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Directorate C - Industry

PREPARATORY STUDY ON FOOD WASTE ACROSS EU 27

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umweltbundesamt

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EXECUTIVE SUMMARY

Addressing a lack of information about food waste in Europe

Food waste is composed of raw or cooked food materials and includes food loss before, during or after meal preparation in the household, as well as food discarded in the process of manufacturing, distribution, retail and food service activities. It comprises materials such as vegetable peelings, meat trimmings, and spoiled or excess ingredients or prepared food as well as bones, carcasses and organs.

Although it constitutes a large proportion of bio-waste, no overall view of the situation of food waste in the European Union had been available. More information on the issue was necessary to determine the scale of the problem and to identify appropriate measures that could be taken. This study aims at providing this information to the European Commission.

Objectives and methodology of this study

Covering the many facets of the problematic at European level, the objectives of this study were to:

- Identify the key causes of food waste in all sectors
- Establish a baseline of food waste data for the EU27
- Quantify the environmental impacts of food across its lifecycle
- Inventory existing food waste prevention measures
- Forecast food waste generation levels over fifteen years (2006-2020)
- Develop policy recommendations for prevention and analyse their impacts

A stakeholder consultation was launched to solicit input from stakeholders on food waste data, prevention measures and policy options. The methodologies for elaborating the study objectives are outlined below.

Four sectors were addressed in each task: Manufacturing, Wholesale/Retail, Food Service and Households. Although Agricultural food waste was not within the scope of the study, there may be important causes and quantities of food waste to tackle in this sector through further research.

A multitude of causes for food waste, predominantly sector specific

The study demonstrates the diversity of causes of food waste, within each of the four sectors investigated. Causes in the Manufacturing, Wholesale/Retail and Food Service sectors are expected to be similar across Europe and will vary according to product specificities. Causes of household food waste identified are predominantly based on UK research, and while they provide a guideline for Europe, this will vary more than other sectors as a result of cultural practices, climate, diet, and socio-economic factors (average size of household, household income, frequency of eating out etc). The UK Waste and Resources Action Programme (WRAP), which leads UK investigations on food waste, recommends conducting Member State level research on causes so that awareness campaigns and other policy measures can be effectively targeted.

Key causes for each sector are outlined below.

Manufacturing sector

- Food waste at this level is **largely unavoidable** (bones, carcasses and certain organs in meat products for example)
- **Technical malfunctions** such as overproduction, misshapen products, product and packaging damage

Household sector

Food waste from meal preparation, leftovers, and purchased food not used in time comprise food waste in the household sector. Causes for this waste involve:

- Lack of **awareness** of (1) the quantity of food waste generated individually, (2) the environmental problem that food waste presents, and (3) the financial benefits of using purchased food more efficiently
- Lack of **knowledge** on how to use food efficiently, e.g. making the most of leftovers, cooking with available ingredients
- **Attitudes**: food undervalued by consumers, lack of necessity to use it efficiently
- **Preferences**: many (often nutritious) parts of food are discarded due to personal taste: apple skins, potato skins, bread crusts for example
- **Planning issues**: 'buying too much' and 'lack of shopping planning' frequently cited as causes of household food waste
- **Labelling issues:** misinterpretation or confusion over date labels is widely recognised as contributing to household food waste generation, leading to the discard of still edible food
- **Storage:** suboptimal storage conditions lead to food waste throughout the supply chain, including in the Household sector
- **Packaging issues:** packaging methods and materials can impact the longevity of food products
- **Portion sizes:** includes issues such as "making too much food" hence leading to uneaten leftovers as well as purchasing the correct portions of food; individually sized portions can minimise food waste but often create additional packaging waste
- **Socio-economic factors**: single person households and young people generate more food waste

Wholesale/Retail sector

- **Supply chain inefficiencies:** better coordination between retailers, distributors, wholesalers and manufacturers can reduce food waste and avoid it being shifted across the supply chain
- **Stock management**: difficulties anticipating demand resulting in overstocking; lack of incentive for higher accuracy in stock management due to take-back provisions in contracts with suppliers and low cost of discarding food

- **Marketing strategies**: two for one deals can shift potential food waste to consumers by encouraging them to purchase more than needed – discounting of excess stock and food near expiry is preferable
- **Marketing standards**: aesthetic issues or packaging defects cause some products to be rejected, although neither food quality or safety is affected
- **High product specificity:** particular issues affect the longevity of specific food products (exposure to light increases in-store food wastage for example)
- **Temperature sensitivity:** meat and dairy products are particularly vulnerable to temperature changes during transportation and storage, risking premature spoilage and impacting food safety

Food Service sector

- **Portion sizes**: the one size fits all approach to food service is a major cause of food waste. Self-service in cafeterias (consumers eat 92% of food they serve themselves) and a choice of portion size in restaurants can redress this.
- **Logistics:** difficulty anticipating number of clients leads to overstocking – increased reliance on reservations can help
- **Attitudes:** the practice of taking leftovers home from restaurants is not universally accepted across Europe (France for example) – strong potential to reduce restaurant food waste
- **Awareness** of food waste as an issue is currently low but rising with environmental awareness as a whole
- **Preferences**: school cafeterias have particular difficulty meeting preferences of schoolchildren – work to improve quality would reinforce signals to schoolchildren about the value of food

Around 90 million tonnes of food waste are generated in the EU each year

The principle source of data on food waste generation was EUROSTAT, which provides data for Manufacturing, Household and 'Other Sectors' for all MS with few exceptions. An estimate of food waste for these three sectors is presented by MS using both EUROSTAT and available national data. The base year is presented as 2006, the year for which the most recent EUROSTAT data is available.

On this basis, the study estimates annual food waste generation in the EU27 at approximately 89Mt, or 179kg per capita (please see below table).

Total Food Waste Generation in EU MS: Best estimate by Member State

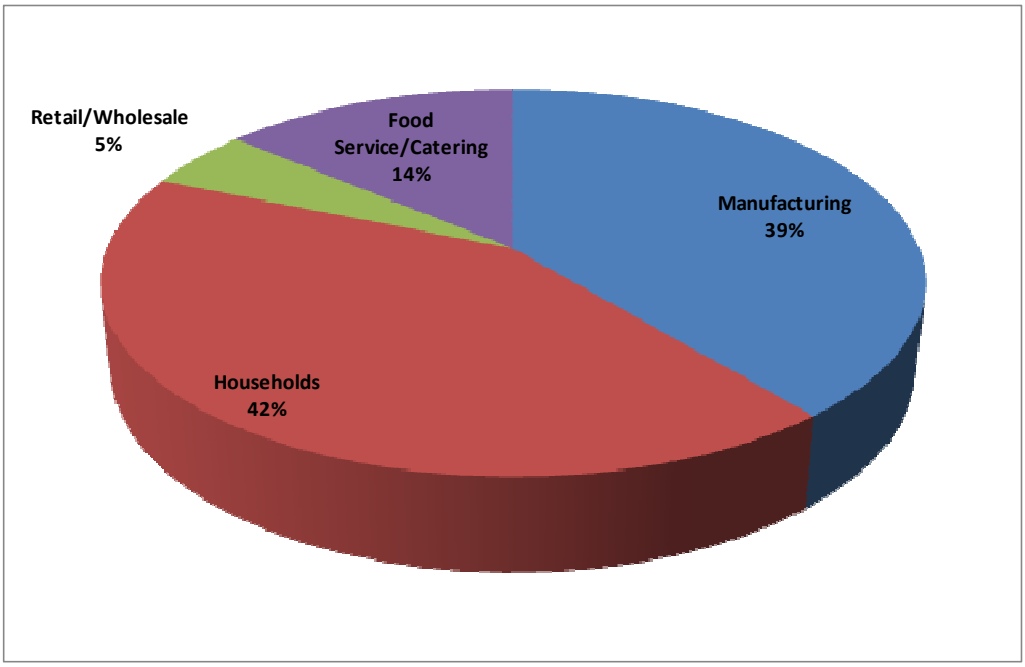
	Manufacturing	Households	Other sectors	Total
EU27	34 755 711	37 701 761	16 820 000	89 277 472
Austria	570 544	784 570	502 000	1 858 000
Belgium	2 311 847	934 760	945 000	4 192 000
Bulgaria	358 687	288 315	27 000	674 000
Cyprus	186 917	47 819	21 000	256 000
Czech Republic	361 813	254 124	113 000	729 000
Denmark	101 646	494 914	45 000	642 000
Estonia	237 257	82 236	36 000	355 000
Finland	590 442	214 796	208 000	1 013 000
France	626 000	6 322 944	2 129 000	9 078 000
Germany	1 848 881	7 676 471	862 000	10 387 000
Greece	73 081	412 758	2 000	488 000
Hungary	1 157 419	394 952	306 000	1 858 000
Ireland	465 945	292 326	293 000	1 051 000
Italy	5 662 838	2 706 793	408 000	8 778 000
Latvia	125 635	78 983	11 000	216 000
Lithuania	222 205	111 160	248 000	581 000
Luxembourg	2 665	62 538	31 000	97 000
Malta	271	22 115	3 000	25 000
Netherlands	6 412 330	1 837 599	1 206 000	9 456 000
Poland	6 566 060	2 049 844	356 000	8 972 000
Portugal	632 395	385 063	374 000	1 391 000
Romania	487 751	696 794	1 089 000	2 274 000
Slovakia	347 773	135 854	105 000	589 000
Slovenia	42 072	72 481	65 000	179 000
Spain	2 170 910	2 136 551	3 388 000	7 696 000
Sweden	601 327	905 000	547 000	2 053 000
United Kingdom	2 591 000	8 300 000	3 500 000	14 391 000

Source: 2006 EUROSTAT data (EWC_09_NOT_093), Various national sources

Certain national studies covered retail and food service sector food waste, providing more detail than EUROSTAT's 'Other Sectors'. A further estimate of food waste was then made, breaking down food waste by Manufacturing, Household, Retail and Food Service sector data. This approximate percentage breakdown is presented below, and more detail can be found on page 63 of the report. Please bear in mind that agricultural food waste was not included in the scope of this study.

This breakdown is not intended to draw a comparison between household and manufacturing sector data, as the reliability of estimates for certain sectors differs. A cross-sector comparison would be more instructive when data available for all sectors is considered more robust.

Percentage breakdown of EU27 food waste arisings by Manufacturing, Households, Wholesale/Retail, and Food Service/Catering sectors (best estimate)



Source: 2006 EUROSTAT data (EWC_09_NOT_093), Various national sources

Households produce the largest fraction of EU food waste among the four sectors considered, at about 42% of the total or about 38Mt, an average of about 76kg per capita.

Manufacturing food waste was estimated at almost 35 Mt per year in the EU27 (70kg per capita), although a lack of clarity over the definition of food waste (particularly as distinct from by-products) among MS makes this estimate fragile.

Once again, the main estimate of this study relies more heavily on EUROSTAT data to estimate manufacturing, household and 'other sector' food waste. A further estimate on the breakdown between retail and food service sector food waste (in place of 'other sectors') relies more heavily on extrapolations, at times from a limited number of sources. According to this further estimate, the following sectoral detail can be presented:

- Wholesale/Retail sector: close to 8kg per capita (with an important discrepancy between MS) representing around 4.4 Mt for the EU27
- Food Service sector: an average of 25kg per capita for EU27, at 12.3 Mt for the EU27 overall. There is a notable divergence between the EU15 at 28kg per capita (due to a higher trend of food waste in the restaurant and catering sector) and 12kg per capita in EU12.

Food which ends up as being discarded by households represents 25% of food purchased (by weight), according to studies completed by WRAP. For the UK, the avoidable portion of this food waste represents a total annual loss per household of approximately £480 or 565 Euros[1].

Important limitations accompany this work of quantification, resulting from the variable reliability of EUROSTAT and national data. Methodologies for collecting and calculating the food waste data submitted to EUROSTAT differs between MS, who are free to choose their own methodology. Limitations in the reliability of EUROSTAT data, due to a lack of clarity on

[1] WRAP (2009) *Household Food and Drink Waste in the UK*

the definition and methodology, may be significant. Implications may involve the inclusion of by-products, green waste or tobacco in the data disclosed in some instances. Additionally, data is missing for some sectors in some MS, and the 'Other Sectors' category is too broad to give a clear insight into the Wholesale/Retail and Food Service sectors. It was not possible to confirm that by-products were not included in some instances in Manufacturing sector data. These issues have been ameliorated using national studies, plausibility checks and informed assumptions as far as possible in an effort to present the best available data; however, these limitations nevertheless present an important issue for data reliability. Food waste data is synthesised in table on page 12 for each MS in manufacturing, household and 'other sectors'; please see table 12 on page 62 of the main report for the sources or assumptions used.

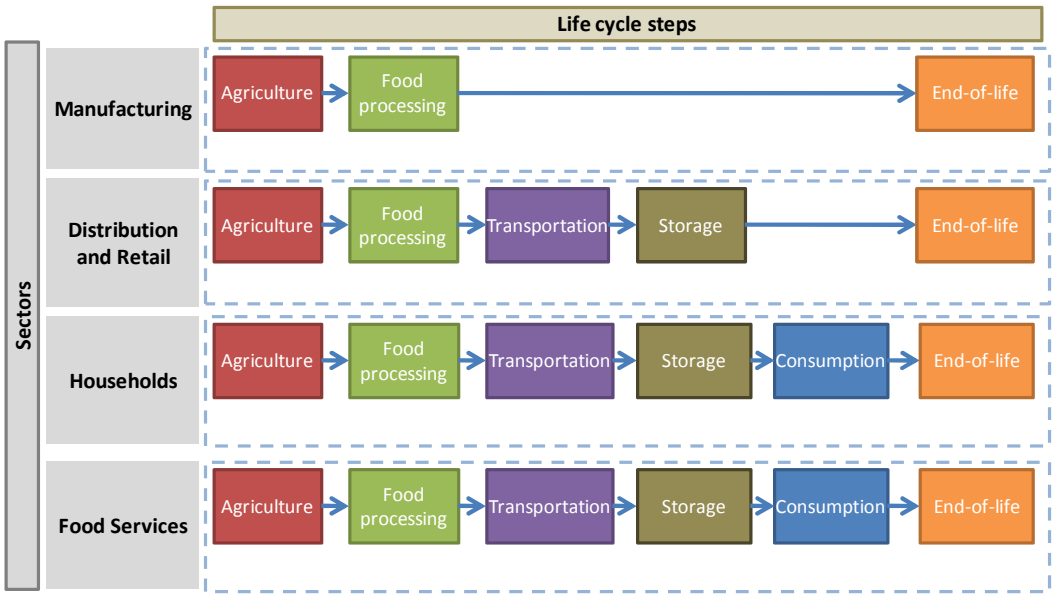
Food waste generates about 170 Mt of CO2 eq. in the EU each year

In order to assess all the environmental benefits of food waste reduction initiatives, one must consider not only the fact that food waste treatment is reduced but that the food processing and other upstream steps of the life cycle are avoided too. For that reason, the environmental impacts of the life cycle of food waste were quantified, not only those linked to the treatment of food waste but also those generated during the other steps of the life cycle before they become waste.

A life cycle approach was used. Without carrying out new life cycle analysis (LCA), the approach focused on identifying available research and extracting data from which extrapolations could be made using the findings of this study.

The results are presented for each of the four sectors considered in this study. The system boundaries for each of them are summarised in the figure below. It should be noted that while agricultural food waste is outside of the scope of this study, the environmental impacts of agriculture in the food supply chain were nevertheless taken into account when assessing the life cycle environmental impacts of food waste generated by the four relevant sectors (see diagram below).

Life cycle steps considered for each sector



The environmental impacts calculated using the selected data are summarised below (only GHG emissions are mentioned here as it is the only environmental indicator, among the four presented in this study, which is quantified in all the studies analysed).

Greenhouse gas emissions of food waste by sector

	Waste amounts in EU27	Greenhouse gases emissions	
	t/yr (rounded figures)	t CO_2 eq./t of food waste	Mt CO_2 eq./yr in EU27
Sector	a	b	a x b / 10^6
Manufacturing	34 756 000	1.71	59
Households	37 703 000	2.07	78
Others	16 820 000	1.94	33
Total	**89 279 000**	**1.9**	**170**

Source: calculated based on EUROSTAT data, national sources and ETC/SCP working paper 1/2009

An average of at least 1.9t CO_2 eq./t of food wasted is estimated to be emitted in Europe during the whole life cycle of food waste. At European level, the overall environmental impact is at least 170 Mt of CO_2 eq. emitted per year (close to the total greenhouse gas emissions of Romania or of the Netherlands in 2008, and approximately 3% of total EU27 emissions in 2008[2]). This figure includes all steps of the life cycle of food waste, namely agricultural steps, food processing, transportation, storage, consumption steps and end-of-life impacts.

Considering the performance of respective sectors, the Household sector presents the most significant impact, both per tonne of food waste (2.07 t CO_2 eq./t) and at the European level (78 Mt CO_2 eq./yr), at 45% of estimated annual GHG emissions caused by food waste. Food waste generated in the Manufacturing sector is responsible for approximately 35% of annual GHG emissions.

Limitations of these estimations relate to the reliability of the food waste quantities calculated earlier in the study, as well as to the nature of environmental data available in existing studies: no data was available about the specific food products which constitute food waste for instance. Only environmental data about the food sector in general (production, consumption) in Europe were available and thus used.

Wide range of food waste prevention initiatives – recently established, diffuse and mostly small scale

Measures to prevent food waste in the EU were identified principally through a literature review, with some valuable contributions from stakeholders provided via questionnaire. Over one hundred initiatives were inventoried.

Typology of initiatives:

- ➔ awareness campaigns (of which WRAP's Love Food Hate Waste is the key example)
- ➔ informational tools (e.g. sector specific prevention guidelines and handbooks)

[2] EUROSTAT

- training programmes (e.g. food service staff prevention skills, waste-free cooking workshops for consumers)
- logistical improvements (e.g. stock management improvements for retailers, reservation requirements for cafeterias, ordering flexibility in hospitals)
- waste measurement activity (e.g. hands-on quantification and composition analysis of food waste by households, restaurants or schools)
- research programmes (development of new sector/product specific prevention methodologies, such as Time Temperature Indicators)
- regulatory measures (such as separate collection of food waste requirements in Ireland)
- food redistribution programmes (diverting otherwise discarded food to charitable groups)
- development of industrial uses - turning food waste into by-products for other purposes (only one example identified – the production of fish chips from manufacturing sector fish waste, although other examples are likely to be available)

Quantitative results were difficult to attain, because measurement of impact had often not been carried out, particularly at local level. Many initiatives had been recently launched and had not yet been measured, underlining the early stage of development of food waste prevention activity.

Research showed the usefulness of a concerted approach, as currently used in the UK and in development in Austria. Initiatives demonstrate important pockets of interest in the issue throughout the EU, although awareness is currently at a preliminary level, suggesting the usefulness of best practice and resource sharing at the EU level.

Food waste is expected to rise to about 126 Mt by 2020 without additional prevention policy or activities

Using the previous findings of the study, EUROSTAT projections and via a literature review, the impacts of the following factors on food waste from the baseline year 2006 to 2020 were considered:

- population growth
- disposable income
- possible policy impacts
- existing prevention initiatives

Impacts of population and disposable income

Based on anticipated EU population growth and increasing affluence only, food waste is expected to rise to about 126 Mt in 2020 from about 89 Mt in 2006. Through the literature review and using EUROSTAT statistical trends, the assumption is made here that, with an increase in disposable income, there is an associated increase in food waste generation. The methodology incorporates growth in food waste for EU12 and EU15 that progresses at different rates.

Impacts of prevention activity

Earlier findings of this study, namely that the majority of initiatives are very recent and very few have measured results, result in a profound difficulty in accurately forecasting their

future impacts. On this basis, no impact due to food waste prevention initiatives has been applied to the data in the forecasting.

Environmental impacts

The above forecast would result in an additional 70Mt of carbon dioxide equivalent emitted in 2020 as a result of food waste, an additional 40%. This brings the estimate of annual food waste related emissions to about 240Mt in 2020.

Policy and other issues

It should be noted that policies to divert food waste from landfill will not tackle the bigger issue of food waste generation. The impact of waste policy, such as the waste prevention specifications of the revised Waste Framework Directive, the Landfill Directive, and the Communication on future steps in bio-waste management in the European Union, on food waste is considered to be neutral in terms of the absolute amounts of waste generated. Waste policy does, however, have a considerable impact on the treatment of food waste once it has been generated. This study forecasts that by 2020 the amount of food waste sent to landfill will decrease from about 40.5 million tonnes to about 4.0 million tonnes in compliance with policy.

This leaves an estimated 122 million tonnes of food waste across the EU27 by 2020 still to manage via other residual treatment technologies.

Without successful long-term pan-EU waste prevention activities achieving notable behaviour change in the way people buy and use food, the treatment capacity required to handle food waste will need to increase by more than a factor of two. The challenge this poses for raising capital, securing permission to build and planning (or extending existing facilities) will be considerable.

Limitations

Limitations in food waste quantities, based principally on inconsistent definitions of food waste and methodologies for calculation, presented a major difficulty in the accurate identification of trends, in addition to the unavailability of time series data. The main conclusion that can be drawn from this exercise is that statistical improvement and time series data are needed in all MS to provide reliable data on food waste generation that could form a basis for more robust and reliable estimations and forecasting.

Five policy recommendations identified for their prevention potential

The investigation of food waste prevention measures and the development of food waste quantities and forecasts informed this task, which involved the identification of five policy options for implementation at EU level to strengthen existing efforts to prevent food waste.

The following five policy options were examined alongside a business as usual scenario:

Policy Option 1: EU food waste data reporting requirements

Option 1: EUROSTAT reporting requirements for MS on food waste and a standardisation of methodologies for calculating food waste quantities at MS level to ensure comparability. A feature of this is the clear exclusion of by-products from food waste data reporting.

The lack of reliable data on food waste has been a recurring obstacle in this study, impacting the assessment of the environmental impacts of food waste, the anticipated developments in food waste generation over time, and the setting of targeted policies for waste prevention.

This policy option enables legislators at European and national level to direct action on food waste by providing a quantitative basis for policymaking and target setting.

The food waste reduction potential of this initial policy option is considered negligible, as it serves as a basis for further action. Food waste quantities will indeed directly inform the choice of further policy options.

The cost for the EU enacting this policy option is considered negligible by EUROSTAT. The administrative costs for MS are estimated at €1,000 to €3,000 by the Irish Environmental Protection Agency, though these may vary somewhat between MS. The cost of undertaking bin characterisation study is estimated by the Irish Environment Agency at €30,000. The Danish Environment Agency conducts a major national food waste study every ten years, at a cost of €270,000. These data suggest a possible range of costs for MS for meeting new data reporting requirements. Some investment in data collection and analysis will improve the level of reporting accuracy.

While difficulties defining food waste and separating out by-product volumes were highlighted, this policy option was overall considered practical by stakeholders at European and national level.

Policy Option 2: Date labelling coherence

Option 2: The clarification and standardisation of current food date labels, such as “best before”, “sell by” and “display until” dates, and the dissemination of this information to the public to increase awareness of food edibility criteria, thereby reducing food waste produced due to date label confusion or perceived inedibility.

The function of food product labelling is to ensure consumer safety and inform their decision making. Research on date labelling undertaken in the UK shows that 45-49% of consumers misunderstand the meaning of the date labels “best before” and “use by” (WRAP 2010). WRAP’s Household Food Waste Programme Manager, Andrew Parry, furthermore estimates that 1 million tonnes of food waste or over 20% of avoidable food waste in the UK is linked to date label confusion. These results show that food product labelling in this case is not functioning optimally and makes date labelling a principle issue in household food waste prevention.

