in future intervention designs. The frequently used narrative that food waste reduction saves money might therefore work for some target groups (particularly those with little money) but might even have the opposite effect on individuals who prides themselves on having the financial means not to care about small expenditures.

People's values and attitudes towards food waste behaviour also matters because people often are inclined to **reject information when accepting it would challenge their values** and social identities (so called "selective exposure") (Borgstede and Andersson 2010). Insights into how people deal with information and how they use "mental shortcuts" and deal with complexity (see chapter 4.5 on nudging) lead to the conclusion that **too much information overwhelms consumers** and can lead to less satisfying choices. Rather, information should be tailored to **provide knowledge and skills to change particular food waste behaviours**, ideally **at the point of decision**.

Further, the often-overlooked weakness of providing information on specific food-waste-preventing behaviours is that some consumers do not perceive the information to be relevant because they already perform the behaviour. One way to optimize the influence of recommendations is by tailoring information to the consumer so they **receive information that addresses routines and behaviours that they do not yet or not yet sufficiently perform** (Stöckli, Niklaus, and Dorn 2018; Schmidt 2016).

³¹ For example print, social media, auditory, video, personal contacts and events. Building on the insights of social norms, a strategy can also be built around addressing influencers and "change agents", that will then reach out to a wider community.

Messages should be framed in a positive way. The attempt to change people's attitudes towards food waste through evoking **negative emotion and blaming consumers might have the opposite effect** on their behaviours, as was shown by Russell et al. (2017) and (Birau and Faure 2018).

Consumers also need to be convinced that they are able to change their behaviour, as evidenced in prior research showing that consumers' **perceived behavioural control** affects household food waste (Stancu, Haugaard, and Lähteenmäki 2016). It is thus important that public campaigns foster the idea of "self efficacy", i.e. that consumers are able to make a difference and can change their behaviour.

7.1.3 Social norm campaigns

Many public campaigns aim to improve consumer awareness about negative consequences of wasting food. However, research suggests that **informational interventions that increase awareness might be the least effective** (Stöckli, Niklaus, and Dorn 2018; Osbaldiston and Schott 2012). In fact, there is an **intention-behaviour gap**.

A more **promising campaign strategy could be the use of social norms**. Social norm campaigns have been successful in changing sustainable behaviour in other areas (Goldstein, Cialdini, and Griskevicius 2008). Especially campaigns **emphasizing the positive behaviour of others** have shown success, whereas emphasizing what people should do has typically been less influential in changing behaviour. In this respect, it is important to realize that campaigns that emphasize the high amount of food waste generated by households may actually backfire, as these suggest that food waste is "normal" behaviour that others also perform, thereby justifying the behaviour (see above). The fact that the quantity of household food waste is rather private, and people cannot really compare their food waste behavior might provide a chance for social norm campaigns, as –different to other behaviours that are visible in the public – efforts will be needed to **set a social norm, rather than change a social norm**.

7.1.4 Improving ability

In order to **address consumer abilities** to reduce food waste, education-based interventions are a useful measure to improve skills and knowledge of consumers. **Knowledge** is e.g. needed to know **how products are stored correctly**, and to understand **the differences between the use-by and best-before date labels** (European Commission 2018). The REFRESH survey showed that consumers who have good **skills to plan accurately, cook creatively with leftovers, and who know how to prolong shelf life of products have less household food waste** (van Geffen, van Herpen, and van Trijp 2017). Improving skills and providing instructions has been shown to be successful when used in isolation, but **more effective when used in combination with other interventions, such as commitment and prompts** (Schmidt et al., 2016; Osbaldiston & Schott, 2012).

7.1.5 Monitoring and Evaluation

Though there have been many interventions and campaigns addressing consumer food waste, there are only very few studies that have evaluated to what extent these activities actually reduced or prevented food waste. The few that are available follow different assessment methodologies, so their results are not comparable.

Future interventions should include monitoring, ideally based on a standardised framework (see chapter 6). Analysis should be done as part of the interventions to draw conclusions about efficiency and cost-effectiveness

7.2 Integrated policies to reduce consumer food waste

7.2.1 Collaboration with retail and hospitality

This report focuses on the question how policy makers can influence consumer food waste. Chapter 7.1 shows how public campaigns - the most frequently used intervention to address consumer food waste - can be improved. It is important to realize though, that even if consumer food waste is often at the center of interventions and media attention, food waste reduction needs to be addressed **all along the supply chain**, starting from primary production.

Other actors in the food chain, particularly **retail and hospitality** have significant **influence on consumer behaviour** and therefore also need to be involved in public strategies addressing consumer food waste. **Examples** of interventions that are implemented by retail and hospitality but still have an impact on consumer behaviour include: the availability of surplus products in supermarkets, relaxed marketing standards (to allow e.g. "wonky vegetables"), the availability of smaller packages in stores, requirements for high diversity in bread shelves during all opening hours, on pack information about date marking, limiting BOGOF (buy one get one free) promotions, requirements for food donation, or availability of smaller portions and "doggy bags" in restaurants (see chapter 4.3.3 and 4.6).

7.2.2 System perspective on food behaviour to increase synergies

Reducing food waste is an important international objective and for that reason also a central part of the global sustainable development agenda. However, the generation of food waste is not the only problem in the current global food system, nor is the only problem that is related to food and consumers.

Food systems are closely linked with **health impacts**, with 1.5 billion people being **overweight** (WHO 2017) and 795 million people **undernourished** globally (FAO 2015). In Europe, and many other countries with "western diets" **consumption of meat and other animal proteins is above a healthy level** and causes significant health impacts.

Consumer demand is also connected with **ecosystem health and the agricultural production system**: According to UNEP (2016) global food systems are estimated to be responsible for a third of degraded soils, a quarter of greenhouse gas emissions and 60% of terrestrial biodiversity loss, as well as the exploitation or overexploitation of around 91% of commercial fish populations. The

concentration on only a few crops (FAO estimates that only 30 crops provide 95% of human food energy (FAO 2016)) in the global food systems also makes the food system less resilient to climate change and other challenges.

Many argue that the magnitude of the food waste problem is to a large degree a **symptom of a dysfunctional food system**. Policies against food waste therefore also need to look for synergies to achieve a more general **shift towards a more sustainable and resilient food system**. A similar call for a more integrated perspective on food policies that combines environmental protection, health aspects, sustainable agriculture and rural livelihoods can also be made with regard to **consumer behaviour policies**. In chapter 3.1 we show that food waste is a “collateral damage” resulting from conflicting objectives and priorities.

It is therefore important to consider these aspects early in the planning of interventions and policies in order to reduce existing conflict of targets, increase synergies and **improve overall coherence of policy interventions**. Below we illustrate some of the interventions and topics where policy makers need to consider conflicting objectives or can build on synergies with other policy areas.

1. Health

Conflicts between health objectives and food waste occur because of the pressure to “**eat up**” food to avoid food waste on the one hand and the attempt to reduce overconsumption (with negative health impacts) that would rather suggest people should not eat up when they are full on the other hand. Therefore, attention must be given to adapt portion size/allow buffet style menu options or reuse leftovers/use doggy bags. Other examples with tradeoffs include **convenience food** that often comes in single portions (therefore avoiding food waste) but is often the less healthy and highly processed option or storing fruits and vegetables in suboptimal conditions (e.g. not in the fridge) to allow **easy access to healthy food** (e.g. for kids). Synergies between health and food waste reduction include **improved skills for (creative) cooking**.

2. Environment and resource efficiency

Shelf life of perishable products can often be increased by **packaging**. Yet, packaging – particularly single use plastic wrapping – increases (plastic) waste and is therefore a clear trade off. Alternatives could be multi-use packaging and (biodegradable/compostable) packaging based on renewable resources.

3. Regional food production and consumption

Supporting regional food supply has benefits for the environment as it supports **closed nutrient cycles**. Shorter distances also support **reduced food losses during transport**. Surplus and food waste can be easier reused within compost and biogas facilities. Regional food systems (or “city region food systems”) also enable consumers to get spatially **(re)connected to food production**. This plays a role as many argue that the large levels of food waste can partly be attributed to people’s lost connection with food, becoming an abundant commodity.

4. Sales

Sales and advertisement play a very significant role in stimulating consumption levels as a whole by fostering values and norms of consumerism. The force of sales, if measured by expenditures, by far outweighs any likely action by government or civil society organizations (Umpfenbach 2014). A means to influence behaviours would thus be to restrict advertisement and sales promotions (e.g. with regard to BOGOF offers). However, this has proven to be politically difficult, even for smoking and advertisement of unhealthy foods for children. More effective and feasible policy may be to shape corporate culture and sales initiatives so that food waste preventing behaviours become a desirable social attribute (e.g. buying wonky vegetables, surplus products etc.), e.g. through voluntary commitments or ethical guidelines.

Recent research shows that consumers' attitudes towards food products are diminished when they waste unused food (van Herpen and De Hooge 2018). Companies generally want to ensure that consumers have a positive attitude towards their products, and this insight could thus stimulate industry to take measures that ensure that their consumers will not waste their products.

5. Price and social inequality

The availability and pricing of products are very strong factors in influencing behaviours. Increases in income or decreases in prices will always provide strong drivers for greater consumption and may affect food waste. Current food prices do not reflect the **external costs of food production** and consumption with regard to negative environmental, animal welfare and health impacts. Many therefore argue that food must internalize these costs. This however would come with challenges for those that are already **socially disadvantaged** and/or below the poverty line. These persons would face difficulties to pay higher food prices.

6. Time availability

A key challenge to overcome food waste behaviours is the **perceived lack of time to consider alternatives** or **acquire the skills necessary** for a new, more sustainable practice (Jörissen et al. 2015). In other cases it is simply the **lack of time to prepare food or use leftovers**, even if skills and motivation are there. Increased availability of time therefore influences food waste reducing actions. **Time availability can be influenced by policy makers**, e.g. by supporting part time working models, encouraging norms of reduced working hours, parental leave and childcare, and longer statutory vacation times.

Most research on time policies suggest that less working hours will lower environmental impacts, because of reduced consumption and changes in leisure activities (Reisch 2015)³². Direct implications on food waste generation have however not yet been assessed. If additional time is actually used for food waste

³² There is a difference regarding gender to be considered, where men tend to use more out-of-work time for leisure whereas women tend to do more housework (Reisch 2015).

prevention activities depends on the motivation and ability of consumers. In addition, researchers see a set of social benefits if additional income is swapped for increased leisure time, e.g. more time spent in family and community activities.

This overview shows how important it is to have an integrated perspective on food behaviour and to see where synergies to other policy areas can be exploited. This leads to greater policy coherence.³³ Interventions that target behaviour in a multi-faceted way addressing multiple objectives may even be more cost effective. Similarly, intervention designers should better exploit synergies and learn from related areas of research such as health and waste reduction as well as the general behaviour change literature.

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³³ See for an overview of tradeoffs between EU policy areas with direct relevance for food waste.

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