An EU level date labelling coherence policy would involve the addition of a requirement on harmonised date labels to the Food Information Regulation, currently being debated in the European Parliament.

The development and diffusion of guidance to businesses on which food products should carry which data label is recommended. An increased emphasis on storage guidance is further suggested, in particular its importance for the lifespan of the product and the validity of its date label. Lastly, the dissemination of information to the public on the meaning of the harmonised date labels will be an important contributor to the success of this policy. This includes an understanding that “best before” dates are primarily related to quality rather than safety, and that using their own judgement (visual, olfactory and taste) is adequate for many food products.

The food waste reduction potential of this policy option can be estimated at up to 20% of avoidable food waste, based on UK research.

The cost for the EU and for MS is considered to be negligible. The costs for industry based on familiarisation costs with new regulations is estimated at €232,000 per EU15 Member State and at €47,000 per EU12 MS, based on UK Food Standards Agency data.

Policy Option 3: EU targets for food waste prevention

Option 3: The creation of specific food waste prevention targets for MS, as part of the waste prevention targets for MS by 2014, as recommended by the 2008 Waste Framework Directive. This policy option relies upon improved MS food waste data reporting (as proposed in policy option 1).

This policy option quantitatively addresses anticipated increases in food waste generation, aligns with broader European targets for waste prevention and can be adapted easily to MS specificities. Methods for achieving targets would be set at MS level, possibly as part of national waste prevention programmes.

The food waste reduction potential of this policy option will depend on the percentage target adopted and the level of success in achieving the target.

Costs for the EU are considered negligible; costs for MS will be determined by the waste prevention strategy adopted to meet the target.

Policy Option 4: Recommendation and subsidy on the separate collection of food waste in the MS

Option 4: Recommendation of MS adoption of separate collection of food waste or biodegradable waste, for the household and/or food service sector. Subsidy for the development of separate collection and treatment infrastructure.

Multiple stakeholders noted the "waste prevention effect" of separating food waste from household or food service waste for separate collection, although this relationship has not yet been proven quantitatively. The act of separating food is important in increasing awareness effectively among participants, by confronting them directly and regularly with the quantity of food waste they generate. It is especially effective where accompanied by an awareness campaign on the need to reduce food waste.

This policy option also supports the EU policy objective of "using waste as a resource" and enables the separate recovery of a valuable waste material.

The food waste reduction potential of this policy option cannot be estimated at this time, given that previous research has not addressed the potential "waste prevention effect" of separate collection and because a clear link was not apparent in the available data, due to discrepancies and changes across time in the scope of materials collected, and the type of collection methods employed.

The costs for separate collection vary according to MS differences and treatment differences, but are comparable to the treatment costs of mixed waste according to a 2007 UK study (see below).

Estimated costs of food waste separate collection

Costs of implementing separate food waste collection	
Cost of separate collection followed by composting	35-75 €/tonne
Cost of separate collection of bio-waste followed by anaerobic digestion	80 to 125 €/tonne
Compared with landfill and incineration	
Cost of landfill of mixed waste	55 €/tonne
Cost of incineration of mixed waste	90 €/tonne

Source: Eunomia 2007

Policy Option 5: Targeted awareness campaigns

Option 5: Targeted awareness campaigns, aimed at the household sector and the general public, to raise awareness on food waste generation, environmental and other impacts of biodegradable waste, prevention methods and practical tips to encourage behaviour change and a long-term reduction in food waste generation.

Households are responsible for the greatest proportion of avoidable food waste, and principle causes of household food waste have been identified as lack of awareness, lack of knowledge on methods for avoiding food waste, date label confusion, inappropriate storage and portion mis-sizing, among others. These causes can be directly addressed through awareness campaigns, and it is recommended that MS adapt campaigns to correspond with locally identified causes of food waste.

The EU role in such a policy might involve a web-based resource hub on food waste prevention, including sample communications materials, good practice examples, and informational tools for specific sectors. This might build on the existing European Week for Waste Reduction website. Potential for an EU network of interested policymakers on food waste, for policy level best practice sharing and discussion, is also highlighted as part of this policy.

The food waste prevention potential of this policy option can be estimated at 1.8% of total food waste or 3% of avoidable food waste, based on the UK Love Food Hate Waste campaign's results so far. With continued investment in the campaign, this should be expected to rise along with an increase in MS consciousness of the issue.

The cost of the policy for the EU is estimated at between €90,000 and €180,000, based on the website and network costs of the Green Spider Network. The cost for MS campaigns is estimated at €0.04 per inhabitant, based on the WRAP Love Food Hate Waste campaign, approximately € 20 million for EU27. Shared resources and best practices provided by an EU web-based resource hub may, however, reduce costs for MS.

➔ **Policy selection**

The environmental and economic costs and benefits of the five policy options and the business as usual scenario were analysed via an impact assessment matrix (presented hereafter), enabling the delineation of three options providing important waste prevention benefits at limited cost.

The impact analysis concluded that the three priority options are data reporting requirements, date labelling coherence, and targeted awareness campaigns.

The assessment demonstrated that option 1 (data reporting requirements) had limited food waste reduction potential, but facilitated the development of targets and strategies that would not be possible without robust baseline data. Costs for MS and industry were identified as moderate, in most cases focusing on the harmonisation of methodologies rather than the sourcing of previously uncollected data.

Option 2 (date labelling coherence) was selected for its expected food waste prevention potential, based on its capacity to improve consumer information on food edibility across the EU, and the evidence on existing uncertainty in this area. The comparatively limited cost of this policy option, and the possibility to integrate it into the Food Information Regulation currently being debated, were also considered.

Option 5 (awareness campaigns) was selected due to stakeholder agreement on its necessity and essential role in behaviour change. Its potential to reduce food waste will be linked to the budget invested in awareness-raising, though this is expected to be consistently less than the potential financial savings to households through more efficient use of purchased food. The EU role might involve the sharing of best practices and informational tools across MS.

Options 3 and 4 were not considered priority actions.

Option 3, given its dependence upon the effective implementation of option 1, was not prioritised in this assessment, in consideration of EUROSTAT's warning on potential delays in the implementation of option 1. However, it should be noted that this policy option could be integrated into national waste prevention programmes required to be developed by MS not later than the end of 2013, under Article 29 of the revised Waste Framework Directive.

Option 4 was not selected at this time given a current lack of robust quantitative evidence on the "waste prevention effect" of separate collection, although widely observed. The practical nature of separating food waste from general household or workplace waste reminds individuals regularly of the quantities of food waste they are responsible for. This increased consciousness of food wasting behaviours can lead to prevention at source, according to several stakeholders. Additionally, the subsequent environmental benefits of the separation collection and proper treatment of food waste are ample, providing a robust means of using waste as a resource for energy or soil regeneration purposes. However, given that prevention would not be the primary aim of a major policy of this kind and that implementation costs are significant, it has been left open to development by other avenues for its substantial recycling opportunities.

Overall, an EU approach to food waste, particularly regarding data, was considered essential.

Synthesis of policy analysis

	Sectors targeted	Cost inputs			Summary of cost inputs	Estimated food waste prevention potential	Additonal expected benefits
		Implementation costs for EU institutions	Implementation costs for MS	Implementation costs for industry			
Option 1: EU food waste reporting requirements	All	0 to -	-	- to --	Principle costs linked to research and enforcement required to achieve standardisation	0 to +	Possible business prevention effect; makes subsequent strategies possible
Option 2: Date labelling coherence	All	-	-	- to --	Principle costs for industry for potential repackaging	+ to ++	Financial savings for households
Option 3: EU targets for food waste prevention	All	- to --	- to --	- to --	Costs fall primarily to MS for implementation of national food waste prevention initiatives to meet targets	+ to ++	Financial savings for households
Option 4: Requirement on separate collection of food waste in the MS	Households and Food Service	-- to ---	-- to ---	- to +	Costs for the EU and for MS will depend upon the level of subsidy and investment. Implementation costs to industry may be followed by profits from separate bio-waste treatment in the longer term.	+	Separates a valuable waste stream from municipal waste, with significant opportunities for environmental benefits
Option 5: Targeted awareness campaigns	Households	-	- to --	0	Costs are primarily linked with use of various communication mediums such as advertising, website development etc.	+	Financial savings for households; targets behaviour change; potential brand advantage for retailers

INTRODUCTION

BACKGROUND

Bio-waste is defined by the European Commission in the green paper on the management of bio-waste[3] as biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, and comparable waste from food processing plants. The definition does not include forestry or agricultural residues, manure, sewage sludge or other biodegradable waste, such as natural textiles, paper or processed wood. Bio-waste accounts for 30-45 % of municipal solid waste in Europe[4].

Food waste, composing a large proportion of bio-waste, is waste composed of raw or cooked food materials and includes food materials discarded at anytime between farm and fork; in households relating to food waste generated before, during or after food preparation, such as vegetable peelings, meat trimmings, and spoiled or excess ingredients or prepared food. Food waste can be both edible and inedible. Edible food waste is considered avoidable, although WRAP describes some of this as "possibly avoidable", given certain foods that are not unanimously considered edible. The distinction is clarified in the below table.[5]

Figure 1: Edible and inedible food waste

Edible food waste	
Avoidable food waste	Food that is thrown away that was, at some point prior to disposal, edible (e.g. slices of bread, apples, meat)
Possibly avoidable food waste	Food that some people eat and others do not (e.g. bread crusts, potato skins)
Inedible food waste	
Unavoidable food waste	Waste arising from food preparation that is not, and has not, been edible under normal circumstances (e.g. bones, egg shells, pineapple skins)

Source: based on WRAP (2009) *Household Food and Drink Waste in the UK*

The environmental, economic, and social implications of food waste are of increasing public concern worldwide[6]. The environmental costs of food waste include for example the **landfill expansion and methane emissions** that contribute to climate change. In monetary

[3] EC (2008) *Green Paper on the management of bio-waste in the European Union,* Brussels, Belgium

[4] EurActiv website (29 June 2009) 'EU bio-waste directive moves a step closer' [Accessed 21 July 2009 online: www.euractiv.com/en/sustainability/eu-biowaste-directive-moves-step-closer/article-183575]

[5] WRAP (2009) *Household Food and Drink Waste in the UK*

[6] Recent report by UNEP's Rapid Response Assessment Team warns that up to 25% of the world's food production may become lost due to environmental breakdown by 2050 unless action is taken www.grida.no/publications/rr/food-crisis/

terms, food waste also means money wasted, given the considerable amount of edible food thrown away every year in the EU. Other costs include the maintenance of landfills (where food waste is most often disposed). High levels of food waste contribute to higher costs in waste management (transport costs, operations costs in the treatment plants, separation costs in some cases). Biogenic waste (food residues) usually show a high water content and therefore low heat value, heavily influencing the calorific value of the waste and therefore the energy efficiency of combustion plants. Wasting food also raises social questions, particularly given the current global financial crisis, rising food prices and international food shortages.

On the other hand, the environmental impacts of the needless production of food must be considered at the different life stages (production, transport, manufacturing, distribution…) of the food chain, taking into account that the food sector represents 30/31% of Global Warming Potential[7]. These life-cycle impacts must be added to those resulting from the waste itself.

According to a recent UNEP study[8] over half of the food produced today is lost, wasted or discarded as a result of inefficiencies in the human-managed food chain. Reducing the amount of food waste is critical if MS are to meet targets on addressing climate change and limiting greenhouse gas emissions as well as fulfilling obligations under the European Landfill Directive to reduce biodegradable waste going to landfill.

Despite the advances in food waste management (increased home-composting, technical innovations in waste treatment), waste volumes continue to grow. Research and increased efficacy of measures at all levels in the EU is thus called for to reduce the significant environmental, economic and social impacts of food waste.

In this study, the sectors below related to the life cycle of food products are referred to. Please note that while cited in relation to aggregated environmental impacts of the food production chain, the Agricultural sector is out of the scope of the analysis presented on food waste causes, quantities and potential policy options, as defined by the study's Terms of Reference. The sectors cited can be understood to mean the following in context of this study:

- **Agricultural sector:** Production sector involved with agricultural activities such as cattle raising, farming and harvesting of fruits and vegetables. May produce products which are sent directly to market or used as inputs for other production processes, e.g. apples could be sold as such or could be used as a primary material for the manufacturing of apple juice or apple sauce
- **Manufacturing sector:** Production sector involved in the processing and preparation of food products for distribution
- **Wholesale/Retail sector:** Production sector involving the distribution and sale of food products to individuals and organisations
- **Food Service sector:** Production sector involved in the preparation of ready-to-eat food for sale to individuals and communities; includes catering and restauration activities in the hospitality industry, schools, hospitals and businesses
- **Household sector:** Sector involves food waste generated in the home by consumers in household units

[7] Environmental Impact of Products (EIPRO) ec.europa.eu/environment/ipp/pdf/eipro_report.pdf

[8] UNEP (2009) *The Environmental Food crises: Environment's role in averting future food crises*

CONTEXT

Obesity is a growing global problem, affecting 1.7 billion people, while 800 million people worldwide are under-nourished. On a local level, 200,000 people go hungry in Brussels, while this study estimates that Belgian households throw away 89kg of food per person each year. Globally, nine million people die of hunger each year[9], while current food production is sufficient to feed the world's population.

The production and consumption of food products has shifted over the last thirty years as a result of rising per capita incomes, lifestyle changes and demographic shifts, such as an increase in single person households. Concentration and competition in the international food market has driven changes in the variety and availability of food products. Technological innovations have incited further changes, for example, increases in crop monoculture. Attitudes towards food safety, product labelling, and the impact of food consumption on the environment have had broader impacts, a recent example being the evolution of the 'low-impact diet', where meat consumption is minimised and local, seasonal produce is prioritised.

EU POLICY MEASURES TO REDUCE FOOD WASTE

The management of food waste involves several policy areas including sustainable resource management, climate change, energy, biodiversity, habitat protection, agriculture and soil protection. This section provides an overview of the existing EU and MS measures to reduce the environmental impacts of food waste.

- **Biodegradable waste diversion targets of the Landfill Directive 1999/31/EC**

  The Council Directive 1999/31/EC of 26 April 1999 also known as the Landfill Directive, sets as a policy target the staggered reduction of biodegradable municipal waste (BMW) going to landfill. The Landfill Directive places an absolute target on the tonnage of BMW that can be land filled by 2006, 2009 and 2016 by linking the quantity permitted to the quantity produced in 1995. Thus the Directive obliges MS to reduce the amount of biodegradable waste in landfills by 65% by 2016 compared to 1995 levels. This means, for instance, that if BMW production doubles between 1995 and 2016, only 17.5 % of BMW produced in 2016 can be land filled. As of 2006, MS are restricted to land filling a maximum of 75% of the total amount by weight of BMW produced in 1995. This target becomes 50% in 2009 and 35% in 2016. However, the Landfill Directive does not submit countries to binding specifications on methods for disposal of BMW not sent to landfills, a situation which has led most MS to opt for incineration.

- **Waste Framework Directive**

  Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 aims to protect human health and the environment against harmful effects caused by the collection, transportation, treatment, storage and disposal of waste.

  On June 17th 2008, the European Parliament adopted a legislative resolution approving the Council's common position for a new Waste Framework Directive. The Waste

[9] Bruxelles Environnement: http://documentation.bruxellesenvironnement.be/documents/Ecoles_DosPedAlimentation_4_FR.PDF?langtype=2060

Framework Directive was reviewed with the aim of simplifying it, providing clearer definitions and strengthening the measures required on waste prevention.

The revised Directive will streamline EU waste legislation by replacing three existing directives: the current Waste Framework Directive, the Hazardous Waste Directive and the Waste Oils Directive.

The revised Directive:

- sets new recycling targets to be achieved by MS by 2020
- strengthens provisions on waste prevention through an obligation for MS to develop national waste prevention programs and a commitment from the EC to report on prevention and set waste prevention objectives
- sets a clear, five-step hierarchy of waste management options in which prevention is the preferred option, followed by re-use, recycling and recovery, with safe disposal as the last recourse
- clarifies a number of important definitions, such as recycling, recovery and waste, also draws a line between waste and by-products and defines end-of-waste criteria

Furthermore, there is a clear strategy towards the separate collection and treatment of bio-waste:

Article 22 "Bio-waste": "Member States shall take measures, as appropriate, and in accordance with Articles 4 and 13, to encourage:

(a) the separate collection of bio-waste with a view to the composting and digestion of bio-waste

(b) the treatment of bio-waste in a way that fulfils a high level of environmental protection

c) the use of environmentally safe materials produced from bio-waste

➢ **Thematic Strategy on the Prevention and Recycling of Waste**

The Thematic Strategy on the prevention and recycling of waste sets a direction for EU action and describes the ways in which waste management can be improved. The aim of the strategy is to reduce the negative impact on the environment that is caused by waste throughout its lifecycle, from production to disposal.

The main focus of the strategy for preventing waste production is on reducing the environmental impact of waste and products that will become waste. In order to be effective, this impact must be reduced at every stage of a resource's lifecycle. The strategy places particular emphasis on biodegradable waste, two-thirds of which must be redirected for disposal using methods other than landfill as is required under Directive 1999/31/EC.

➢ **Green Paper on bio-waste management in the EU**

In December 2008, the Commission published a Green Paper on bio-waste management in the EU and launched a consultation process to gather opinions on whether a specific stand-alone EU Bio-waste Directive was needed. The purpose of the Green Paper was to explore options for the further development of the management of bio-waste by reviewing the current situation of bio-waste management in the EU.

- **Communication on future steps in bio-waste management in the European Union**

  In May 2010, the Commission released a Communication on bio-waste management in the EU, including recommendations on managing bio-waste such as encouraging the usage of separate collection as well as laying out the future planned steps on the part of the EC for addressing bio-waste in the EU. The key tenets of EC future action related to bio-waste include: encouragement of prevention of bio-waste, treatment of bio-waste according to the waste hierarchy, protection of EU soils via a focus on compost and digestate, investment in research and innovation and efforts to reinforce the full implementation of the existing set of EU waste legislation.

OBJECTIVES AND METHODOLOGY

This study investigates food waste, quantifying the scale of the problem in the EU27, identifying the causes of food waste, its environmental impacts and existing reduction initiatives, forecasting the evolution of food waste over a fifteen year period (2006-2020) and finally developing additional policy options and modelling their potential results. Detail on the steps in the study can be found below along with information on the stakeholder consultation accompanying the study.

In the work of quantification, the majority of data originates from 2006. In some cases, the only available data came from research undertaken in other years; which was used where no alternative was available.

Quantification of Food Loss & Identification of Causes

The first portion of the current study seeks to investigate causes of food waste, as assessed in literature and grouped into the sectors of Manufacturing, Retail/Wholesale, Food Service/Catering and Households. Next, the study estimates currently generated food waste volumes, using EUROSTAT data to estimate food waste generation for the four sectors, with a baseline year of 2006. This is complemented by an analysis of the potential environmental impacts of food waste generation, including GHG, throughout the entire lifecycle of the food production chain.

Inventory of Existing Initiatives

The second portion of the study seeks to identify and analyse existing food waste prevention initiatives, including awareness campaigns, research projects, industrial uses, redistribution programmes, waste measurement programmes, informational tools, regulatory measures, training programmes and logistical improvements.

Forecasts Based on Current Scenario

The third portion of the study forecasts future food waste generation over a 15 year time horizon (from 2006 to 2020), considering the impact of factors such as population growth, disposable income, policy impact, prevention initiatives and other environmental factors.

Identification and Analysis of additional Policy Measures

The fourth portion of the study identifies and analyses five additional policy measures for possible implementation by the EC to address food waste. The five

potential policy options were selected based on analysis in the previous portions of the study focusing on food waste causes, quantities and forecasted future food waste generation. The five options were selected in close consultation with the European Commission. A semi-quantitative impact matrix was completed to assess the economic, environmental and social costs and benefits of each option and to select the three most promising options for reducing food waste generation in the EU27. As a final step, three policy options were selected, once again in consultation with the European Commission, using a semi-quantitative matrix and an assessment of pros and cons. The three selected policy options were compared with food waste forecasting completed earlier in the study.

STRUCTURE OF THE REPORT

The report is divided into four chapters reflecting four tasks:

Task 1: Quantification of Food Loss & Identification of Causes

Task 2: Inventory of Existing Initiatives

Task 3: Forecast based on Current Scenario

Task 4: Identification & Analysis of Additional Policy Measures

1. QUANTIFICATION OF FOOD LOSS & IDENTIFICATION OF CAUSES

INTRODUCTION

Chapter 1 seeks to quantify current food loss in the EU and identify food waste causes across the following four sectors: **Manufacturing, Wholesale/Retail, Food Service and Households**. The chapter comprises the following sections:

- **1.1** Causes of food waste
- **1.2** Quantity of food waste
- **1.3** Quantitative assessment of environmental impact of food waste

KEY FINDINGS

Section 1.1 assesses the **causes of food waste**, examining specific areas of and reasons for food loss in the following sectors: Manufacturing, Wholesale/ Retail, food service and restaurants (including hospitality industry, schools, hospitals) and Households. Causes of food waste are common to both the household and the Food Service sectors and involve a range of issues including **portion size, labelling, packaging, storage, awareness, preferences, planning and socio-economic factors**. In the Wholesale/Retail and Manufacturing sectors logistical and technical issues figure prominently. The range of food waste causes identified imply two sorts of prevention strategies, those that implicate producers and retailers in helping prevent household food waste by incentivising the creation and promotion of waste resistant products and those aiming at consumer behaviour change through educational tools and campaigns. Section 1.1 provides context for the sector-specific initiatives documented in Chapter 0 and for informing policy selection in Chapter 4.

Section 1.2 identifies **quantities of food waste** produced, assimilating available data on food waste generation by MS and by sector (Manufacturing, Wholesale/Retail, Food Service, and Households). Using EUROSTAT data and the findings of a literature review and stakeholder consultation, the study arrived at the **best estimate of approximately 89 Mt of food waste generated in the EU27 annually.** An analysis by sector showed that the Household sector **produces the greatest proportion of food waste and generate predominantly avoidable food waste**. The Manufacturing sector is responsible for the next largest proportion of food waste; however, predominantly inedible food waste is produced. Both the Manufacturing sector and the Wholesale/Retail sector have significantly less standardised data available to accurately assess food waste generation.

Section 1.3 involves a quantitative assessment of environmental impact of food waste. The overall impact of food waste in Europe **can be estimated as equal to at least 170 Mt of CO_2 eq., with an average of 1,9 t CO_2 eq./t of food wasted**. In comparison, this figure is in between the total emissions of greenhouse gases of Romania (145.916 Mt, according to EUROSTAT) and of the Netherlands (206.911 Mt, according to EUROSTAT) in 2008.

1.1 CAUSES OF FOOD WASTE

This initial section of Chapter 1 synthesises the use of the existing evidence base, stakeholder experience and selected expert interviews to document the principle causes of food waste in four key sectors. Food waste generated by the Manufacturing, Wholesale/Retail, Food Service and Household sectors is explored separately below, highlighting the specific areas where food is lost, providing a context for the sector-specific initiatives documented in Chapter 0 and informing policy selection in Chapter 4.

Causes of food waste are common to households and businesses, and involve portion size, labelling, packaging and storage issues on the one hand, and awareness, preferences, planning and socio-economic factors on the other. These causes invite two groups of prevention strategies, those that implicate producers and retailers in helping prevent household food waste, by incentivising the creation and promotion of waste resistant products, and those targeting consumers through educational tools and campaigns. Table 1 below lists the key causes of food waste and the sectors they impact.

Table 1: Key causes of food waste and impacted sectors

	Manufacturing & Processing	Wholesale & Retail		Food Service and Restaurants			Households
		Distribution & Wholesale	Retail	Hospitality industry	Schools	Hospitals	
Awareness				●	●	●	●
Knowledge			●	●	●	●	●
Attitudes				●	●		●
Preferences					●	●	●
Portion size			●	●	●	●	●
Planning				●	●	●	●
Storage		●	●				●
Socio-economic factors							●
Labelling			●	●	●		●
Packaging	●	●	●				●
Handling		●	●				
Stock management		●	●				
Logistics	●			●	●	●	
Product quality requirements	●		●				
Technical malfunctions	●						

Sources of food waste exist at all process stages between farm and fork. This study begins when raw materials and fresh produce leave the farm, as agricultural policy is not an area this study touches upon.[10] Among the four sectors investigated, household waste has been most fully analysed in the available literature. The concentration of research at household level is validated by the findings in section 1.2 of Chapter 1 on quantities: this sector indeed generates the highest proportion of edible food waste.

The principle causes by sector are described below.

[10] While this study does not cover agricultural food waste prevention, it may be noted that there have been several recent occasions where crops have been left in the field unpicked, because the market price of the crop did not justify the expense of harvesting. The Agricultural sector may be an important statistical area for food waste for further research.

i. MANUFACTURING & PROCESSING

Food waste is largely unavoidable (inedible) at this level, according to Danish research to be published this year[11], particularly for meat products, involving principally bones, carcasses, and organs that are not commonly eaten.

Technical malfunctions also play a role, including overproduction, inconsistency of manufacturing processes leading to misshapen products or product damage, packaging problems leading to food spoilage, and irregular sized products trimmed to fit or discarded entirely.

At processing level, much waste is generated as a result of legislative restrictions on outsize produce. The phasing out of regulations on the size and shape of fruit and vegetables, approved by the European Commission (Commission Regulation (EC) No 1221/2008 of 5 December 2008) should significantly reduce the quantity of fresh produce needlessly discarded before reaching retail outlets.[12] This odd-shaped produce will now be available at a lower cost, increasing the access of low-income families to fresh fruit and vegetables.

ii. HOUSEHOLDS

Causes of household food waste which can be addressed by policies targeted at producers:

Labelling issues

Misinterpretation or confusion over date labels is widely recognised for its contribution to household food waste. In many MS, there is a lack of consistency in the terms employed ("best before", "use by", "sell by", "display until"), with a tendency among consumers to treat all terms equally, and in some cases to leave a safety margin before the stamped date.

Applying "best before" dates to products that show visible signs of decay may be unnecessary, causing consumers to discard something that does not pose a safety risk. Consumers might be better left to judge the quality and safety of such products autonomously, bread or potatoes for example. The use of "best before" dates, by contrast, on products that are liable to pose microbiological risks after a certain date, is also a concern, eggs or yoghurt for example. In this scenario, consumers may consider the date as a quality indicator, when in fact the product may have become dangerous.

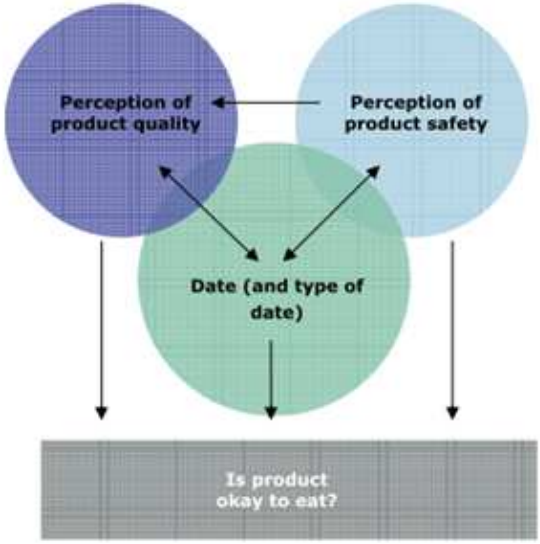
At the point where consumers decide whether to eat or discard a food product in the household, sensory judgements on the quality and safety of the food will interplay with an assessment of the date label on the product. A lack of clarity and consistency in date labels thus results in a greater proportion of discarded food that was in fact still edible.

The following diagram shows the interaction of criteria used in assessing product edibility.

[11] Copenhagen Resource Institute (2010) *Study for the Danish Ministry of the Environment* [As yet unpublished]

[12] COMMISSION REGULATION (EC) No 1221/2008 of 5 December 2008: eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:336:0001:0080:EN:PDF

Figure 2: 'Routes' to deciding whether a product is okay to eat[13]



Source: WRAP (2008) ***Research into consumer behaviour in relation to food dates and portion sizes***

Storage

Inappropriate storage conditions leads to food waste throughout the supply chain and is no less important in the household. Lack of consistency in food storage labels can contribute to premature food spoilage, as can the absence of storage guidance and lack of consumer attention to labels where provided. Storage conditions will also vary based on climate and household temperature. WRAP reports that over two million tonnes of food is not being stored correctly in the UK, multiplying food wastage and presenting potential safety concerns.[14] Optimal storage conditions, by contrast, can significantly extend the edible life of products, often beyond expiry dates. Airtight containers, for example, easily maintain the quality of dry foods such as fruits, nuts, rice, pasta, beans and grains over long periods.

Packaging issues

Packaging can also enhance food product longevity. The lifetimes of products with a high water content, cucumbers for example, can be extended fivefold through plastic film wrapping, as it reduces water loss.[15] Packaging also performs a protective function for fragile goods. The trade-off between food and packaging waste must then be considered, based on the environmental impacts of the two waste streams, though this again will be highly product specific. In some instances, lightweight packaging can significantly extend the shelf life of fresh produce; in other cases the benefit can be marginal.

Re-sealable packaging furthermore can easily extend the edible life of many food products.

[13] WRAP (2008) *Research into consumer behaviour in relation to food dates and portion sizes*

[14] Ibid.

[15] Morrisons "Keep it Fresh Test": www.morrisons.co.uk/Corporate/Press-office/Corporate-releases/Morrisons-launch-Great-Taste-Less-Waste-campaign-to-save-families-up-to-600-per-year-/

Portion sizes

The trade-off between food and packaging waste continues when considering portion sizes. Bulk packaging minimises the ratio of packaging to food product delivered to the consumer, though the quantity may be greater than the consumer can use while the product is fresh.

Individually sized portions can minimise food waste, but create extra waste in another waste stream (plastics, glass etc). Better storage knowledge, freezing and preserving information, and storage equipment in the household can help bulk purchases last longer and minimise reliance on smaller portions.

Causes of household food waste that can be addressed through consumer-targeted policies:

Awareness

Not everyone thinks about what they throw away. While the last three decades have seen a growing general environmental awareness in the EU, food waste has not been a policy priority since the First World War: abundant food production in the intervening years has induced some complacency in the purchase, consumption and wastage of food resources.

While resource efficiency is gaining in profile, the profusion of environmental behaviour changes called for can be overwhelming. Wasteful behaviours with regard to food can be entirely unconscious. Drawing public attention to the extent of the problem can be highly effective, or awareness campaigns might focus on the practical or attitudinal considerations which are discussed separately below.

Knowledge

A lack of awareness coupled with a lack of knowledge about prevention measures exacerbates food waste in the household. In practical terms, items such as leftover meat, bread, rice or pasta, which were historically reemployed in many classic European dishes, are now more easily discarded. Stale bread for example was habitually transformed into a range of traditional dishes: *panzanella* in Italy, *pain perdu* in France, bread pudding in the UK, taking advantage of every morsel of food. Information on food waste prevention techniques can thus help households understand how to buy smarter and use what they buy more efficiently.

Planning issues

A lack of attention in food purchasing can be attributed to the abundant availability of food in MS and the relatively low cost of food products in relation to household income. “Buying too much” or “lack of shopping planning” are thus frequently cited as causes of food waste in the household, due to goods purchased that perhaps do not combine well to make a meal, were not wanted to by the other members of the household or in the case of highly perishable goods, could not be eaten in time.

Compounding lack of planning on the part of consumer, the promotional sale of several units of food products by retailers (two-for-one deals, for example) has

been identified as a further source of household food waste, in terms of buying more than is needed.

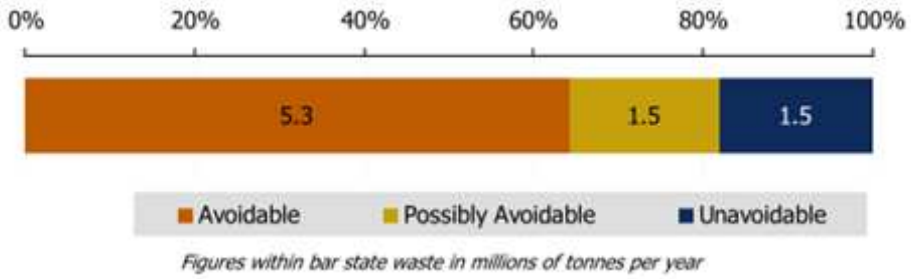
Careful planning does not resolve all issues however. The planning and purchase of very specific food products for a particular recipe or special occasion, which was then not made or did not happen, was identified as a cause of household food waste by a 2001 US study[16]. Many of these non-versatile food products are ultimately discarded after a certain time in the kitchen cupboard or after reaching their expiry date.

Preferences

Some food waste is generated needlessly, mainly due to a lack of planning and attention. However, other food waste materials are discarded due to personal preference by the consumer, and this area represents 1.5 million tonnes per year in the UK according to WRAP (see below division of household food waste by avoidability). Examples of food items discarded due to preferences include potato skins, apple skins, bread crusts etc. It may be particularly difficult to effect change in this area.

Changes in habits or diets may also play a role in the discard of food products with longer shelf lives (products with a high calorific content may feature strongly here). Causes of food waste in the household waste stream may also include products purchased for the first time that the consumer then "did not like"[17].

Figure 3: Weight of food and drink waste generated by UK households, split by avoidability[18]



Source: WRAP (2009) *Household Food and Drink Waste in the UK*

Attitudes

A problem informally but frequently cited for the generation of food waste is the undervaluing of food resources by consumers based on its low market value. The obesity crisis, furthermore, demonstrates a change of relationship with an attitude towards food in comparison with previous eras.

[16] Wansink, B. (2001) 'Abandoned Products and Consumer Waste: How did That get into the Pantry?' *Choices* foodpsychology.cornell.edu/workcenter/2001-2002_dfs/Abandoned-Products-Choices-2001.pdf

[17] Wansink, B. (2001) 'Abandoned Products and Consumer Waste: How did That get into the Pantry?', *Choices* foodpsychology.cornell.edu/workcenter/2001-2002_dfs/Abandoned-Products-Choices-2001.pdf

[18] WRAP (2009) *Household food and drink waste in the UK*

Life cycle costing of food products with the aim of reflecting their real economic and environmental price might in the long-term change the perceptions of food as rapidly disposable.

Similarly, cultural norms, such as cooking more than the family or group of visitors could possibly eat, remain present in many MS and worldwide. The OECD, in its environmental performance review of Korea, makes an observation that also rings true in the EU:

> "Traditionally, it is considered courteous to prepare more food for a meal than can be eaten, and it is customary to have leftover food."[19]

Further attitudinal considerations regard overwhelming the consumer with environmental obligations. This is a recurrent problem with waste prevention affecting many waste streams beyond food: consumers feel that they have 'done their duty' by engaging in a highly visible environmental behaviour, such as recycling, but waste prevention is difficult to see and therefore easier to ignore or avoid.

Attitudes that may help counteract food waste include the recent interest in a 'local impact diet' and the return of the 'clean your plate' ethic, which had been omnipresent in the earlier half of the 20th Century. However, this comes at a time when obesity and excessive food consumption have also become a problem.

Household food behaviours are habitual and intuitive[20], and a wide range of causes can be attributed to actions that the consumer does not think about. Food waste preventing behaviours are thus also multiple, and a suitable response will involve a range of complementary policies.

Socio-economic factors

Certain socio-economic conditions are more conducive to the generation of food waste. Single person households are more wasteful because of the lack of opportunity for sharing food, young people generate more food waste (due to fewer meals being consumed at home, less concern for waste, less experience meal-planning etc.)[21].

Socio-economic causes are likely to be the least manoeuvrable through policy application, but while the size of the household is unlikely to be influenced, the behaviours within it irrespective of size remain susceptible to general consumer-oriented awareness and informational strategies.

iii. DISTRIBUTION AND WHOLESALE

Limited sources of information on the scale of food waste at this level have been identified; Charlotte Henderson of WRAP's Retail Grocery Supply Chain Programme noted that the distribution phase was not a key area in WRAP research as not a great deal of food waste is generated during this phase. Areas where food waste may be generated include those common to both the Wholesale/Retail sector and at the Manufacturing/Processing level, namely inaccuracies in stock management and forecasting, and packaging problems.

[19] OECD, (2006) *Environmental Performance Reviews: Korea*, OECD Publishing, Paris, France.
[20] DEFRA,(2009) *Food Synthesis Review 2009.*
[21] WRAP, (2008) *The food we waste*.

Excess stock due to **"take-back" systems and last minute order cancellation**[22], such as contractual obligations for suppliers to accept the return of products with 75% residual shelf life from retailers who have not yet sold them, can result in the discard of safe and edible food products on a large scale. Inaccurate ordering and forecasting of demand also affects the Wholesale/Retail sector.

Stock transportation can lead to both packaging and storage problems. Poor packaging performance resulting in damage to food products will lead to the discard of the product. As noted earlier, damage to the product's primary or secondary packaging also often means the product will be discarded, while the food itself is unharmed. It is expected generally however that packaging materials have been optimised to minimise waste and hence waste is expected to be limited here.

Furthermore, extreme changes in temperature during shipment can spoil or shorten the shelf life of food products. Meat and fish products are particularly sensitive to temperature conditions during transportation and storage. The degree of degradation of such products can be attributed to cumulated breaks in the cold chain. Research on **'time temperature indicators'** currently underway aims to enable the tracking of temperature changes of food products during the supply chain, facilitating the identification of those areas where food spoilage occurs.[23]

iv. The Retail Sector

Food waste due to inefficiencies in business operations are shared across the supply chain, and in the Retail sector focus on stock management. Difficulties anticipating demand resulting in overstocking affect most product groups; seasonal foods (Christmas cakes or Easter eggs for example) are particularly sensitive to this because of their short shelf life.[24] Storage, handling and packaging also impact food condition and thus wastage.

Charlotte Henderson underlined that food waste in the Retail Sector is highly product specific, leading WRAP to focus on eleven fruit and vegetables in a resource mapping study to be published in 2010. Exposure to light increases in-store wastage of potatoes, for example. Optimised storage conditions for fresh produce in particular in the retail environment will increase the amount sold to consumers, increasing turnover and reducing waste at the same time.

Marketing strategies (two for one deals, for example) often promote food nearing the end of its edible life, addressing overstocking problems. However, this may **shift some of the food waste from Retail level to Households**, where sufficient time to safely consume the product is lacking.

Minimum product quality requirements may increase the quantity of edible food discarded at Retail level, due to packaging defects, product damage or aesthetic issues that do not affect the quality or safety of the food. Promotional strategies could help to reduce this type of waste. Furthermore, the sale of different qualities of fresh produce at different price levels can help maximise their use (Premium, regular and economy level onions for example, based on size and condition).

[22] DEFRA (2007) *Report Food Industry Group on Waste*

[23] FRESHLABEL, Enabling traceability of the Cooling Chain of Fresh and Frozen Meat and Fish Products by means of Taylor-made Time/ Temperature Indicators: http://cordis.europa.eu//fetch?CALLER=FP6_PROJ&ACTION=D&DOC=2900&CAT=PROJ&QUERY=1170700790497&RCN=74777&DOC=1&QUERY=012686305b05:3625:021800bc

[24] OECD (2002) *Household Food Consumption: Trends, Environmental Impacts and Policy Responses*

Hospitality Industry

The hospitality industry for the purposes of this study refers to hotels, restaurants and for-profit catering services (including workplace cafeterias). This area includes, in principle, catering facilities provided by transport services (rail companies, airlines etc), though this has not been covered by this study due to a lack of evidence at the present time. Phil Williams of WRAP was interviewed regarding this area, discussing the current WRAP hospitality industry food waste study.

Causes of food waste generation strongly resemble those identified in the Household sector and are discussed below.

- **Portion sizes**

Consumers eat 92% of the food they serve themselves, according to a 2005 study at Cornell University[25]. Where portion sizes are imposed, in cafeterias/canteens for example, food waste is generated that might have been avoided by allowing customers to serve themselves and pay for their serving by weight.

There seems to be scope to optimise set portion sizes of dishes. Where a self-service option is not viable, a choice of portion size may reduce food waste generation by recognising that individuals have different portion needs. Restaurants such as the chain TGI Friday's in the United States are demonstrating that this is viable by offering smaller versions of existing dishes (please see 2.1).

Furthermore, the preponderance of single serving items in hotels and many catering facilities, (jams, cereals, juice and milk cartons for example), lead to food waste that could easily be avoided by allowing customers to serve themselves from central containers.

- **Awareness**

Hospitality industry awareness of food waste is growing in line with overall environmental awareness, but is currently still low, according to Phil Williams, responsible for WRAP's hospitality industry food waste study, which will be published this year. Importantly, WRAP mentioned anecdotal evidence of significantly higher awareness in businesses that had their food waste collected separately, as workers physically confronted the quantities of food waste they had generated.

- **Logistics**

Difficulties in planning in the hospitality industry can be linked to variability in the numbers of customers anticipated. Two key issues stand out here:

- **Reservations:** where reservations are expected, the quantity of food needed, particularly highly perishable products, is much easier to estimate

[25] Wansink, B., (2005) 'Super bowls : serving bowl size and food consumption', Journal of the American Medical Society smallplatemovement.org/doc/big_bowls_spoons.pdf

- **Buffets:** where food is served via a buffet, customers often expect that nothing will run out, particularly in the luxury market, causing businesses to prepare and cook substantially more than will be consumed. Free or all-you-can-eat buffets may furthermore increase the amount of food taken and not consumed by customers.

A final logistical issue in restaurants is cooking, according to the 'just in time' principle. Where food is overcooked or not cooked at the same time as the rest of the table's dishes, it is commonly discarded and the process is restarted.

➢ **Attitudes**

The practice of taking home restaurant leftovers is frowned upon in some parts of Europe, a practice that would enable substantial reduction of restaurant food waste.

➢ **Knowledge**

The lack of clearly defined channels for hospitality industry enterprises to direct edible food towards charitable organisations may strongly impact the diversion of edible food waste from opportunities for reuse.

Schools

Familiar issues arise in school cafeterias and other cost-catering environments. Anja Van Campenhout of Bruxelles Environnement was consulted on this section. Key causes of food waste in schools include:

➢ **Attitudes**

Food is often not considered valuable to children, as it is plentiful. The question has been raised as to whether free school lunches further undermine the perceived value of food among schoolchildren. This may also contribute to taking more than is needed.

➢ **Preferences**

Limited budgets or lack of motivation to raise quality can aggravate food waste in schools, which have often had difficulty appealing to the tastes of their customers. Bio-Forum, an association representing the organic agriculture sector in Belgium, has combated these problems by working on food presentation and the choice of spices in its Sustainable Canteens programme, part of which focuses on schoolchildren.

➢ **Portion sizes**

Fixed portion sizes in schools often results in larger waste quantities, because appetites can vary particularly strongly among children.

➢ **Logistics**

Studies in the USA have found that scheduling lunch after breaktime can reduce food waste by 30%[26], given that children are hungrier, and do not hurry through their lunches to start breaktime.

[26] Wasted Food "Lunchlady laments" www.wastedfood.com/2007/05/22/recess/

Mixing of ingredients in large quantities before serving can exacerbate food waste, because mixed products often last less long than products that are stored separately.

Hospitals

Research into food waste generated by hospitals and institutions takes place predominantly at a local level, according to Phil Williams at WRAP. Catering in institutions such as hospitals creates particular food waste problems because individuals fed often have little control over eating times, portion sizes or meal choice. A lack of autonomy, often compounded by low food quality, results in a scenario where patients may opt to eat less than they might otherwise.

1.2 QUANTITY OF FOOD WASTE

This portion of Chapter 1 details the identification of possible sources of data on food waste generation at MS level and by sector (Manufacturing, Wholesale/Retail, Food Service and Households). Data was collected through the EUROSTAT database, through a literature review and via stakeholder consultation. Where gaps in data were apparent, hypotheses were made and are clearly described below, in order to reach the most accurate estimation of current EU food waste generation based on existing information.

i. PRIMARY DATA SOURCE: EUROSTAT

Relevant waste categories

The principle source of data on food waste generation was EUROSTAT[27], which lists data for the 27 EU MS in the following categories:

- **(EWC_09) Animal and vegetal wastes**
- **(EWC_0911) Animal waste of food preparation and products**
- **(EWC_093) Animal faeces, urine and manure**

From these a further waste stream, more pertinent to the current study, can be calculated:

- **(EWC_09_NOT_093): Animal and vegetal waste excluding slurry and manure**

Methodologies of data collection and calculation differ between MS. EUROSTAT states that "Member States are free to decide on the data collection methods. The general options are: surveys, administrative sources, statistical estimations or some combination of methods." (EWC_09) Animal and vegetal wastes may as a result, in some instances, include some green wastes in addition to food waste, but it forms nevertheless the most reliable waste category for which all MS have data.

Other more specific data available on EUROSTAT, including (EWC_0911) animal waste of food preparation and products, are included within the EWC_09 total

[27] EUROSTAT Data Explorer: http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

and have therefore not been disregarded. As this study does not address agricultural waste, (EWC_093) animal manure has been excluded.

Sectors

The EWC_09 data are given for all MS by NACE-branch[28]. The NACE branches distinguished are:

- **A - Agriculture, hunting and forestry**
- **DA - Manufacture of food products; beverages and tobacco**
- **HH - Households**
- **Other Sectors**

Branch DA has been used for Manufacturing sector data and branch HH for the Household sector. As this study does not address agricultural waste, Branch A - Agriculture, hunting and forestry has been excluded from calculations, but the EUROSTAT data for this sector remains in Table 2 below for reference purposes. It can be noted that this sector has the second highest proportion of food waste according to EUROSTAT data disclosure.

Generation of (EWC_09_NOT_093)

2006 is the most recent year for which data is available on EUROSTAT, and this was used as the reference year.

Table 2 below shows the generation of (EWC_09_NOT_093): Animal and vegetal waste excluding slurry and manure for the year 2006 in tonnes and Table 3 in kg/capita. Per capita calculations used EUROSTAT population data for the EU27, also with 2006 as the reference year.

[28] The NACE (Nomenclature des Activités Economiques des Communautés Européennes) designates the type of activity selected. Relevant NACE branches for this preparatory calculation are DA (Manufacture of food products, beverages and tobacco), HH (Households), A (Agriculture, Hunting and forestry). The"Other category" NACE branch has also been used.

Table 2: Animal and vegetal waste excluding slurry and manure (EWC_09_NOT_093) in tonnes in 2006

	NACE Branch					
	A -Agriculture, hunting and forestry	DA - Manufacture of food products; beverages and tobacco	HH-Households	Other sectors	Total	Total without Agriculture, hunting and forestry
EU-27	**32 636 495**	**37 307 575**	**23 351 264**	**16 821 345**	**110 116 678**	**77 480 183**
Austria	9 500	570 544	661 300	502 259	1 743 603	1 734 103
Belgium	170 682	2 311 847	934 760	945 308	4 362 597	4 191 915
Bulgaria	255 754	358 687	0	27 491	641 932	386 178
Cyprus	19 574	186 917	0	21 421	227 912	208 338
Czech Republic	123 559	361 813	108 723	112 673	706 768	583 209
Denmark	997	101 646	38 923	45 341	186 907	185 910
Estonia	24 036	237 257	1 298	36 059	298 650	274 614
Finland	2 334	590 442	95 102	207 587	895 465	893 131
France	453 300	626 000	2 973 800	2 128 974	6 182 074	5 728 774
Germany	525 441	1 848 881	7 676 471	862 344	10 913 137	10 387 696
Greece	284 662	73 081	0	2 400	360 143	75 481
Hungary	311 772	1 157 419	45 509	305 840	1 820 540	1 508 768
Ireland	1 568	465 945	538 651	292 806	1 298 970	1 297 402
Italy	98 652	5 662 838	2 706 793	407 530	8 875 813	8 777 161
Latvia	38 049	125 635	10 466	10 531	184 681	146 632
Lithuania	271 599	222 205	737	248 291	742 832	471 233
Luxembourg	691	2 665	62 538	30 829	96 723	96 032
Malta	7 481	271	1 778	2 840	12 370	4 889
Netherlands	1 256 541	6 412 330	1 703 416	1 206 057	10 578 344	9 321 803
Poland	16 462 589	6 566 060	2 049 844	356 259	25 434 751	8 972 162
Portugal	41 057	632 395	0	373 767	1 047 219	1 006 162
Romania	8 037 598	487 751	0	1 089 466	9 614 815	1 577 217
Slovakia	41 357	347 773	78 546	105 021	572 697	531 340
Slovenia	6 521	42 072	25 215	65 232	139 040	132 519
Spain	1 046 681	2 170 910	6 950	3 387 592	6 612 133	5 565 452
Sweden	3 122 000	601 327	386 011	547 335	4 656 673	1 534 673
United Kingdom	22 500	5 142 864	3 244 433	3 500 092	11 909 889	11 887 389

Source: 2006 EUROSTAT data (EWC_09_NOT_093)

Where there is zero marked in Table 2 above, this reflects a zero on EUROSTAT data, likely because no data was provided by the MS.

Excluding branch A (Agriculture, hunting and forestry), the above table provides an estimation of the quantity of food waste generated in the EU27, as disclosed by MS. It amounts to 77.5 million tonnes per annum, or around 157kg per capita per annum for approximately 493 million EU inhabitants.

Table 3 : Animal and vegetal waste excluding slurry and manure (EWC_09_NOT_093) in kg/capita in 2006

Animal and vegetal waste excluding slurry and manure (09 minus 09.03) in kg/capita 2006

	Population	NACE Branch					
		A -Agriculture, hunting and forestry	DA - Manufacture of food products; beverages and tobacco	HH-Households	Other sectors	Total	Total without Agriculture, hunting and forestry
EU-27	**493 194 250**	**66**	**76**	**47**	**34**	**223**	**157**
Belgium	10 511 382	16	220	89	90	415	399
Bulgaria	7 718 750	33	46	0	4	83	50
Czech Republic	10 251 079	12	35	11	11	69	57
Denmark	5 427 459	0	19	7	8	34	34
Germany	82 437 995	6	22	93	10	132	126
Estonia	1 344 684	18	176	1	27	222	204
Ireland	4 209 019	0	111	128	70	309	308
Greece	11 125 179	26	7	0	0	32	7
Spain	43 758 250	24	50	0	77	151	127
France	63 229 443	7	10	47	34	98	91
Italy	58 751 711	2	96	46	7	151	149
Cyprus	766 414	26	244	0	28	297	272
Latvia	2 294 590	17	55	5	5	80	64
Lithuania	3 403 284	80	65	0	73	218	138
Luxembourg	469 086	1	6	133	66	206	205
Hungary	10 076 581	31	115	5	30	181	150
Malta	405 006	18	1	4	7	31	12
Netherlands	16 334 210	77	393	104	74	648	571
Austria	8 254 298	1	69	80	61	211	210
Poland	38 157 055	431	172	54	9	667	235
Portugal	10 569 592	4	60	0	35	99	95
Romania	21 610 213	372	23	0	50	445	73
Slovenia	2 003 358	3	21	13	33	69	66
Slovakia	5 389 180	8	65	15	19	106	99
Finland	5 255 580	0	112	18	39	170	170
Sweden	9 047 752	345	66	43	60	515	170
United Kingdom	60 393 100	0	**85**	54	58	197	197

Source: 2006 EUROSTAT data (EWC_09_NOT_093)

Again, where there is zero marked in Table 3 above, this reflects a zero on EUROSTAT data, likely due to lack of data disclosure by the Member State.

Limitations and need for further research

Although (EWC_09) forms the most reliable waste category for which all MS have data, several limitations where identified in EUROSTAT data:

- As mentioned above, EWC_09 may, in some instances, include some green wastes in addition to food waste

- Data on EUROSTAT is missing for certain sectors in some countries
- The 'Other Sectors' category is too broad to give a clear insight into the Wholesale/Retail and Food Service sectors
- The 'DA - Manufacture of food products; beverages and tobacco' includes tobacco, which is not considered food waste. However, due to unavailability of other data to separate out this portion of the 'DA' NACE category, the EUROSTAT data has been used including tobacco, and this is a limitation in accuracy that has been ameliorated with the addition of secondary data sources as far as possible.
- Large discrepancies have further been identified, showing that for example households in Denmark produce 7kg of food waste per capita, whereas in Luxembourg this is 133kg per capita. Furthermore, food waste generation in the Manufacturing sector of different MS varies to a much larger extent than can be explained by the scale of the food production industry in those countries (see Table 7). Most discrepancies are likely due to a lack of standardisation in definitions and allocation of data, rather than exceptional differences between MS.

As a consequence, an extensive literature search, combined with the stakeholder consultation, was undertaken in order to get more precise information on countries' quantities of food waste. To complement the literature review, minimum scenarios were generated for the Manufacturing and Household sectors, where in some instances EUROSTAT and national data were evidently under-reported.

ii. SECONDARY DATA SOURCE: NATIONAL STUDIES

Certain MS have carried out detailed research on food waste nationally, and these results have been collated in Table 4 by sector.

Occasionally national studies presented data per capita but not total data. In these instances, the per capita figure was multiplied by the 2006 population of that MS, as recorded on EUROSTAT. Calculations were made for:

- Estonia, where SEI 2008 reports 30% of mixed municipal waste is kitchen waste, and EEIC 2008 states 356,000 tonnes of mixed municipal waste were generated in Estonia in 2008, an average 30% of this comes to 106,800 tonnes. This was subsequently divided between the Household and Food Service sectors.
- France, where the Danish Environment Ministry Food Waste Report of 201029 and the ADEME, the French Environment Agency, report household food waste in France at 100kg per capita per annum, this has been multiplied by the population of France in 2006, totalling 6,322,944 tonnes.
- Ireland, where a study by the Clean Technology Centre for the Irish EPA shows that food waste is 16.6% of household municipal waste, which is stated as 1,761,000 tonnes in 2008, resulting in 292,326 tonnes of food waste.
- The Netherlands, where the Danish Environment Ministry Food Waste Report presents household food waste per capita per annum as 76-149kg. An average of 112.5kg per capita was thus used to generate the national total. While among the

[29] Not yet published at time of writing

higher figures, it compares reasonably well to the EUROSTAT per capita figure, which is 104kg per capita.[30]

- Sweden, where the Naturvårdsverket (2010) study identifies household food waste in Sweden at 100kg per capita per annum, and this was multiplied by the Swedish population in 2006, totalling 905,000 tonnes.

The most comprehensive data on food waste is presented by WRAP in the UK. The 2010 study on supply chain food waste[31] presents up-to-date quantities of food waste arisings in the Manufacturing, Wholesale/Retail and Household sectors. Published at the end of March 2010, the quantities presented here have been updated to reflect changes in UK food waste estimates as a result of this study. The current WRAP estimate on the Food Service sector is unchanged at 3Mt, although a WRAP study on food waste arisings in the Hospitality industry is currently underway which may significantly change this figure.

[30] The Danish Environment Ministry commissioned a major study on food waste in 2010, using comparative examples from MS across Europe. National data for some MS, such as the Netherlands, originated from this report.

[31] WRAP, (2010) *Waste arisings in the supply of food and drink to households in the UK.*

Table 4: Food waste generation in MS as reported by national studies, by sector, in tonnes/year

	Food Manufacturing and Processing industry	Wholesale and retail (including market waste)	Households	Food service and restaurant waste	Source
EU-27					
Austria		267 000	784 570	103 500	Obersteiner & Schneider (2006), Ademilua (2009), BMLFUW (2009)
Belgium					
Bulgaria					
Cyprus					
Czech Republic					
Denmark		45 676	494 914		Danish Environmental Ministry Food Waste Report (2010)
Estonia			82 236	24 564	SEI 2008, EEIC 2008
Finland			90 000		YTV Helsinki 'Food wastage survey' (2009)
France			6 322 944	1 080 000	Danish Environmental Ministry Food Waste Report (2010), ADEME (2004)
Germany				2 000 000	Kohl (2009)
Greece			1 461		Panagiotis & Christopoulos (2005)
Hungary					
Ireland			292 326		Clean Technology Centre/Irish EPA 'Food Waste Prevention and Home Composting' (2009)
Italy					
Latvia					
Lithuania					
Luxembourg					
Malta					
Netherlands			1 837 599		Calculated from Danish Environmental Ministry Food Waste Report (2010)
Poland					
Portugal					
Romania					
Slovakia					
Slovenia				11 405	ARSO (2010)
Spain					
Sweden		110 253	905 000	298 880	Calculated from Naturvårdsverket (2010)
United Kingdom	2 591 000	366 000	8 300 000	3 000 000	WRAP (2010), WRAP (2009)

Source: Various national sources; refer to 'Source' column on right side of table[32]

[32] National data for some MS was sourced from the Danish Environment Ministry report on food waste in Europe

iii. CALCULATING FOOD WASTE GENERATION IN ALL EU MEMBER STATES

In this section, the best available data on food waste in the Manufacturing and Household sectors will be presented. In the Manufacturing sector, a plausibility check will be used to qualify the results of the primary data source, EUROSTAT. In the Household sector, where data is more heterogeneous, a minimum scenario will be used where data is lacking or insufficiently robust.

The remaining food waste generated in the EU, excluding agriculture for the purposes of this study, is classified on EUROSTAT as 'Other Sectors'. Using this and the supplementary data from national studies (see Table 4 above), a best estimate for the division of this food waste between the Wholesale/Retail sector and the Food Service sector has been made. An overview of data limitations and recommendations is presented in the conclusion.

Manufacturing sector

Research on food waste quantities in the Manufacturing sector is limited, and the only clear source identified for food wastage at this level, other than EUROSTAT, was WRAP's 2010 supply chain study for the UK.

EUROSTAT data for this sector is nevertheless comprehensive and fairly comparable. Only three MS, with particularly small populations, lack data: Cyprus, Luxembourg and Malta. A hypothesis was not made for these MS using data from neighbouring countries as food production data was also lacking, and a hypothesis for Luxembourg based on food production and food waste in Belgium was considered unhelpful; missing data for these MS does not affect the overall total significantly.

Based on EUROSTAT data, food waste in the Manufacturing sector represents 76kg per capita in the EU. Per capita ratios were also calculated at the National level, but results yielded by this exercise were so heterogeneous as to be considered unhelpful at MS level, ranging from 393kg per capita in the Netherlands to 7kg per capita in Greece. This high heterogeneity could be consistent with the geographic repartition of the EU food industry, which is highly concentrated in certain countries –such as the Netherlands – and less in others – such as Greece.

Compared to food production levels in each MS however, EUROSTAT data was used to generate proportions of food wastage, ranging from 1% in Germany to 21% in Estonia, and 5% overall for the EU. Please see Table 5 .

Table 5 : Food waste (FW) generation in Manufacturing sector, total (in tonnes) and percentage wasted

	Food production in tonnes EUROSTAT 2006	FW in Manufacturing sector tonnes (EUROSTAT 2006)	WRAP Manufacturing sector FW tonnes	Population EUROSTAT 2006	FW per capita EUROSTAT	% of food wasted with EUROSTAT data	% of food wasted with WRAP data
EU-27	766 179 686	37 307 575		493 194 250	76	**5**	
Austria	9 914 359	570 544		8 254 298	69	**6**	
Belgium	27 470 839	2 311 847		10 511 382	220	**8**	
Bulgaria	4 849 152	358 687		7 718 750	46	**7**	
Cyprus	0	186 917		766 414	244		
Czech Republic	13 034 071	361 813		10 251 079	35	**3**	
Denmark	9 103 122	101 646		5 427 459	19	**1**	
Estonia	1 143 852	237 257		1 344 684	176	**21**	
Finland	9 845 332	590 442		5 255 580	112	**6**	
France	106 199 337	626 000		63 229 443	10	**1**	
Germany	138 078 334	1 848 881		82 437 995	22	**1**	
Greece	6 170 557	73 081		11 125 179	7	**1**	
Hungary	11 702 284	1 157 419		10 076 581	115	**10**	
Ireland	5 382 309	465 945		4 209 019	111	**9**	
Italy	97 088 841	5 662 838		58 751 711	96	**6**	
Latvia	1 606 037	125 635		2 294 590	55	**8**	
Lituania	4 020 685	222 205		3 403 284	65	**6**	
Luxemburg	0	2 665		469 086	6		
Malta	0	271		405 006	1		
Netherlands	50 834 267	6 412 330		16 334 210	393	**13**	
Poland	47 233 940	6 566 060		38 157 055	172	**14**	
Portugal	12 496 826	632 395		10 569 592	60	**5**	
Romania	10 845 823	487 751		21 610 213	23	**4**	
Slovakia	3 841 080	347 773		5 389 180	65	**9**	
Slovenia	1 176 515	42 072		2 003 358	21	**4**	
Spain	101 939 483	2 170 910		43 758 250	50	**2**	
Sweden	5 197 871	601 327		9 047 752	66	**12**	
United Kingdom	87 004 770	5 142 864	2 591 000	60 393 100	85	**6**	3

Source: 2006 EUROSTAT data, (Manufacturing sector from EWC_09_NOT_093)

➢ **Plausibility check**

In order to check the plausibility of the EUROSTAT data, which was the overarching source of data for this sector, the AWARENET[33] study on food waste and by-products and the Arcadis study on the management of Bio-Waste[34] were used. The study provides estimates of food wastes and by-products for different food product categories.

Table 6: Percentage of food wastes and by-products in different processes

Production process	% of wastes and by-products
Fish canning	30-65
Fish filleting, curing, salting and smoking	50-75
Crustaceans processing	50-60
Molluscs processing	20-50
Beef slaughtering	40-52
Pig slaughtering	35
Poultry slaughtering	31-38
Milk, butter and cream production	Negligible
Yoghurt production	2-6
Fresh, soft and cooked cheese production	85-90
White wine production	20-30
Red wine production	20-30
Fruit and vegetables juice production	30-50
Fruit and vegetables processing and preservation	5-30
Vegetable oil production	40-70
Corn starch production	41-43
Potato starch production	80
Wheat starch production	50
Sugar production from sugar beet	86

Source: Fuentes, et. al. (2004) *AWARENET: Agro-Food Wastes Minimisation and Reduction Network*

The food production of each MS is separated into similar categories by EUROSTAT and by AWARENET (please see Table 6). While Table 6 includes both food wastes and by-products and the percentages presented do not show purely food or bio-waste, it is a useful reference point for verifying the range of products and sectors taken into account when measuring food waste.

UK food production by product category was aligned with EUROSTAT categories and the proportion of food waste and by-products in the UK was determined as 15,190,170 tonnes. Using WRAP data on Manufacturing sector food waste in the UK (2,591,000 tonnes), it was determined that in the UK, food waste represents 17% of food waste and by-products. Given a

[33] Fuentes, et. al., (2004) *AWARENET: Agro-Food Wastes Minimisation and Reduction Network.*

[34] Arcadis (2009) *Assessment of the options to improve the management of bio-waste in the European Union*

lack of other data, this ratio was applied to the other MS, as a plausibility check on EUROSTAT Manufacturing sector food waste data.

The AWARENET plausibility check thus shows, for the quantities produced of each category of food in each MS, what proportion of this is “normally” wasted, with the UK as the guideline. The percentage of food waste according to EUROSTAT data and according to the AWARENET scenario are in general reasonably similar. Larger differences from the AWARENET scenario will be accounted for either by inefficiencies in the MS or by discrepancies in data disclosure in those MS. Estonia, the Netherlands and Sweden show particular differences. Please see the Table 7.

EUROSTAT data in the Manufacturing sector was thus able to be taken for the EU27, with the exception of the UK were the more recent WRAP study will be used.

While questions were raised on the potential inflation of Manufacturing sector food waste values due to the inclusion of by-products, notably as a result of differences in the definition and calculation of food waste among MS, Manufacturing sector data presented in this report should be considered as the best available data.

Table 7: Comparison of EUROSTAT and WRAP data with AWARENET scenario

	Food production in tonnes EUROSTAT 2006	FW in Manufacturing sector tonnes (EUROSTAT 2006)	WRAP Manufacturing sector FW tonnes	AWARENET FW and By-products 2004 tonnes	Scenario 17% of AWARENET tonnes	% of food wasted with EUROSTAT data	% of food wasted with WRAP data	% of food wasted with AWARENET scenario
EU-27	766 179 686	37 307 575		174 447 387	29 755 636	**5**		**4**
Austria	9 914 359	570 544		2 013 469	343 439	**6**		**3**
Belgium	27 470 839	2 311 847		4 815 067	821 310	**8**		**3**
Bulgaria	4 849 152	358 687		1 555 522	265 327	**7**		**5**
Cyprus	0	186 917		0	0			
Czech Republic	13 034 071	361 813		2 969 333	506 482	**3**		**4**
Denmark	9 103 122	101 646		2 951 293	503 404	**1**		**6**
Estonia	1 143 852	237 257		296 049	50 497	**21**		**4**
Finland	9 845 332	590 442		2 011 259	343 062	**6**		**3**
France	106 199 337	626 000		22 515 220	3 840 440	**1**		**4**
Germany	138 078 334	1 848 881		37 440 051	6 386 181	**1**		**5**
Greece	6 170 557	73 081		2 116 667	361 042	**1**		**6**
Hungary	11 702 284	1 157 419		2 665 911	454 727	**10**		**4**
Ireland	5 382 309	465 945		1 072 793	182 987	**9**		**3**
Italy	97 088 841	5 662 838		22 924 638	3 910 275	**6**		**4**
Latvia	1 606 037	125 635		345 452	58 924	**8**		**4**
Lituania	4 020 685	222 205		982 404	167 570	**6**		**4**
Luxemburg	0	2 665		0	0			
Malta	0	271		0	0			
Netherlands	50 834 267	6 412 330		9 513 069	1 622 652	**13**		**3**
Poland	47 233 940	6 566 060		13 748 480	2 345 090	**14**		**5**
Portugal	12 496 826	632 395		3 064 803	522 766	**5**		**4**
Romania	10 845 823	487 751		3 819 591	651 511	**4**		**6**
Slovakia	3 841 080	347 773		1 079 955	184 209	**9**		**5**
Slovenia	1 176 515	42 072		214 114	36 522	**4**		**3**
Spain	101 939 483	2 170 910		20 085 422	3 425 987	**2**		**3**
Sweden	5 197 871	601 327		1 056 655	180 235	**12**		**3**
United Kingdom	87 004 770	5 142 864	2 591 000	15 190 170	2 591 000	**6**	3	**3**

Source: 2006 EUROSTAT data (Manufacturing sector from EWC_09_NOT_093), WRAP[35], AWARENET[36]

[35] WRAP (2010) *Waste arisings in the supply of food and drink to households in the UK*

[36] DEFRA (2004) *Total Food: Exploiting co-products – minimizing waste*

Household sector

The most comprehensive data on food waste so far undertaken has focused on the Household (HH) sector, although data remains scattered.

Table 8 shows the EUROSTAT (EWC_09_NOT_093) data for the (HH) sector, as well as the data produced by MS studies. EUROSTAT data for households contains discrepancies that cannot be explained by other factors, such as differences in GDP or environmental awareness. As methodologies for collecting and calculating household data seem to vary so widely among MS EUROSTAT disclosures, a minimum scenario has been used to compare with both EUROSTAT and national data.

Table 8: Household food waste – EUROSTAT, National Studies and Minimum Scenario (in tonnes)

	Population EUROSTAT 2006	HH-Households EUROSTAT 2006 (tonnes)	National studies (tonnes)	Source	Municipal waste	Minimum scenario based on municipal waste (8.375%)
EU27	493 194 250	23 351 264		Eurostat (2010)	254 981 427	21 354 695
Austria	8 254 298	661 300	784 570	Obersteiner & Schneider (2006), Ademilua (2009)	5 092 902	426 531
Belgium	10 511 382	934 760			4 992 906	418 156
Bulgaria	7 718 750	0			3 442 563	288 315
Cyprus	766 414	0			570 978	47 819
Czech Republic	10 251 079	108 723			3 034 319	254 124
Denmark	5 427 459	38 923	494 914	Danish Environmental Ministry Food Waste Report (2010)	4 000 037	335 003
Estonia	1 344 684	1 298	82 236	Calculated from (SEI 2008, EEIC 2008)	626 623	52 480
Finland	5 255 580	95 102	90 000	YTV Helsinki 'The food w astage survey' 2009	2 564 723	214 796
France	63 229 443	2 973 800	6 322 944	Calculated from Danish Environmental Ministry Food Waste Report (2010)	34 965 882	2 928 393
Germany	82 437 995	7 676 471		Eurostat (2010)	46 659 905	3 907 767
Greece	11 125 179	0	1 461	Panagiotis & Christopoulos (2005)	4 928 454	412 758
Hungary	10 076 581	45 509			4 715 840	394 952
Ireland	4 209 019	538 651	292 326	Irish EPA 'Food Waste Prevention and Home CompostingReport' (2009)	3 367 215	282 004
Italy	58 751 711	2 706 793			32 195 938	2 696 410
Latvia	2 294 590	10 466			943 076	78 983
Lithuania	3 403 284	737			1 327 281	111 160
Luxembourg	469 086	62 538			329 298	27 579
Malta	405 006	1 778			264 064	22 115
Netherlands	16 334 210	1 703 416	1 837 599	Danish Environmental Ministry Food Waste Report (2010)	10 208 881	854 994
Poland	38 157 055	2 049 844			9 882 677	827 674
Portugal	10 569 592	0			4 597 773	385 063
Romania	21 610 213	0			8 319 932	696 794
Slovakia	5 389 180	78 546			1 622 143	135 854
Slovenia	2 003 358	25 215			865 451	72 481
Spain	43 758 250	6 950			25 511 060	2 136 551
Sw eden	9 047 752	386 011	905 000	Calculated from Naturvårdsverket (2010)	4 496 733	376 601
United Kingdom	60 393 100	3 244 433	8 300 000	WRAP (2010)	35 511 143	2 974 058

Source: 2006 EUROSTAT data (Household sector from EWC_09_NOT_093), Various national sources (see above for detail)

➢ **Minimum scenario**

The 2009 Arcadis study[37] reports that in countries as different as Belgium and Bulgaria the share of bio-waste in municipal waste is as similar as 35.9 % and 33.5 %, respectively.

Annex A of the study estimates furthermore that food constitutes 25% of bio-waste that is backyard composted. The percentage of bio-waste that is incinerated or aerobically digested varies greatly between 10% and 90%, but is most often 50%. The 25% estimate of food in composted bio-waste was thus taken as a conservative estimate of the food waste in bio-waste overall, lacking more robust data.

The lower estimate of bio-waste in municipal waste (that of Bulgaria at 33.5%) was taken, offering a **minimum scenario of food waste in municipal waste at 8.375%** (33.5% multiplied by 25%). The quantities of municipal waste in the EU27 were collected and 8.375% of these sums was calculated, in order to check the plausibility of EUROSTAT and national data using a completely separate data source. EUROSTAT, national studies and the minimum scenario based on municipal waste data were each calculated per capita by MS, and these values can be easily compared in below.

➢ **Best available data**

The national studies selected were generally considered to be more accurate, based on more intensive research and more rigorous methodologies than disclosure of animal and vegetal waste data under the (HH) Household sector on EUROSTAT.

When no national research was identified, EUROSTAT data was used, unless the per capita quantity was anomalously low.

The lowest minimum scenario, based on 8.375% of municipal waste, was 22kg of food waste per capita per annum in the Household sector. When EUROSTAT or a national study fell below this figure, 22kg was taken instead, as a plausible minimum.

[37] Arcadis (2009) *Assessment of the options to improve the management of bio-waste in the European Union*

Table 9 below clearly indicates whether EUROSTAT, the national study, or the minimum scenario, were selected as the best available data. **The total quantity of household food waste for the EU, based on this selection, is found to be 37.7Mt, and 76kg per capita.**

Table 9: Household food waste per capita (EUROSTAT, national studies and minimum scenario), final data selection and reasoning (kg/capita)

	Household FW EUROSTAT data per capita	National studies per capita	Minimum scenario per capita	Final quantity	Final quantity per capita	Source	Reason
EU27	47	87	43	37 701 761	76		
Austria	80	95	52	784 570	95	Obersteiner & Schneider (2006), Ademilua (2009)	National study considered more accurate
Belgium	89		40	934 760	89	Eurostat (2010)	Only data source
Bulgaria	0		37	288 315	37	Minimum scenario: 8.375%	No data available
Cyprus	0		62	47 819	62	Minimum scenario: 8.375%	No data available
Czech Republic	11		25	254 124	25	Minimum scenario: 8.375%	Other sources below cut off
Denmark	7	91	62	494 914	91	Danish Environmental Ministry Food Waste Report (2010)	National study considered more accurate
Estonia	1	61	39	82 236	61	Calc. from (SEI 2008, EEIC 2008)	National study considered more accurate
Finland	18	17	41	214 796	41	Minimum scenario: 8.375%	Other sources below cut off
France	47	100	46	6 322 944	100	Danish Environmental Ministry Food Waste Report (2010)	National study considered more accurate
Germany	93		47	7 676 471	93	Eurostat (2010)	Only data source
Greece	0	0	37	412 758	37	Minimum scenario: 8.375%	No data available
Hungary	5	0	39	394 952	39	Minimum scenario: 8.375%	Other sources below cut off
Ireland	128	69	67	292 326	69	Irish EPA 'Food Waste Prevention and Home CompostingReport' (2009)	National study considered more accurate
Italy	46		46	2 706 793	46	Eurostat (2010)	Only data source
Latvia	5		34	78 983	34	Minimum scenario: 8.375%	Other sources below cut off
Lithuania	0		33	111 160	33	Minimum scenario: 8.375%	Only data source
Luxembourg	133		59	62 538	133	Eurostat (2010)	Only data source
Malta	4		55	22 115	55	Minimum scenario: 8.375%	Other sources below cut off
Netherlands	104	113	52	1 837 599	113	Danish Environmental Ministry Food Waste Report (2010)	National study considered more accurate
Poland	54		22	2 049 844	54	Eurostat (2010)	Only data source
Portugal	0		36	385 063	36	Minimum scenario: 8.375%	No data available
Romania	0		32	696 794	32	Minimum scenario: 8.375%	No data available
Slovakia	15		25	135 854	25	Minimum scenario: 8.375%	Other sources below cut off
Slovenia	13		36	72 481	36	Minimum scenario: 8.375%	Other sources below cut off
Spain	0		49	2 136 551	49	Minimum scenario: 8.375%	Other sources below cut off
Sweden	43	100	42	905 000	100	calc. from Naturvårdsverket (2010)	National study considered more accurate
United Kingdom	54	137	49	8 300 000	137	WRAP (2010)	National study considered more accurate

Source: 2006 EUROSTAT data (Household sector from EWC_09_NOT_093), Various national sources (see above for detail)

Other Sectors

The remaining food waste generated in the EU, excluding agriculture for the purposes of this study, is classified on EUROSTAT as 'Other Sectors'. Using this and the supplementary data from national studies (see Table 4 above), two scenarios for the division of this food waste between the Wholesale/Retail sector and the Food Service/Catering sector have been generated.

Food waste generated by sectors other than Agriculture, Manufacturing and Households, falls broadly into the Wholesale/Retail sector and the Food Service/Catering sector. Waste from businesses and institutions (schools for example) that is qualitatively similar to household waste is usually collected and treated with municipal waste, so much of this may be classified under the (HH) Household waste stream on EUROSTAT.

■ This section will look at the supplementary evidence from national studies on Retail/Wholesale and Food Service food waste and compare this to EUROSTAT data for 'Other Sectors': please find this in table 10 below.

➢ **Wholesale/Retail sector**

Methodologies used to calculate food waste in this area appear to vary in scope; the data for Austria and Denmark for example focus on retail or retail and market food waste, the other studies include wholesale and distribution food waste specifically.

National data on Wholesale/Retail sector food waste were particularly lacking, with only four national studies identified. Per capita figures for the UK, Denmark and Sweden were quite closely comparable, at 6kg, 8kg and 12kg per capita. Austrian data per capita was anomalously high, at 32kg. To ameliorate this discrepancy, this high figure was excluded and an average of 8.89kg of retail food waste per capita was reached using the British, Danish and Swedish data. Please see table 10 below further details.

The average of 8.89kg per capita is then applied to all those MS lacking national data. A retail food waste estimate is reached using the 2006 populations of those nations. National data is used wherever available and the data used for each MS is clearly presented in table 11.

However, given that all of the available retail food waste data originates from EU15 MS, its pertinence for the EU12 is not known. More detailed data in the retail sector is much needed to gauge the food waste impact of the sector more robustly.

➢ **Food Service/Catering sector**

National data available in this sector came from both the EU15 and the EU12. An average for the EU15 and for the EU12 was thus made separately, as the trend was towards higher food waste in the restaurant and catering sector in the EU15, which may reflect differences in disposable income or consumption of services in this sector. The EU15 (27kg per capita) and the EU12 (12kg per capita) averages were used to complete data for MS lacking other evidence, based on their populations. This can be seen in Table 11,

which clearly indicates where national data was used and where the EU15/EU12 assumptions were inserted.

Table 10: EUROSTAT food waste data on 'Other Sectors'; National FW data on Wholesale/Retail and Food Service/Catering sectors

		EUROSTAT 2006 'Other sectors' tonnes	Other sectors EUROSTAT data per capita	Retail/ Wholesale FW - National studies tonnes	Retail/ Wholesale FW- National studies - kg per capita	Source	Food service/ catering FW - National studies tonnes	Food service/ catering FW - National studies - kg per capita	Source
	Average (excluding extremes)				**8,89**				
	EU15	**14 440 221**						27,32	
	EU12	**2 381 124**						11,98	
	EU27	**16 821 345**	**34**						
EU-15	Austria	502 259	61	267 000	32	BMLFUW (2009) - Only Retail & Market FW	103 500	13	BMLFUW (2009)
EU-15	Belgium	945 308	90						
EU-12	Bulgaria	27 491	4						
EU-12	Cyprus	21 421	28						
EU-12	Czech Republic	112 673	11						
EU-15	Denmark	45 341	8	45 676	8	Danish Environmental Ministry Food Waste Report (2010) - Only Retail FW, 2001 data			
EU-12	Estonia	36 059	27				24 564	18	Calc. from (SEI 2008, EEIC 2008)
EU-15	Finland	207 587	39						
EU-15	France	2 128 974	34				1 080 000	17	ADEME (2004)
EU-15	Germany	862 344	10				2 000 000	24	Kohl (2009)
EU-15	Greece	2 400	0						
EU-12	Hungary	305 840	30						
EU-15	Ireland	292 806	70						
EU-15	Italy	407 530	7						
EU-12	Latvia	10 531	5						
EU-12	Lithuania	248 291	73						
EU-15	Luxembourg	30 829	66						
EU-12	Malta	2 840	7						
EU-15	Netherlands	1 206 057	74						
EU-12	Poland	356 259	9						
EU-15	Portugal	373 767	35						
EU-12	Romania	1 089 466	50						
EU-12	Slovakia	105 021	19						
EU-12	Slovenia	65 232	33				11 405	6	ARSO (2010)
EU-15	Spain	3 387 592	77						
EU-15	Sweden	547 335	60	110 253	12	Naturvårdsverket (2010)	298 880	33	Naturvårdsverket (2010)
EU-15	United Kingdom	3 500 092	58	366 000	6	WRAP 2010	3 000 000	50	WRAP (2008)

Source: 2006 EUROSTAT data (Other Sectors from EWC_09_NOT_093), Various national sources (see above for detail)

Table 11: National data on Wholesale/Retail and Food Service/Catering sectors and assumptions (no EUROSTAT data)

		Retail/ Wholesale FW tonnes	Source	Reason	Wholesale & Retail (kg/c)	Food Service/ Catering tonnes	Source	Reason	Food Service/ Catering (kg/c)	TOTAL tonnes	Wholesale & Retail (%)	Food Service/ Catering (%)
	European Union 27	**4 433 331**			9	**12 263 210**			25	**16 696 541**	**27%**	**73%**
EU-15	Austria	267 000	BMLFUW (2009)	Only sectoral data available	32	103 500	BMLFUW (2009)	Only sectoral data available	13	370 500		
EU-15	Belgium	93 417	Assumption : 8,89kg/c	No data available	9	287 147	Assumption : 27,32kg/c	No data available	27	380 564		
EU-12	Bulgaria	68 598	Assumption : 8,89kg/c	No data available	9	92 472	Assumption : 11,98kg/c	No data available	12	161 071		
EU-12	Cyprus	6 811	Assumption : 8,89kg/c	No data available	9	9 182	Assumption : 11,98kg/c	No data available	12	15 993		
EU-12	Czech Republic	91 104	Assumption : 8,89kg/c	No data available	9	122 810	Assumption : 11,98kg/c	No data available	12	213 914		
EU-15	Denmark	45 676	Danish Environmental Ministry Food Waste Report (2010)	Only sectoral data available	8	148 266	Assumption : 27,32kg/c	Only sectoral data available	27	193 942		
EU-12	Estonia	11 951	Assumption : 8,89kg/c	No data available	9	24 564	Calc. from (SEI 2008, EEIC 2008)	Only sectoral data available	18	36 515		
EU-15	Finland	46 708	Assumption : 8,89kg/c	No data available	9	143 570	Assumption : 27,32kg/c	No data available	27	190 278		
EU-15	France	561 935	Assumption : 8,89kg/c	No data available	9	1 080 000	ADEME (2004)	Only sectoral data available	17	1 641 935		
EU-15	Germany	732 646	Assumption : 8,89kg/c	No data available	9	2 000 000	Kohl (2009)	Only sectoral data available	24	2 732 646		
EU-15	Greece	98 872	Assumption : 8,89kg/c	No data available	9	303 914	Assumption : 27,32kg/c	No data available	27	402 786		
EU-12	Hungary	89 553	Assumption : 8,89kg/c	No data available	9	120 720	Assumption : 11,98kg/c	No data available	12	210 273		
EU-15	Ireland	37 407	Assumption : 8,89kg/c	No data available	9	114 981	Assumption : 27,32kg/c	No data available	27	152 387		
EU-15	Italy	522 140	Assumption : 8,89kg/c	No data available	9	1 604 960	Assumption : 27,32kg/c	No data available	27	2 127 101		
EU-12	Latvia	20 393	Assumption : 8,89kg/c	No data available	9	27 490	Assumption : 11,98kg/c	No data available	12	47 882		
EU-12	Lithuania	30 246	Assumption : 8,89kg/c	No data available	9	40 772	Assumption : 11,98kg/c	No data available	12	71 018		
EU-15	Luxembourg	4 169	Assumption : 8,89kg/c	No data available	9	12 814	Assumption : 27,32kg/c	No data available	27	16 983		
EU-12	Malta	3 599	Assumption : 8,89kg/c	No data available	9	4 852	Assumption : 11,98kg/c	No data available	12	8 451		
EU-15	Netherlands	145 166	Assumption : 8,89kg/c	No data available	9	446 213	Assumption : 27,32kg/c	No data available	27	591 379		
EU-12	Poland	339 111	Assumption : 8,89kg/c	No data available	9	457 130	Assumption : 11,98kg/c	No data available	12	796 240		
EU-15	Portugal	93 934	Assumption : 8,89kg/c	No data available	9	288 737	Assumption : 27,32kg/c	No data available	27	382 671		
EU-12	Romania	192 055	Assumption : 8,89kg/c	No data available	9	258 895	Assumption : 11,98kg/c	No data available	12	450 950		
EU-12	Slovakia	47 895	Assumption : 8,89kg/c	No data available	9	64 564	Assumption : 11,98kg/c	No data available	12	112 458		
EU-12	Slovenia	17 804	Assumption : 8,89kg/c	No data available	9	11 405	ARSO (2010)	Only sectoral data available	6	29 209		
EU-15	Spain	388 890	Assumption : 8,89kg/c	No data available	9	1 195 374	Assumption : 27,32kg/c	No data available	27	1 584 264		
EU-15	Sweden	110 253	Naturvårdsverket (2010)	Only sectoral data available	12	298 880	Naturvårdsverket (2010)	Only sectoral data available	33	409 133		
EU-15	United Kingdom	366 000	WRAP 2010	Only sectoral data available	6	3 000 000	WRAP (2008)	Only sectoral data available	50	3 366 000		
	EU-15	**3 514 212**			9	**11 028 355**			28	**14 542 567**	**24%**	**76%**
	EU-12	**919 119**			9	**1 234 855**			12	**2 153 974**	**43%**	**57%**

Source: 2006 EUROSTAT data (Other Sectors from EWC_09_NOT_093), Various national sources (see above for detail)

➢ **Composition of 'Other Sectors'**

Using the hypotheses made for the Wholesale/Retail and Food Service/Catering sectors, the total food waste of these sectors combined would be 16,035,896 tonnes (see above Table 11). The EUROSTAT data for 'Other Sectors' is, comparably, 16,696,541 tonnes (see table 11). This provides an idea of the possible respective proportions of these two sectors, while it should be noted that for the Retail sector in particular, data is very limited and methodologies of calculation vary widely.

iv. DATA LIMITATIONS

The European Topic Centre on Sustainable Consumption and Production stipulated that a recent study commissioned on agricultural waste and residues was intended to include food processing waste, but was not able to deliver the required data.

Food processing waste has also been excluded from the 'Assessment of the options to improve the management of bio-waste in the European Union', to be published shortly by the European Commission, due to a lack of data.

Birgitte Jørgensen Kjær at the European Topic Centre commented that "in the absence of any European requirement, no systematic data on food processing waste is provided by Member States."

Reliable, standardised data on food waste in the Retail sector was notably difficult to acquire at MS level, and is currently the subject of an Early Day Motion in the UK House of Commons, that would require all large retailers (and manufacturers) to disclose their food waste arisings annually.[38]

It should be noted, that food waste that is home-composted is not included in household food waste estimates and thus estimates should be considered as conservative. All figures presented in this report must thus be considered as approximate estimations representing the best available data.

v. RESULTS

Overall, it is this study's best estimate that 89Mt of food waste are generated in the EU based on 2006 EUROSTAT data and other available recent data.

Two total food waste generation scenarios for the EU27 are presented in this conclusion, as a result of the two scenarios for 'Other Sectors'. At 89.2 and 89.3 Mt respectively (see Table 12 and Table 13 below), they are very similar. It is underlined, however, that this is a best estimate, based on the available data and the expert judgement of the consortium team.

In the Household sector, a minimum value of food waste generation per capita was applied, at 8.375% of the MS municipal waste arisings.

Hypotheses made on the Wholesale/Retail and Food Service/Catering sectors were presented in table 9

[38] Early Day Motion on Food Waste: edmi.parliament.uk/EDMi/EDMDetails.aspx?EDMID=40689

Table 9 to demonstrate a potential breakdown of food waste generation in these sectors in the EU, based on the available evidence. However, the sources available form a weak base for extrapolation across all MS. EUROSTAT data for 'Other Sectors', however, yields highly variable results when food waste generation is compared on a per capita basis across MS (see Table 10). In both scenarios, however, the total results are quite similar.

Table 12 below presents the best estimate of total food waste arisings using the EUROSTAT 'Other Sectors' data and Table 13 shows the best estimate of total food waste arisings using hypotheses for the Wholesale/Retail and Food Service/Catering sectors. It should be noted that while manufacturing and household data is considered to be relatively useful, two scenarios are presented for the other sectors because the available evidence has not been sufficient to allow a more robust proposal.

Table 12: Scenario 1 Total Food Waste Generation in Manufacturing, Household and Other Sectors using best available data (EUROSTAT 09_NOT_093 'Other Sectors' is the source for all MS under 'Other Sectors'; All EUROSTAT data is for 2006, retrieved from database in 2010) in tonnes

	Manufacturing	Source	Households	Source	Other sectors (EUROSTAT)	Total
EU27	34 755 711	Sum of MS data	37 701 761	Sum of MS data	16 820 000	89 277 472
Austria	570 544	EUROSTAT 09_NOT_093 'DA' Sector	784 570	Obersteiner & Schneider (2006), Ademilua (2009)	502 000	1 858 000
Belgium	2 311 847	EUROSTAT 09_NOT_093 'DA' Sector	934 760	EUROSTAT 09_NOT_093 'HH' Sector	945 000	4 192 000
Bulgaria	358 687	EUROSTAT 09_NOT_093 'DA' Sector	288 315	Minimum scenario: 8.375%	27 000	674 000
Cyprus	186 917	EUROSTAT 09_NOT_093 'DA' Sector	47 819	Minimum scenario: 8.375%	21 000	256 000
Czech Republic	361 813	EUROSTAT 09_NOT_093 'DA' Sector	254 124	Minimum scenario: 8.375%	113 000	729 000
Denmark	101 646	EUROSTAT 09_NOT_093 'DA' Sector	494 914	Danish Environmental Ministry Food Waste Report (2010)	45 000	642 000
Estonia	237 257	EUROSTAT 09_NOT_093 'DA' Sector	82 236	Calc. from (SEI 2008, EEIC 2008)	36 000	355 000
Finland	590 442	EUROSTAT 09_NOT_093 'DA' Sector	214 796	Minimum scenario: 8.375%	208 000	1 013 000
France	626 000	EUROSTAT 09_NOT_093 'DA' Sector	6 322 944	Danish Environmental Ministry Food Waste Report (2010)	2 129 000	9 078 000
Germany	1 848 881	EUROSTAT 09_NOT_093 'DA' Sector	7 676 471	EUROSTAT 09_NOT_093 'HH' Sector	862 000	10 387 000
Greece	73 081	EUROSTAT 09_NOT_093 'DA' Sector	412 758	Minimum scenario: 8.375%	2 000	488 000
Hungary	1 157 419	EUROSTAT 09_NOT_093 'DA' Sector	394 952	Minimum scenario: 8.375%	306 000	1 858 000
Ireland	465 945	EUROSTAT 09_NOT_093 'DA' Sector	292 326	Irish EPA 'Food Waste Prevention and Home Composting Report' (2009)	293 000	1 051 000
Italy	5 662 838	EUROSTAT 09_NOT_093 'DA' Sector	2 706 793	EUROSTAT 09_NOT_093 'HH' Sector	408 000	8 778 000
Latvia	125 635	EUROSTAT 09_NOT_093 'DA' Sector	78 983	Minimum scenario: 8.375%	11 000	216 000
Lithuania	222 205	EUROSTAT 09_NOT_093 'DA' Sector	111 160	Minimum scenario: 8.375%	248 000	581 000
Luxembourg	2 665	EUROSTAT 09_NOT_093 'DA' Sector	62 538	EUROSTAT 09_NOT_093 'HH' Sector	31 000	97 000
Malta	271	EUROSTAT 09_NOT_093 'DA' Sector	22 115	Minimum scenario: 8.375%	3 000	25 000
Netherlands	6 412 330	EUROSTAT 09_NOT_093 'DA' Sector	1 837 599	Danish Environmental Ministry Food Waste Report (2010)	1 206 000	9 456 000
Poland	6 566 060	EUROSTAT 09_NOT_093 'DA' Sector	2 049 844	EUROSTAT 09_NOT_093 'HH' Sector	356 000	8 972 000
Portugal	632 395	EUROSTAT 09_NOT_093 'DA' Sector	385 063	Minimum scenario: 8.375%	374 000	1 391 000
Romania	487 751	EUROSTAT 09_NOT_093 'DA' Sector	696 794	Minimum scenario: 8.375%	1 089 000	2 274 000
Slovakia	347 773	EUROSTAT 09_NOT_093 'DA' Sector	135 854	Minimum scenario: 8.375%	105 000	589 000
Slovenia	42 072	EUROSTAT 09_NOT_093 'DA' Sector	72 481	Minimum scenario: 8.375%	65 000	179 000
Spain	2 170 910	EUROSTAT 09_NOT_093 'DA' Sector	2 136 551	Minimum scenario: 8.375%	3 388 000	7 696 000
Sweden	601 327	EUROSTAT 09_NOT_093 'DA' Sector	905 000	calc. from Naturvårdsverket (2010)	547 000	2 053 000
United Kingdom	2 591 000	WRAP (2010)	8 300 000	WRAP (2010)	3 500 000	14 391 000

Source: 2006 EUROSTAT data (EWC_09_NOT_093), Various national sources (see above for detail)

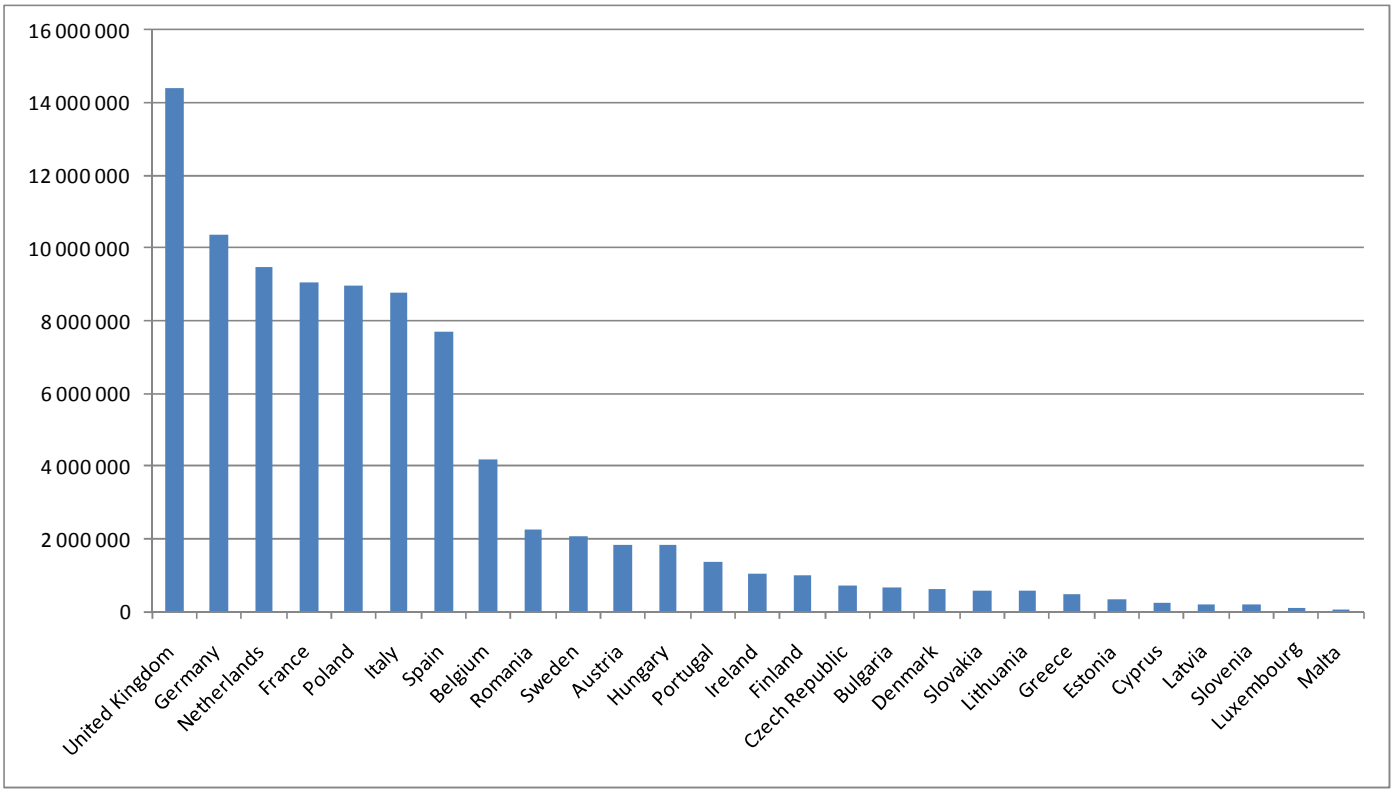
Table 13: Scenario 2 Total Food Waste Generation in Manufacturing, Household, Wholesale/Retail and Food Service/Catering sectors: Best estimate for all sectors using available data in tonnes

	Manufacturing	Source	Households	Source	Retail/Wholesale	Source	Food Service/ Catering	Source	Total
EU27	34 755 711	Sum of MS data	37 701 761	Sum of MS data	4 433 331	Sum of MS data	12 263 210	Sum of MS data	89 154 013
Austria	570 544	EUROSTAT 09_NOT_093 'DA'	784 570	Schneider (2006), Ademilua (2009)	267 000	BMLFUW (2009)	103 500	BMLFUW (2009)	1 725 614
Belgium	2 311 847	EUROSTAT 09_NOT_093 'DA' Sector	934 760	EUROSTAT 09_NOT_093 'HH' Sector	93 417	Assumption : 8,89kg/c	287 147	Assumption : 27,32k	3 627 171
Bulgaria	358 687	EUROSTAT 09_NOT_093 'DA' Sector	288 315	Minimum scenario: 8.375%	68 598	Assumption : 8,89kg/c	92 472	Assumption : 11,98k	808 072
Cyprus	186 917	EUROSTAT 09_NOT_093 'DA' Sector	47 819	Minimum scenario: 8.375%	6 811	Assumption : 8,89kg/c	9 182	Assumption : 11,98k	250 730
Czech Republic	361 813	EUROSTAT 09_NOT_093 'DA' Sector	254 124	Minimum scenario: 8.375%	91 104	Assumption : 8,89kg/c	122 810	Assumption : 11,98k	829 851
Denmark	101 646	EUROSTAT 09_NOT_093 'DA' Sector	494 914	Danish Environmental Ministry Food Waste Report (2010)	45 676	Danish Environmental Ministry Food Waste Report (2010)	148 266	Assumption : 27,32k	790 502
Estonia	237 257	EUROSTAT 09_NOT_093 'DA' Sector	82 236	Calc. from (SEI 2008, EEIC 2008)	11 951	Assumption : 8,89kg/c	24 564	Calc. from (SEI 2008, EEIC 2008)	356 008
Finland	590 442	EUROSTAT 09_NOT_093 'DA' Sector	214 796	Minimum scenario: 8.375%	46 708	Assumption : 8,89kg/c	143 570	Assumption : 27,32k	995 515
France	626 000	EUROSTAT 09_NOT_093 'DA' Sector	6 322 944	Danish Environmental Ministry Food Waste Report (2010)	561 935	Assumption : 8,89kg/c	1 080 000	ADEME (2004)	8 590 879
Germany	1 848 881	EUROSTAT 09_NOT_093 'DA' Sector	7 676 471	EUROSTAT 09_NOT_093 'HH' Sector	732 646	Assumption : 8,89kg/c	2 000 000	Kohl (2009)	12 257 998
Greece	73 081	EUROSTAT 09_NOT_093 'DA' Sector	412 758	Minimum scenario: 8.375%	98 872	Assumption : 8,89kg/c	303 914	Assumption : 27,32k	888 625
Hungary	1 157 419	EUROSTAT 09_NOT_093 'DA' Sector	394 952	Minimum scenario: 8.375%	89 553	Assumption : 8,89kg/c	120 720	Assumption : 11,98k	1 762 643
Ireland	465 945	EUROSTAT 09_NOT_093 'DA' Sector	292 326	Irish EPA 'Food Waste Prevention and Home Composting Report' (2009)	37 407	Assumption : 8,89kg/c	114 981	Assumption : 27,32k	910 658
Italy	5 662 838	EUROSTAT 09_NOT_093 'DA' Sector	2 706 793	EUROSTAT 09_NOT_093 'HH' Sector	522 140	Assumption : 8,89kg/c	1 604 960	Assumption : 27,32k	10 496 732
Latvia	125 635	EUROSTAT 09_NOT_093 'DA' Sector	78 983	Minimum scenario: 8.375%	20 393	Assumption : 8,89kg/c	27 490	Assumption : 11,98k	252 500
Lithuania	222 205	EUROSTAT 09_NOT_093 'DA' Sector	111 160	Minimum scenario: 8.375%	30 246	Assumption : 8,89kg/c	40 772	Assumption : 11,98k	404 383
Luxembourg	2 665	EUROSTAT 09_NOT_093 'DA' Sector	62 538	EUROSTAT 09_NOT_093 'HH' Sector	4 169	Assumption : 8,89kg/c	12 814	Assumption : 27,32k	82 186
Malta	271	EUROSTAT 09_NOT_093 'DA' Sector	22 115	Minimum scenario: 8.375%	3 599	Assumption : 8,89kg/c	4 852	Assumption : 11,98k	30 838
Netherlands	6 412 330	EUROSTAT 09_NOT_093 'DA' Sector	1 837 599	Danish Environmental Ministry Food Waste Report (2010)	145 166	Assumption : 8,89kg/c	446 213	Assumption : 27,32k	8 841 307
Poland	6 566 060	EUROSTAT 09_NOT_093 'DA' Sector	2 049 844	EUROSTAT 09_NOT_093 'HH' Sector	339 111	Assumption : 8,89kg/c	457 130	Assumption : 11,98k	9 412 144
Portugal	632 395	EUROSTAT 09_NOT_093 'DA' Sector	385 063	Minimum scenario: 8.375%	93 934	Assumption : 8,89kg/c	288 737	Assumption : 27,32k	1 400 130
Romania	487 751	EUROSTAT 09_NOT_093 'DA' Sector	696 794	Minimum scenario: 8.375%	192 055	Assumption : 8,89kg/c	258 895	Assumption : 11,98k	1 635 495
Slovakia	347 773	EUROSTAT 09_NOT_093 'DA' Sector	135 854	Minimum scenario: 8.375%	47 895	Assumption : 8,89kg/c	64 564	Assumption : 11,98k	596 086
Slovenia	42 072	EUROSTAT 09_NOT_093 'DA' Sector	72 481	Minimum scenario: 8.375%	17 804	Assumption : 8,89kg/c	11 405	ARSO (2010)	143 763
Spain	2 170 910	EUROSTAT 09_NOT_093 'DA' Sector	2 136 551	Minimum scenario: 8.375%	388 890	Assumption : 8,89kg/c	1 195 374	Assumption : 27,32k	5 891 725
Sweden	601 327	EUROSTAT 09_NOT_093 'DA' Sector	905 000	calc. from Naturvårdsverket (2010)	110 253	Naturvårdsverket (2010)	298 880	Naturvårdsverket (2(	1 915 460
United Kingdom	2 591 000	WRAP (2010)	8 300 000	WRAP (2010)	366 000	WRAP 2010	3 000 000	WRAP (2008)	14 257 000

Source: 2006 EUROSTAT data (EWC_09_NOT_093), Various national sources (see above for detail)

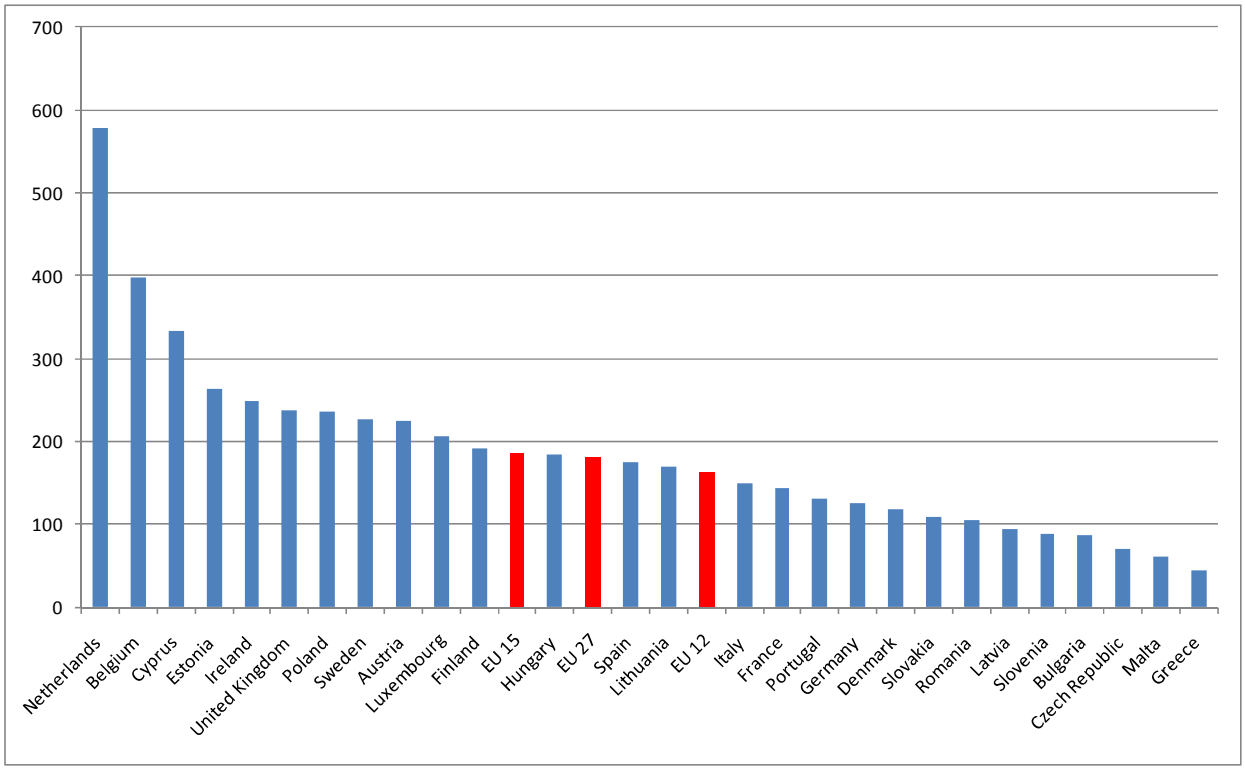
Total food waste arisings are presented in Figure 4 below, based on Scenario 1 (using EUROSTAT 'Other Sectors' data), and are presented per capita in Figure 5. Food waste arisings per capita are particularly high in the Netherlands, as a result of its comparatively large food manufacturing sector. To ameliorate this anomaly, Figure 6 presents the percentage of food wasted in the Manufacturing sector, by comparing food production data to Manufacturing sector food waste generation.

Figure 4: Total food waste arisings by MS based on best available data (tonnes per year)



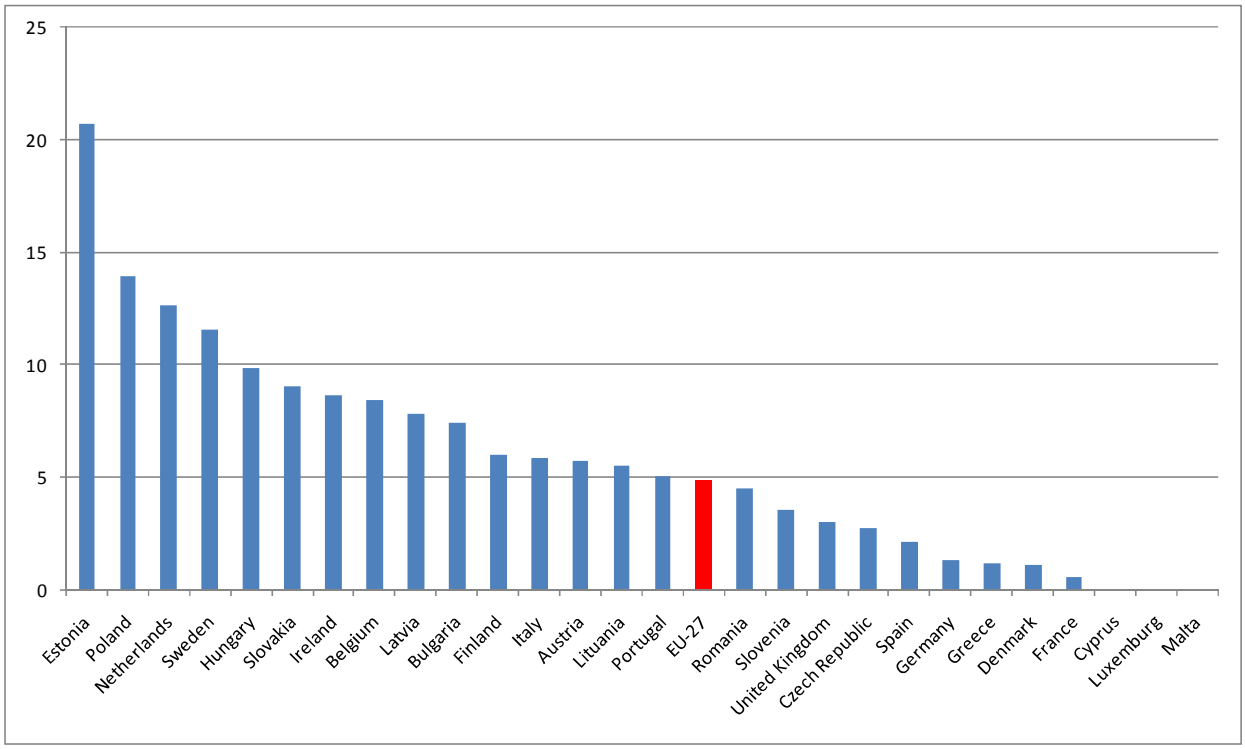
Source: 2006 EUROSTAT data (EWC_09_NOT_093), Various national sources [Scenario 1]

Figure 5: Total food waste arisings by MS based on best available data (kg per capita per year)



Source: 2006 EUROSTAT data (EWC_09_NOT_093), Various national sources [Scenario 1]

Figure 6: Percentage of food wasted in the Manufacturing sector by MS (Food waste in Manufacturing sector/Food production, %)

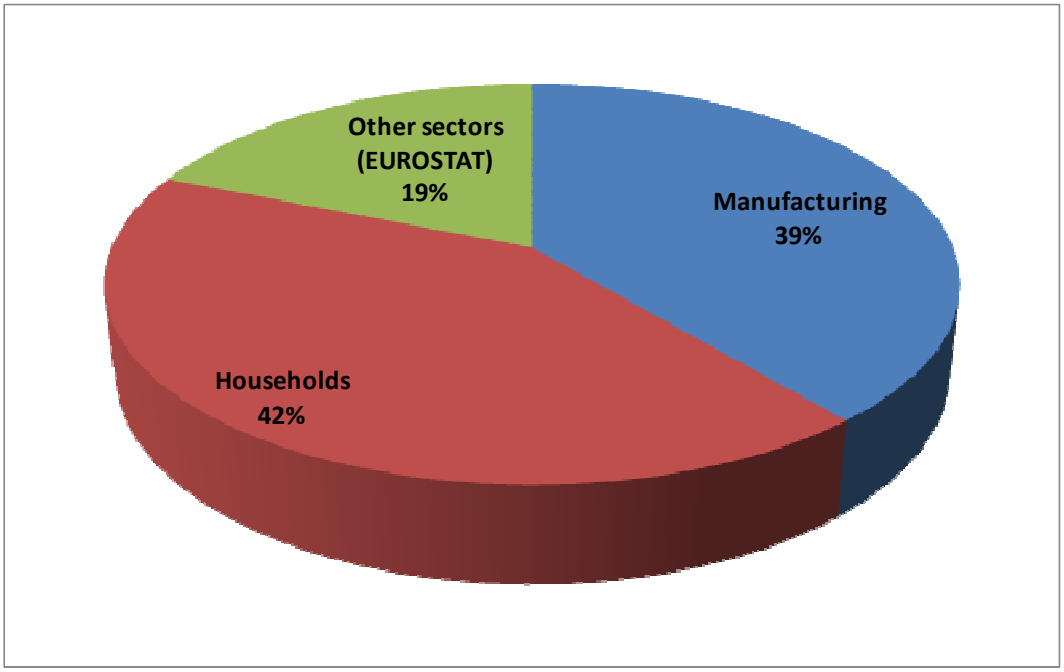


Source: 2006 EUROSTAT data (EWC_09_NOT_093), Various national sources [Scenario 1]

An analysis by sector, based on two data scenarios explained above, shows that households produce the greatest proportion of food waste, justifying the focus of both quantitative research and prevention initiatives on the Household sector. The Household sector, moreover, generates predominantly avoidable food waste (two thirds of Household food waste arisings according to WRAP)[39]. Figure 7 and Figure 8 show the breakdown of food waste by sector, according to the two methodologies presented for 'Other Sectors'.

The Manufacturing sector generates 39% of total food waste arisings, which according to stakeholders is predominantly unavoidable food waste[40], although research to evidence this is lacking.

Figure 7: Scenario 1 Percentage breakdown of EU27 food waste arisings by Manufacturing, Households, and 'Other Sectors'

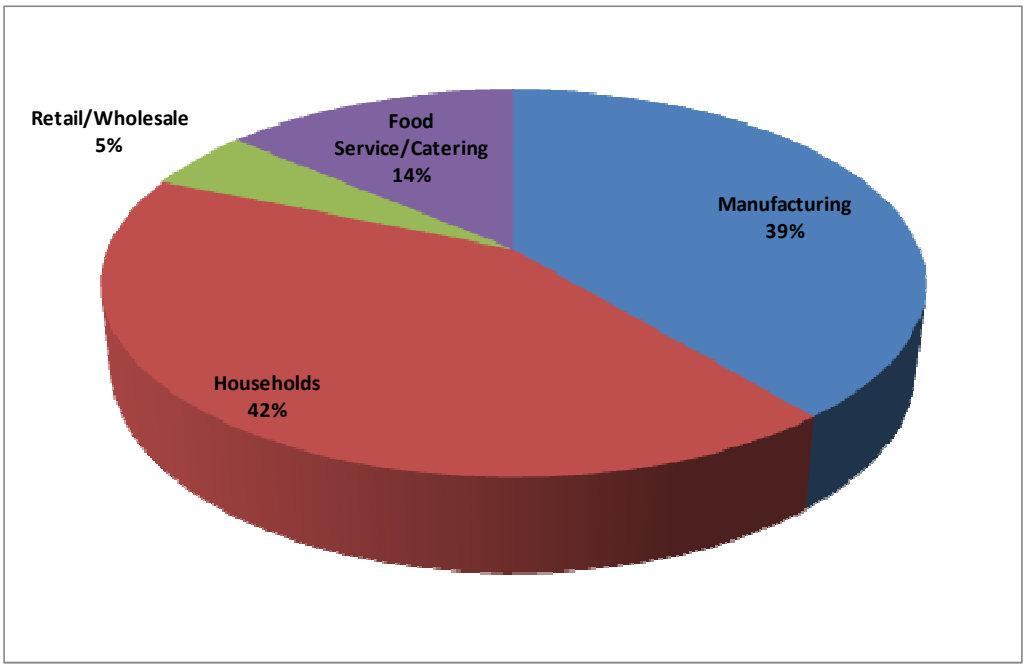


Source: 2006 EUROSTAT data (EWC_09_NOT_093), Various national sources [Scenario 1]

[39] WRAP (2009) *Household food and drink waste in the UK*

[40] According to Charlotte Henderson on WRAP, in a stakeholder interview BIO conducted in February 2010.

Figure 8: Scenario 2 Percentage breakdown of EU27 food waste arisings by Manufacturing, Households, Wholesale/Retail, and Food Service/Catering sectors



Source: 2006 EUROSTAT data (EWC_09_NOT_093), Various national sources [Scenario 2]

The Wholesale/Retail sector, while identified according to Scenario 2 as generating the smallest proportion of food waste at 5%, is also the area where data is the most scarce. Although few studies were identified on food waste in the Manufacturing sector, the EUROSTAT data presented itself as reasonably robust and comparable for a majority of MS. In the Wholesale/Retail sector however, EUROSTAT does not provide explicit data for this category, and only five national studies were available, and it was deemed necessary to exclude the two extremes among these, as anomalies. Moreover, the categorisation and methodologies of data collection and calculation were particularly varied compared to other sectors. Stakeholders such as author Tristram Stuart and EUROPEN cited the retail sector as worthy of particular attention in future data gathering, due to the limited availability of existing reliable data in this sector.

To provide context for this data, international data sources by sector were sought. The United States Department of Agriculture identified Retail sector food loss at 2% in 1995[41], which compares well to our estimate for the Wholesale/Retail sector at 5%, considering that food waste linked to wholesale and distribution is included in our sectoral definition. In the Food Service sector, 4% to 10% of food purchases are estimated to become waste before reaching a customer, though Food Service waste as a proportion of total US food waste was not available.

[41] Economic Research Service, USDA (1997) *Estimating and addressing America's food losses*

vi. DATA VALIDATION

In order to assess data reliability, BIO Intelligence Service spoke with two members of the EUROSTAT Waste Statistics team to understand possible caveats to the data presented above. The EUROSTAT Waste Statistics team highlighted the difficulty of effectively separating out by-products in the reporting and validation of animal and vegetal waste figures. Therefore, the figures presented above may potentially be inflated due to quantities of by-products included. However, EUROSTAT has made MS aware of this challenge and provides specific guidelines on how to distinguish waste from by-products. Assistance and clarification is also provided to MS, as requested, on a case by case basis. As part of the most recent iteration of the animal and vegetal waste data collection and validation, EUROSTAT is completing additional evaluation and intra-data comparability tests to further improve waste data robustness.

The above estimates were also submitted to a sample of stakeholders in order to get their feedback on the estimated tonnages. Stakeholder comments and questions were linked to national level data and manufacturing sector data.

National level data

The CIAA furnished BIO Intelligence Service with additional data on household food waste production in Belgium. Data cited on the Bruxelles Environnement website[42] estimates household food waste at 15 kg/capita/year, while EUROSTAT data shows food waste production in Belgium reaching 89 kg/capita/year. A potential adjustment to the EUROSTAT figure would require additional consultation with Bruxelles Environnement to ensure definitional alignment, as 15 kg/capita/year appears particularly low in comparison with figures for food waste production per capita across the EU27, representing on average 74 kg/capita/year. The original source of the 15 kg/capita/year information is unclear.

The Ministry of the Environment noted that Italy's final data for food waste produced and food waste per household seemed higher than data provided earlier in the study. Data provided by the Italian Ministry of Environment indicated household food waste was 24,62 kg/capita for the reference 2000 (obtained via projection from data collection in the year 1996), while data calculations from EUROSTAT data resulted in 46 kg/capita for the reference year 2006. BIO Intelligence Service could include Italy's data estimations in Table 8 reflecting national studies providing data on food waste. However, due to the significantly earlier date of the Italian data combined with uncertainty on definitional alignment of food waste, BIO Intelligence Service assessed that EUROSTAT data provided a more accurate and updated picture of household food waste production quantities in Italy.

Wageningen University and Research Centre in the Netherlands provided data from a study which is currently being finalised by CREM43 on household waste. This study estimated total household food waste (avoidable and unavoidable) at 72.9 kg/capita/year, a drop from the 113 kg/capita/year currently included in BIO's calculations. In BIO's calculations, original EUROSTAT data was modified

[42] Bruxelles Enviornnement, 'Eviter le gaspillage alimentaire' : www.bruxellesenvironnement.be/Templates/Particuliers/informer.aspx?id=3702&langtype=2060

[43] Not yet published.

based on figures in the Danish Environmental Ministry Food Waste Report (2010), considered more accurate, which estimated household food waste at 76-149 kg/capita/year with an average of approximately 112.5 kg/capita/year. Pending the finalisation and validation of the CREM data, BIO Intelligence Service could potentially incorporate the data change, particularly as the definition of household food waste in the CREM study aligns with the current study's definition (portion of MSW which is food waste, organic waste including vegetables and fruits and food-related products disposed of in the sink).

Manufacturing sector

The European Commission expressed surprise at the figure of food waste generated (excluding by-products) representing 5% of food production (in volume), due to expectations of a focus on cost reduction and resource efficiency in the food manufacturing sector to maintain competitive advantage.

Feedback from the CIAA, which represents the European food and drink industry, indicated that this percentage is most likely highly variable across MS and food sub-sectors. Dale Farm, a northern-Ireland based dairy manufacturer, indicated that for dairy manufacturing 5% seemed high for the production of liquid products, which have a benchmark of 0.75% to 1.75%; however, other dairy-related products have varying percentages of food waste associated with their manufacture.[44] For example, the production of butter would most likely be higher than 1.75% but not necessarily as high as 5%.

Stakeholder feedback from CLITRAVI indicated that in the meat processing industry this percentage is also highly variable depending on the type of meat product being produced. However, for processed meat the figure was estimated at 0.4 to 0.5%[45]. A manufacturer based in the Netherlands cited this percentage as approximately 0.01% for their operations.[46]

The CIAA also cited the difficulty of disaggregating food and packaging waste, indicating that potential inflations in this figure could be due to the challenge of effectively separating packaging waste and by-products from food waste volumes. Additionally, both CIAA and Dale Farm cited the competitively-sensitive nature of this data, hence the lack of accurate publically available information. Dairy Crest, a UK dairy manufacturer, noted that food wastage information related to production was measured and used at a facilities management-level and hence was not publically available.[47]

Lone Lykke Nielson of the Danish Ministry of the Environment also highlighted the potential for varied methods of calculation of Manufacturing-sector related food waste.

However, the largest issue related to measuring Manufacturing sector food waste remains methodology and definitional standardisation. The EUROSTAT waste statistics team highlighted the admitted difficulty of separating by-products from food waste across all the sectors measured.

[44] Interview with Dale Farm, July 2010: www.dalefarm.co.uk/
[45] Communication with CLITRAVI, July 2010
[46] Ibid
[47] Interview with Dairy Crest, July 2010: www.dairycrest.co.uk/

Conclusions

In relation to the national level data presented above, given the significantly earlier date of the Italian data combined with uncertainty on definitional alignment of food waste, BIO Intelligence Service assessed that EUROSTAT data provided a more accurate and updated picture of household food waste production quantities in Italy. Hence, no changes were made to the Italy data presented in 1.2.

While the data provided by Belgium is not as robust as that of the Netherlands, the inclusion of either sets of updated quantities modifies overall EU27 food waste quantities by less than 1% (-0.7% change for the Netherlands, -0.9% change for Belgium). While the impact of modifying the household food waste quantities for Belgium and the Netherlands could have more of a significant impact at a national level, their modification does not impact broader hypotheses and predictions related to EU27 food waste volume and future growth outlined in Chapter 3.

As regards the Manufacturing sector data, BIO Intelligence Service acknowledges the potential high level of variability in food waste produced in the Manufacturing sector. However, due to limited feedback, which only represents two sectors (dairy and meat) and is limited to the EU15, it is difficult to draw robust conclusions on the issue. While industry feedback indicates that the average 5% of waste produced appears to be inflated, potentially due to the inclusion of by-products or other production-related waste, in absence of other data, the EUROSTAT figures remain the only EU27 estimate available of food waste produced. This issue highlights the importance of the implementation of standardised and rigorous data reporting for food waste across all sectors in the EU in order to truly assess the order of magnitude of the problem as well as target waste sources and causes in order to optimise prevention activities.

Food waste as a portion of food purchased

According to WRAP's 2009 report on *Household Food and Drink Waste in the UK,* the amount of food[48] wasted per year is 25% of that purchased (by weight). Although data for other MS is unavailable, a similar US study found that on average 14% of household purchases become food waste.[49] While food wasted as a percentage of food purchased could vary across MS, WRAP's data appears to provide the most robust estimation of this value for the EU. Furthermore, WRAP estimates that the portion of this food waste which could be avoided represents a total economic cost to households of £12 billion (€14.1 billion) per year, an average of £480 (€565) per household per year[50].

Despite thorough literature research, no data was available on an EU scale.

[48] Including liquid and solid foods but excluding drink

[49] Foodproductiondaily.com, 'Half of US food goes to waste': www.foodproductiondaily.com/Supply-Chain/Half-of-US-food-goes-to-waste

[50] WRAP (2009) *Household Food and Drink Waste in the UK*

1.3 QUANTITATIVE ASSESSMENT OF ENVIRONMENTAL IMPACT OF FOOD WASTE

This chapter aims at identifying the environmental impacts of food wastage along its life cycle.

Methodological elements

The idea was to use a life cycle approach to assess the environmental impacts in quantitative terms as far as possible. However, due to resources constraints, it was obviously not possible to carry out a new LCA. The approach thus consists in identifying available reports and extracting data from which extrapolations can be made for the purpose of this study.

The following life cycle steps are distinguished:

- **Agriculture**
- **Food processing**
- **Distribution and retail**
- **Final use: households and restaurants**
- **Waste treatment**

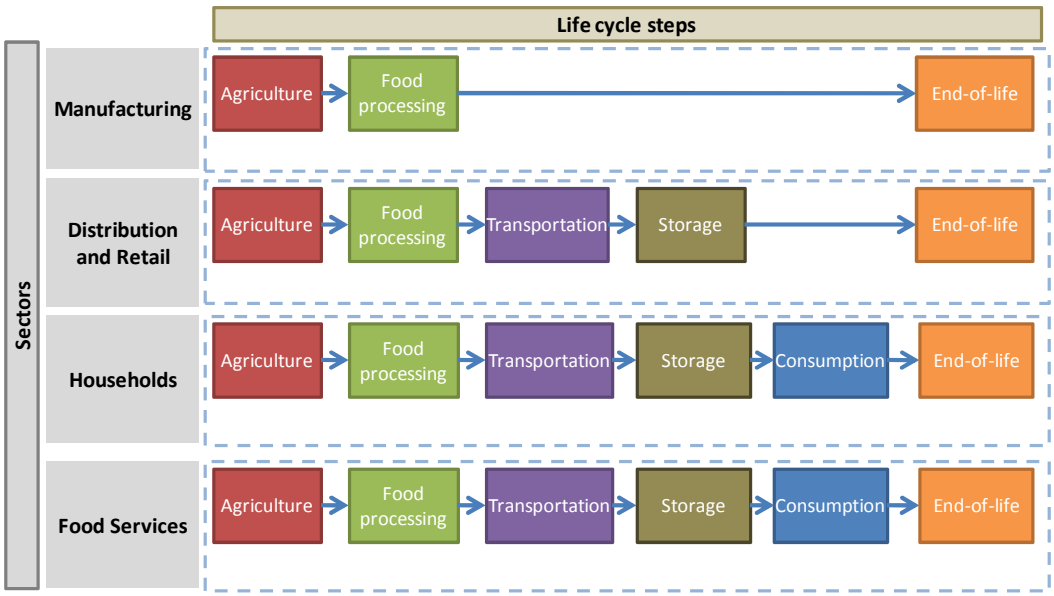
In order to facilitate the use of the data in the following sections, the functional unit used is “tonne of food waste”.

The results are presented for each sector considered in this study (Manufacturing, Wholesale/Retail, Food Service/Catering, Households) as well as for the whole EU27. In most reviewed reports, the sectors considered were different from the ones defined for the present study. Therefore, when necessary, figures have been reallocated accordingly.

Data shown in tables is always cumulated, unless otherwise mentioned. This means that for instance impacts falling under the “Distribution and Retail” category are the sum of impacts occurring throughout the life cycle, from agriculture to retail, plus end-of-life impacts.

Figure 9 (below) indicates, for each sector (Manufacturing, Wholesale/Retail, Food Service/Catering, Households), which life cycle steps are considered when assessing food waste environmental impacts.

Figure 9: Life cycle steps considered for each sector



In all the studies reviewed, GHG are quantified. Some of them also quantify additional environmental impacts (eutrophication, resource depletion, ecotoxicity, etc.). A definition of all environmental impacts included in this section is presented in Appendix 5.

Review of available data about the environmental impacts of food life cycle

Among the different sources available to assess the environmental impacts of food waste, only a few were identified as relevant:

- WRAP (2010) *Waste arisings in the supply of food and drink in the UK*
- BIOIS (2010) *Technical support to identify product categories with significant environmental impact and with potential for improvement by making use of ecodesign measures*
- JRC (2008) *IMPRO Meat & Dairy*
- NAMEA (2009) *ETC/SCP working paper 1/2009*
- Sander (2008) *Climate protection potentials of EU recycling targets*

➢ **WRAP (2010) – referred to as study [1] later in the section**

The WRAP study on "Waste arisings in the supply of food and drink in the UK" has been identified as one of the most relevant due to similar objectives and transparent enough data, although the scope of the study is limited to the UK. One of the objectives of the WRAP report is to quantify the environmental impacts of food waste generated in the UK.

The only indicator calculated in the WRAP study is the global warming potential. This choice is motivated by the fact that accounting for GHG is

the most widely used method to assess the environmental impact of a product. Thus, environmental improvement objectives are often given in terms of a reduction of CO_2 equivalent emissions (as in "Food 2030" (Defra, 2010) or "How low can we go?" (WWF, 2009)).

The WRAP study presents the following key results.

Table 14: Estimated UK annual carbon impact of UK food and drink supply chain and households

Supply chain stage	Per unit impact (t CO_2 eq/t of food waste), including end-of-life treatment
Manufacturing	2.4
Distribution	2.8
Retail	3.2
Household	3.8

Source: WRAP (2010) Food Waste Arisings, p.72, Table 28

As WRAP's breakdown of the supply chain does not exactly fit with the sectors examined in the current study, above-mentioned impacts were reallocated for the purpose of this study as follows:

Table 15: GHG emissions per sector, per tonne of food wasted (Based on WRAP (2010) Food Waste Arisings)

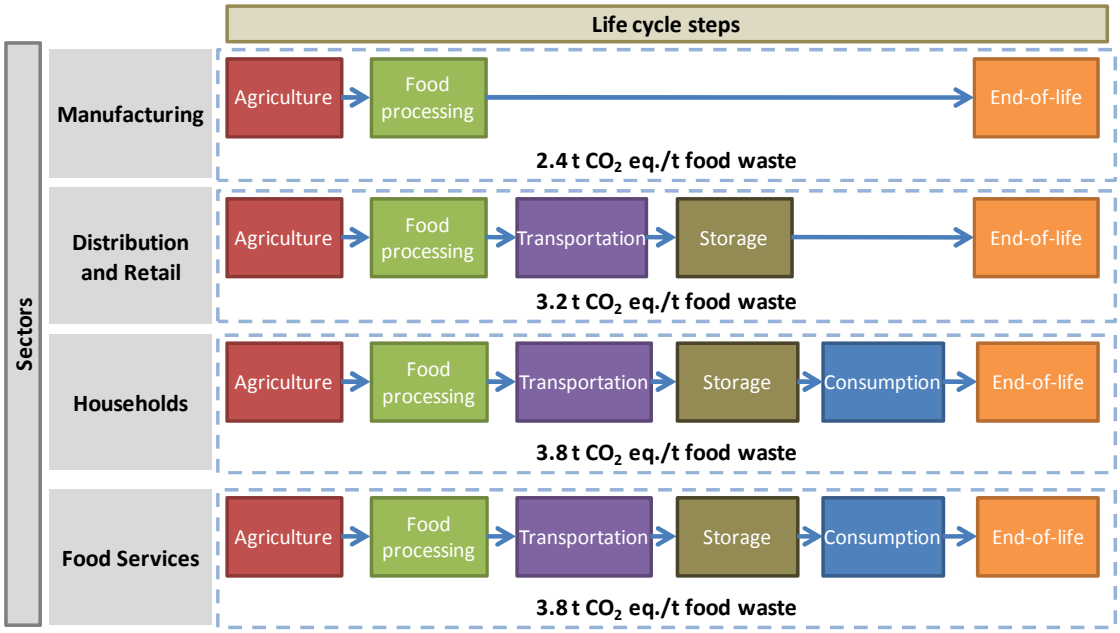
Sector	Data which can be extrapolated for the present study	Assumption
	t CO_2 eq./t of food waste	
Manufacturing	2.4	WRAP data
Distribution and retail	3.2	Distribution food waste arisings representing only 1% of Retail ones[51], Retail impact was applied
Households	3.8	WRAP data
Food services	3.8	Assumed to be the same as Households, both being end use sectors

Source: Based on WRAP (2010) Food Waste Arisings

The following figure summarises the data that can be extrapolated from the WRAP study for the purpose of the present study.

[51] According to WRAP (2010) Food Waste Arisings, p.72, Table 28, Distribution food waste arisings represent 0.004 million tonnes whereas Retail food waste arisings represent 0.36 million tonnes.

Figure 10: GHG emissions per tonne of food waste and per sector (based on WRAP (2010) Food Waste Arisings)



Source: Based on WRAP (2010) Food Waste Arisings

In the same study, WRAP estimates that emissions from disposal amount to 0.45 tonnes of CO_2 eq per tonne of food waste, data which will be further used when considering other studies below.

- **Ecodesign Workplan (2010, EIPRO data) – referred to as study [2] later in the section**

Another report containing useful information is the EIPRO study (top-down input-output approach), which provided data for the elaboration of the Ecodesign Workplan[52] in the chapter dedicated to food products. The EIPRO study adopted a cradle-to-gate [53] approach, meaning that the data presented cover all the steps from agriculture up to the exit from the production plant, with the transportation step being included. All the other steps downstream, such as retail, households and food services, and end-of-life, are not included. Several environmental impacts are quantified, as presented in **Table 16**. Definitions of those impacts are included in the technical Glossary for Task 1.4 presented in Appendix 5.

[52] BIOIS (2010) *Technical support to identify product categories with significant environmental impact and with potential for improvement by making use of ecodesign measures*

[53] Environmental Impact of Products (EIPRO), page 183, section 5.3.3: www.leidenuniv.nl/cml/ssp/publications/22284_eipro_annex_report.pdf

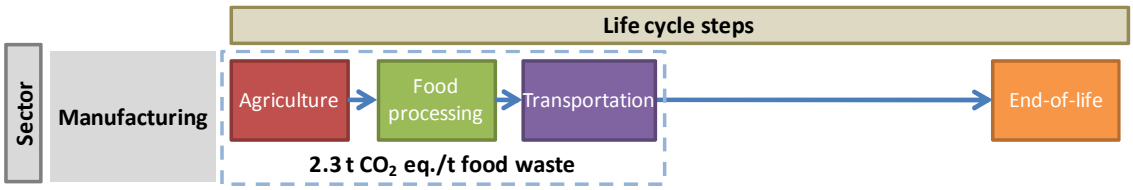
Table 16: Environmental impacts of food production in the EU27, as estimated in Ecodesign Workplan (2010) based on the EIPRO study

Product Family	Product Categories	Total Environmental Impacts by Category				
		GWP 100 (kg CO_2 eq./yr)	Eutrophication (kg PO_4 eq./yr)	Abiotic resource depletion (kg antimony eq./yr)	Human toxicity (kg 1,4-dichlorobenzene eq./yr)	Ecotoxicity (kg 1,4-dichlorobenzene eq./yr)
Food	Meat & meat products	5.6E+11	6.2E+09	-5.9E+10	9.2E+09	3.6E+10
	Dairy products	2.1E+11	2.5E+09	-2.7E+10	3.9E+09	1.7E+10
	Fruit & vegetables	9.2E+10	5.4E+08	-1.4E+10	2.0E+09	1.1E+10
	Table oil & frying fat	5.7E+10	4.6E+08	-7.0E+09	1.0E+09	5.5E+09
	Beverages (non-alcoholic & alcoholic)	7.3E+10	4.6E+08	-1.2E+10	2.0E+09	6.4E+09
	Bakery products	8.1E+10	1.9E+09	-1.2E+10	1.8E+09	7.6E+09
	Coffee, tea, & cocoa	3.0E+10	2.2E+08	-4.6E+09	7.1E+08	2.8E+09
	Grains & pasta	2.7E+10	7.7E+08	-4.2E+09	5.7E+08	2.1E+09
	Fish & fish products	4.5E+10	1.7E+08	-7.6E+09	7.1E+08	2.0E+09
	Jam & sweet products	3.9E+10	5.6E+08	-6.1E+09	9.5E+08	5.9E+09
	Others (Processed foods - cereal, potato chips, etc.)	7.0E+10	1.1E+09	-1.0E+10	1.6E+09	6.6E+09
	Total	1.3E+12	1.5E+10	-1.6E+11	2.5E+10	1.0E+11
	Total per kg food[54]	2.287	0.026	-0.293	0.044	0.182

Source: Ecodesign Workplan (2010), page 51 Table 15; Calculations for total figure

A summary of the cradle-to-gate environmental impacts represented in the Ecodesign Workplan which can extrapolated for the purposes of the current study can be summarised in the graphic below.

Figure 11: GHG emissions per tonne of food waste and per sector (based on Ecodesign Workplan (2010))



Source: Calculations based on Ecodesign Workplan (2010)

- **JRC IMPRO Meat & Dairy (2008)**

This study focuses only on **meat and dairy** products with an input-output approach (top-down). These food product categories were indeed found to be the main contributors in the environmental impact of food products in the EIPRO (2006) study.

The IMPRO Meat & Dairy study shows that the consumption of meat and dairy products in the EU27 has an impact of 66.9 Mt of CO_2 eq. In

[54] On the basis of 562.4 Mt per year for EU27 (Prodcom 2007)

comparison, the Ecodesign Workplan study shows that impacts from these food product categories are as high as 77 Mt of CO_2 eq. in the EU27. The orders of magnitude are similar.

- **ETC/SCP working paper 1/2009 (NAMEA) – referred to as study [3] later in the section**

In the section "Eating and drinking" of this recent working paper, a top-down approach based on assumptions was carried out in order to account for environmental impacts of the whole food chain. For example, a share of impacts from electricity consumption in households was allocated to food products; in the same way, an assumption was made regarding the share of impacts from the "hotel and restaurant services" sector for which food products are actually responsible.

Impacts are calculated on a per capita basis.

Table 17 presents the impacts for the whole EU27 area[55]. The percentages in parentheses in the first column of **Table 17** indicate which shares of each sector were considered attributable to food products. Calculated impacts do not include end-of-life environmental impacts.

Table 17: Environmental impacts attributable to the "Eating and drinking" activity sector (excluding end-of-life impacts) – impacts are not cumulated

Industrial sectors	GHG emissions		Acidification		Photochemical oxidation		Resource depletion	
	t CO2 eq. per capita	Mt CO2 eq./yr EU27	kg SO2 eq. per capita	kt SO2 eq./yr EU27	kg NMVOC eq. per capita	kt NMVOC eq./yr EU27	tonnes per capita	Mt resources /yr EU27
Products of agriculture, hunting and forestry	0.4	200	4.9	2449	1.8	899	1.1	550
Fish and other fishing products, services incidental to fishing	0.02	10	0.2	100	0.3	150	0	0
Food products, beverages and tobacco	1	500	9.7	4847	5.3	2648	2	999
Electrical energy, gas, steam and hot water (20%)	0.3	150	1.6	800	0.6	300	0.2	100
Wholesale and retail trade services, personal and household goods (20%)	0.1	50	0.7	350	0.9	450	0.1	50
Hotel and restaurant services (50%)	0.2	100	1.7	849	1.3	650	0.3	150
Total "Eating and drinking"	**2.02**	**1009**	**18.8**	**9394**	**10.2**	**5097**	**3.7**	**1849**

Source: ETC/SCP working paper 1/2009 for data per capita; Calculations based on EUROSTAT (2009)

According to **Table 17**, 1.0 Gt of CO_2 eq. is released per year at an EU27 level, while the Ecodesign Workplan study reports a slightly higher value of 1.3 Gt of CO_2 eq. (based on EIPRO). The approaches of both studies are similar (calculations are made from environmentally-extended input-output tables), but the time scope is different (2004 data for the ETC/SCP working paper, 2007 for Ecodesign Workplan).

[55] A number of 499695154 inhabitants was taken into account, based on Eurostat (2009)

Regrouping NAMEA industrial sectors to match the present study's sector breakdown[56], **Table 18** can be obtained.

Table 18: Environmental impacts attributable to each sector (excluding end-of-life impacts) – impacts are not cumulated

Industrial sectors	GHG emissions		Acidification		Photochemical oxidation		Resource depletion	
	t CO_2 eq. per capita	Mt CO_2 eq.	kg SO_2 eq. per capita	kt SO_2 eq.	kg NMVOC eq. per capita	kt NMVOC eq.	tonnes per capita	Mt resources
Agriculture	0.42	210	5.1	2548	2.1	1049	1.1	550
Food processing	1	500	9.7	4847	5.3	2648	2	999
Distribution and retail	0.1	50	0.7	350	0.9	450	0.1	50
Households	0.3	150	1.6	800	0.6	300	0.2	100
Restaurants	0.2	100	1.7	849	1.3	650	0.3	150
Total	**2.02**	**1009**	**18.8**	**9394**	**10.2**	**5097**	**3.7**	**1849**

Source: Calculated from the ETC/SCP working paper 1/2009

Dividing by the total amounts of food and drinks produced in EU27 (562.4 Mt, source: Ecodesign Workplan, based on Prodcom data), it is possible to calculate per unit impacts. These are presented in **Table 19** below.

Table 19: Environmental impacts attributable to each sector, per tonne of food waste (excluding end-of-life impacts)

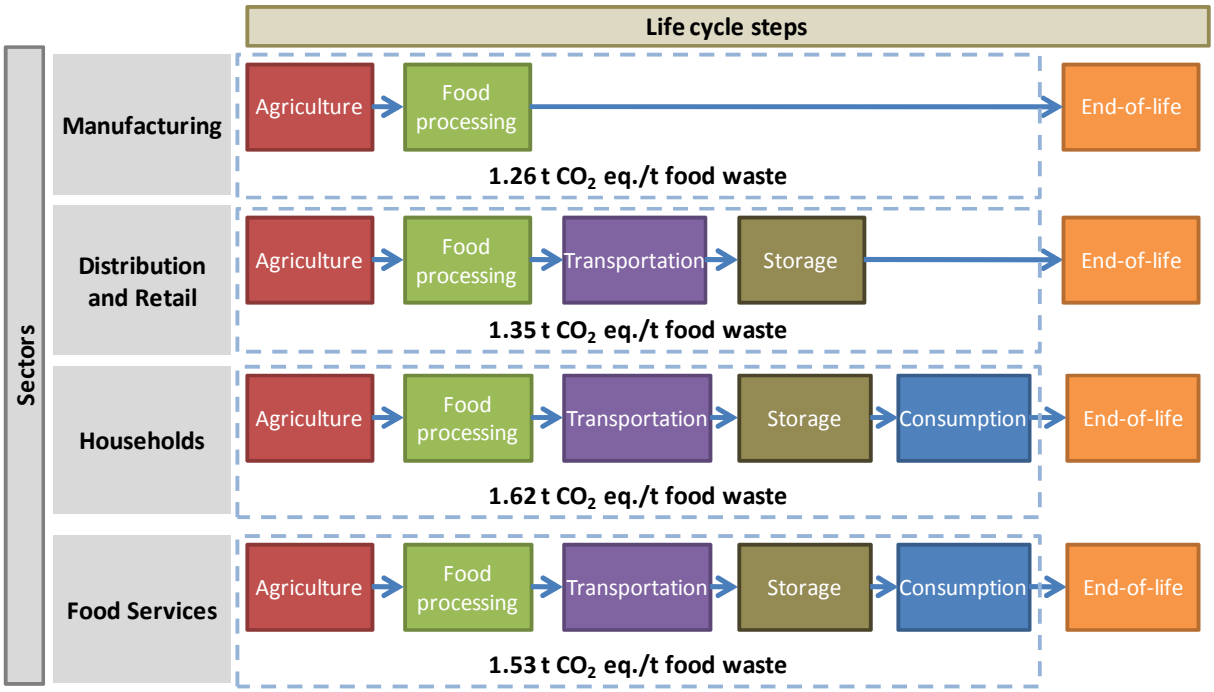
Industrial sectors	GHG emissions t CO_2 eq. per t food waste	Acidification kg SO_2 eq. per t food waste	Photochemical oxidation kg NMVOC eq. per t food waste	Resource depletion tonnes per t food waste
Agriculture	0.37	0.01	1.87	0.98
Food processing	1.26	0.03	6.57	2.75
Distribution and retail	1.35	0.03	7.37	2.84
Households	1.62	0.03	7.91	3.02
Food Services and Catering	1.53	0.03	8.53	3.11

Source: Calculated from the ETC/SCP working paper 1/2009

A summary of the environmental impacts calculated above from the ETC/SCP working paper 1/2009 which can extrapolated for the purposes of the current study are summarised in the graphic below.

[56] The following correspondences were made: Agriculture = Products of agriculture, hunting and forestry + Fish and other fishing products, services incidental to fishing of NAMEA paper; Food processing = Food products, beverages and tobacco; Distribution and retail = Wholesale and retail trade services, personal and household goods; Households = Electrical energy, gas, steam and hot water; Restaurant = Hotel and restaurant services

Figure 12: GHG emissions per tonne of food waste (end-of-life excluded) and per sector (based on ETC/SCP working paper 1/2009)



Source: Calculated from the ETC/SCP working paper 1/2009

➢ **Internal calculations – referred to as study [4] later in the section**

In order to double-check findings in the literature, mainly based on top-down approaches, calculations were undertaken based on life-cycle analysis. This was helpful in order to analyse the accuracy of data found in the different literature sources.

As a proper LCA cannot be performed in detail for all the products consumed in the EU27, representative figures were used from calculations completed for a list of significant product waste flows, grouped in 7 categories: mineral waste, wood waste, food waste, plastic waste, metal waste, glass waste and paper waste.[57]

For each category, an average value chain has been modelled for the main products, e.g. aluminium, copper, lead and steel were the three products considered as representative of the "metal waste" category. Regarding food waste, the following products have been selected:

- corn
- potato
- wheat
- beef
- pork

[57] These calculations were performed in the context of another ongoing project for the European Commission on the Analysis of the evolution of waste reduction and the scope of waste prevention.

- milk

Life cycle inventories from the LCA Food project database[58] (for beef, pork and milk) and the ecoinvent 2.0 database (for corn, potato and wheat) were used.

As only waste flows from Manufacturing and Households were known, two different chains were modelled: one for Manufacturing waste and one for Household waste. Impacts were then calculated for one tonne of each.

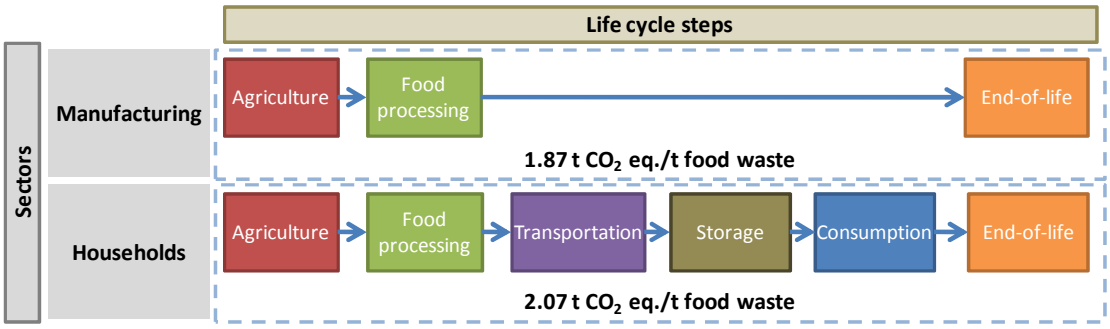
Results obtained for CO_2 emissions are summarised in **Table 20** below.

Table 20: GHG emissions per sector, per tonne of food wasted (2007)

Sectors	GHG emissions t CO_2 eq. per t food waste
Food processing	1.87
Households	2.07

Source: Based on LCA calculations

Figure 13: GHG emissions per tonne of food waste and per sector



Source: Based on LCA calculations

➢ **Sander (2008) Climate protection potentials of EU recycling targets – referred to as study [5] later in the section**

This study is an overview of waste management in the EU and the contribution of waste treatment options to the impact on climate change. The report focuses on mitigation potentials that can be obtained by recycling. The scope of the study is municipal solid waste, distinguishing several fractions:

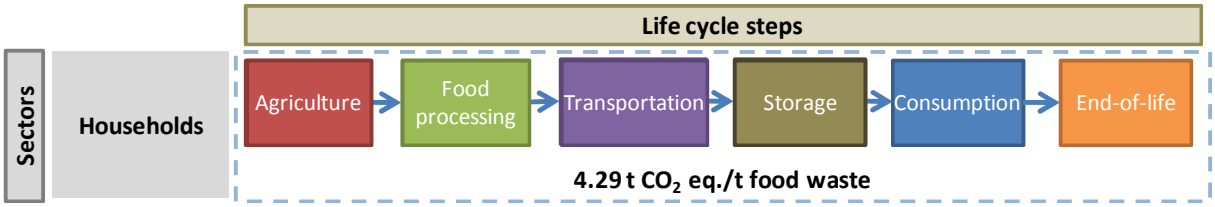
- Paper and cardboard,
- Plastic packaging,
- Textiles,
- Other combustibles,

[58] Background information on the processes can be found on www.lcafood.dk. No written report is available.

- Glass packaging,
- Steel packaging,
- White goods,
- Aluminium packaging,
- Garden waste,
- Kitchen waste.

Food waste falls under the "kitchen waste" category. For this category only, data was gathered from Lundie & Peters (2005), while the rest of the data mainly comes from WRAP (2006). No breakdown over the food life cycle is given, however a breakdown by waste treatment option can be found (based upon municipal solid waste repartition): 37% of recycled waste (4.08 CO_2 eq. per t), 18% of incinerated waste (4.20 CO_2 eq. per t) and 45% of land filled waste (4.50 CO_2 eq. per t). The weighted emission factor is thus 4.29 CO_2 eq. per t.

Figure 14: GHG emissions per tonne of food waste and per sector



Source: Sander (2008)

Comparison of available data about the environmental impacts of food life cycle

Available data for environmental impacts of food waste presented in the previous paragraphs are summarised in **Table 21**, per tonne of food wasted.

As presented above, impacts are cumulated, meaning that, e.g. for WRAP data (study [1]), one tonne of food wasted after the "food processing" step is responsible for 2.4 tonnes of CO_2 equivalents, while one tonne wasted after the "households" step is for 3.8 tonnes of CO_2 equivalents.

Ecodesign Workplan data (based on EIPRO for the impacts, on Prodcom for volumes) is mentioned as study [2] and the ETC/SCP working paper 1/2009 (using the NAMEA framework) is referred to as study [3]. Internal calculations based on LCA were taken into account, for comparison purpose only; they are referred to as source [4]. Sander (2008) is referred to as study [5].

When comparing the data, one can notice the following:

- WRAP data [1] vs Ecodesign Workplan study [2]: 2.8 t CO2 eq. per tonne of food produced for the first one and 2.7 for the other (when including waste treatment), hence very similar data.
- WRAP data [1] vs ETC/SCP working paper [3]: depending on the sector, there is a factor of 1.4 to 2 between the two sources (+40% to +100%); so the data are significantly different but the orders of magnitudes are close.

- ETC/SCP working paper [3] vs LCA approach [4]: very similar data are obtained.
- Sander (2008) [5] gives a high emission factor (the highest in the range of available values).

To further compare [1] and [3], a comparison on a 100 basis is made in **Table 22**, derived from **Table 21**. 100 is considered for the Household sector. It shows that the relative positioning of each sector is similar in the two studies (i.e. for instance, the Distribution and Retail sector reach 84 and 87 respectively when households amounts to 100).

Table 21: Environmental impacts of food waste, per t of food waste, for each sector – Compilation of the different data sources analysed

	Impact category												
	Greenhouse gas emissions (t CO_2 eq./t)							Eutrophication (t PO_4^{3-} eq./t)	Human toxicity (t 1,4-dichlorobenzene eq./t)	Ecotoxicity (t 1,4-dichlorobenzene eq./t)	Acidification (t SO_2 eq./t)	Photochemical oxidation (t NMVOC eq./t)	Resource depletion (t/t)
	a	**b**	**c = b + 0.45**	**d**	**e = d + 0.45**	**f**	**g**						
Sectors[59] Sources of data	[1]	[2], excluding waste treatment	[2], including waste treatment	[3], excluding waste treatment	[3], including waste treatment	[4]	[5]	[2]	[2]	[2]	[3]	[3]	[3]
Manufacturing	**2.4**	**-**	**-**	**1.26**	**1.71**	**1.87**	**-**	**-**	**-**	**-**	**26.32**	**6.57**	**2.75**
Distribution (excl. Retail)	2.8	2,3	2,7	1.35	1.80	-	-	0.026	0.044	0.182	27.56	7.37	2.84
Distribution and retail	**3.2**	**-**	**-**	**1.35**	**1.80**	**-**	**-**	**-**	**-**	**-**	**27.56**	**7.37**	**2.84**
Households	**3.8**	**-**	**-**	**1.62**	**2.07**	**2.07**	**4.29**	**-**	**-**	**-**	**30.41**	**7.91**	**3.02**
Food services	3.8	-	-	1.53	1.98	-	-	-	-	-	30.58	8.53	3.11
End-of-life only (waste treatment)	*0.45*	-	-	-	-	-	-	-	-	-	-	-	-

Source: Derived from WRAP (2010), Ecodesign Workplan (2010), ETC/SCP working paper 1/2009 (NAMEA) and internal calculations

[1] WRAP (2009) *Waste arisings in the supply of food and drink in the UK*

[2] BIOIS (2010) *Technical support to identify product categories with significant environmental impact and with potential for improvement by making use of ecodesign measures*

[3] ETC/SCP working paper 1/2009, using the NAMEA framework

[4] BIO Intelligence Service based on LCA calculations

[5] Sander (2008) *Climate protection potentials of EU recycling targets*

"-" data not available

[59] See **Figure 9** above where the life cycle steps per sector are mentioned

Table 22: Impact of food waste from each sector on a 100 basis

Sectors	Greenhouse gases emissions (CO_2 eq. -100 basis)		
	[1]	[3], including waste treatment	average
Manufacturing	**63**	**83**	**73 ± 10%**
Distribution (excl. Retail)	74	87	80 ± 7%
Distribution and Retail	**84**	**87**	**86 ± 1%**
Households	**100**	**100**	**100 ± 0%**

Source: Derived from WRAP (2010), Ecodesign Workplan (2010), ETC/SCP working paper 1/2009 (NAMEA) and internal calculations

Selection of data about the environmental impacts of food life cycle to be used in the rest of this study

ETC/SCP working paper 1/2009 (using the NAMEA framework) [3] was selected because of its close results with internal bottom-up calculations ([4]). Study [5] was neglected as no breakdown by life-cycle step was available.

The data are presented for three sectors, in order to fit with calculated quantities in Scenario 1 presented in section 1.2 of Chapter 1:

- Manufacturing
- Households
- Others (Distribution and Retail and Food Services/Catering)

Regarding the "Others" sector, the "Distribution and Retail" and the "Food Services/Catering" data have been used, a ratio of 24/76 between both sectors being implemented on quantities based on section 1.2 (Scenario 2).

Table 23 summarises the environmental impacts, per sector and per tonne of food waste, resulting from **Table 21**.

Table 23: Environmental impacts of food waste, per tonne of food waste, per sector

	Impact category, per tonne of food waste, per sector			
	Greenhouse gases emissions (t CO_2 eq./t)	Acidification (t SO_2 eq./t)[60]	Photochemical oxidation (t NMVOC eq./t) [61]	Resource depletion (t/t) [62]
Manufacturing	1.71	26.32	6.57	2.75
Households	2.07	30.41	7.91	3.02
Others	1.94[63]	27.56	7.37	2.84
Total[64]	**1.9**	**28.7**	**7.5**	**2.9**

Source: Calculations based on ETC/SCP working paper 1/2009

Table 24 presents the estimated total environmental impacts of food waste in the EU27 per year, based on those selected factors.

Table 24: Annual environmental impacts of food waste in the EU27, per sector

	Waste amounts in EU27 (t/yr)	Impact category, per year, per sector			
		Greenhouse gases emissions (Mt CO_2 eq./yr)	Acidification (kt SO_2 eq./yr)	Photochemical oxidation (kt NMVOC eq./yr)	Resource depletion (Mt/yr)
Food processing	34 756 000	59[65]	915	229	96
Households	37 703 000	78	1146	298	114
Others	16 820 000	33	502	139	51
Total	**89 279 000**	**170**	**2 563**	**666**	**261**

Source: Calculations based on ETC/SCP working paper 1/2009

[60] Excluding end-of-life impacts
[61] Excluding end-of-life impacts
[62] Excluding end-of-life impacts
[63] Example of calculation for the Others sector: 1.80 x 24% + 1.98 x 76% = 1.94
[64] Obtained by using the quantities of food waste allocated to each sector – see

Table 24
[65] Example of calculation: 1.71 t of CO2/t of waste × 34 756 000 inhab / 1 000 000 = 59 Mt CO2 / yr

Limitations

The geographical context appears to be an important limitation. Although it is probably not the only reason to explain the differences between data from [1] and [3], using data that is valid for the UK only would have been a too rough assumption when one observes the differences in the estimated greenhouse gases emissions from both studies' data.

Another important limitation is the split of economic sectors in the ETC/SCP study [3]. The authors were obliged to consider rough assumptions because the food chain is not covered by food-specific sectors in the NAMEA framework. Further research for a better division of sectors is needed, e.g. which food waste originates from food service or retail sector activities, so as to be able to assess the environmental impacts of different sectors more accurately.

Further research is also needed to distinguish the impacts of food according to the food type, in order to target specific food industries where food wastage is truly at stake. The EIPRO study distinguishes food types, but not step per step.

Another limitation concerns the boundaries of the systems analysed here. From a theoretical point of view, the environmental impacts of the life cycle of only the food products that constitute food waste (and not of all food products manufactured and put on the market) should be assessed. This would first require that the composition of food waste be known, which is not the case. This would also require environmental data about those food products. As described in the previous sections of this chapter, only environmental data about the food sector in Europe were available and thus used.

Key results

Regarding the overall impact of food waste, it can be estimated that **at least** 170 Mt of CO_2 eq. are emitted in Europe only because of food waste, with an average of 1.9 t CO_2 eq./t of food wasted. This figure includes all steps of the life cycle of food waste, namely agricultural steps, food processing, transportation, storage, consumption steps and end-of-life impacts. In comparison, this figure is in between the total emissions of greenhouse gases of Romania (145.916 Mt, according to Eurostat) and of the Netherlands (206.911 Mt, according to Eurostat) in 2008. It also represents approximately 3% of total EU27 emissions in 2008.[66]

Along its life cycle, a food product is raised or harvested, transformed, packed, transported, stored, sold, consumed and eaten or thrown away. Logically, impacts cumulate along the life cycle, so that waste from households has an environmental impact which is more important than the impact from manufacturing waste (table 21). However, food waste generated in the Manufacturing sector is responsible for approximately 73% of the total impact of household waste, in terms of greenhouse gases emissions. All in all, it can be observed that for greenhouse gases emissions, acidification, photochemical oxidation and resource depletion indicators, most of the impact (at least three quarters) occurs before the moment when the food product comes out of the processing factory (in other terms, is concentrated between the cradle and the gate). When considering the sectors, the Household sector is the one with the

[66] EUROSTAT

greatest contribution, both per tonne of food waste (2.07 t CO_2 eq./t) and at the European level (78 Mt CO_2 eq./yr, that is 46% of estimated annual Greenhouse gases emissions due to food waste).

2. INVENTORY OF EXISTING INITIATIVES

INTRODUCTION

Chapter 2 features an inventory of existing EU food waste prevention initiatives and an analysis of the current state of play of food waste prevention strategies in the EU27. The chapter comprises the sections below:

- **2.1:** Identification of existing initiatives
- **2.2**: Analysis of initiatives

KEY FINDINGS

Section 2.1 outlines the identification of existing food waste prevention initiatives in the EU through the literature review and stakeholder questionnaire. The final inventory, found in Appendix II, consists of 106 initiatives related to a variety of sectors, MS and prevention approaches. With 39% of the initiatives identified launched in 2009 and awareness campaigns and informational tools being the predominant measure employed, it appears that **food waste prevention is not yet well-established, and building awareness and triggering simple behaviour changes is an important first step to undertake**.

Section 2.2 consists of an analysis of the initiatives identified in section 2.1, notably of the types of instruments used and the level of their implementation. The instruments utilised included **awareness campaigns, informational tools, training programs, logistical improvements, waste measurement activities, research programmes, regulatory instruments, food redistribution programmes and the development of industrial uses for food waste**. Quantitative results were often difficult to obtain because measurement of impact had often not been carried out, particularly at the local level. Many initiatives had recently been launched and hence their results had not yet been measured, highlighting the early stage of development of food waste prevention activity. Sub-section iii presents a selection of initiatives in the form of mini fact sheets to show the wide range of possible food waste prevention activities and relevant results where available.

2.1 IDENTIFICATION OF EXISTING INITIATIVES

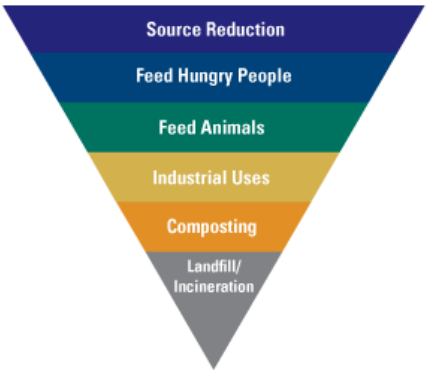
Food waste prevention initiatives were identified via the literature research and through the stakeholder questionnaire. As agreed during the kickoff meeting, the questionnaire incorporated findings from initial research, including examples of prevention initiatives in each sector. 106 initiatives have been identified in total, and significant further results are anticipated, particularly in new Member States. Please find the initiatives in Appendix II.

2.2 ANALYSIS OF INITIATIVES

i. TYPES OF INSTRUMENTS USED

A hierarchy for food waste prevention has been developed by the US Environmental Protection Agency, following the spirit of the EU waste hierarchy as presented in the 2008 Waste Framework Directive. It prioritises reduction at source and presents a list of preference for use, re-use, recycling and waste treatment. While this study does not include composting, it should be noted that approximately one third of all food waste is inedible[67], and thus options such as diversion to animal feed, industrial uses of food waste (cooking oils for example) and composting will usually be the environmentally preferable choice. Energy recovery can be another acceptable option where justified by a life cycle thinking approach. The US EPA hierarchy does not differentiate between waste treatment options; anaerobic digestion is likely to be environmentally preferable to incineration and landfilling.

Figure 15: US EPA Food waste recovery hierarchy[68]



Source: US EPA

The majority of initiatives identified in the study focus on source reduction, the first step in the hierarchy, although eleven initiatives involved food redistribution, predominantly to those in need. Not mentioned in the above hierarchy are those for-profit businesses that redistribute damaged, sub-quality or near-expiry data products to other sales outlets. No examples of food diversion to animal feed were identified so far in the study, but numerous examples no doubt exist.

The initiatives identified have been classified by types of instruments and are described below.

[67] WRAP (2009) *Household food and drink waste in the UK*

[68] US EPA: www.epa.gov/epawaste/conserve/materials/organics/food/fd-gener.htm#food-hier

Reduction at source

- **Awareness campaigns**

A first step in engaging all sectors in food waste prevention, awareness-raising is critical to achieving results in this area. Awareness campaigns identified predominantly target households, although there are effective examples of campaigns in schools and involving restaurants.

- **Informational tools**

Several guides and handbooks have been created by public authorities, industry associations, and NGOs to help specific sectors minimise food waste generation. They describe good practices in the household, the retail environment or even specifically in pubs (public houses) to prevent waste.

- **Training programmes**

There are significant opportunities for teaching food waste prevention skills, particularly in the hospitality industry. One initiative identified provides consumer workshops on waste-free cooking, but a number of waste measurement initiatives also include provisions for food-service staff awareness-raising and training.

- **Logistical improvements**

Optimising operations to minimise food waste, logistical improvements in the Retail environment include stock management tools, selling food products near expiry at low cost, or preparing food products near expiry for sale at the deli counter (where most products are for immediate consumption).

In food service venues, logistical improvements may include reservation requirements for meals to help predict food quantities, satisfaction surveys in cafeterias to help food better meet customer preferences, and ordering flexibility in hospitals to avoid serving patients food they do not want.

- **Waste measurement activities**

Initiatives that engaged participants in waste measurement activities were significant among the study's findings, with eleven initiatives involving households and employees of cafeterias, restaurants and hotels in quantification and composition analysis of the food waste they generate. As noted earlier by WRAP's hospitality industry food waste expert, the act of measurement itself is often enough to stimulate food waste reductions, and because of its hands-on nature, is potentially more effective than information-based awareness-raising.

- **Research programme**

Research programmes frequently help stakeholders collaborate in developing new prevention methodologies for specific waste streams. Research on Time Temperature Indicators and meat quality assessments, as well as practical research on food waste prevention in hotels, for example, shows the range of possibilities for food efficiency improvements. Packaging also provides great scope for further research, in terms of opportunities for extending the shelf life of products. This may be achieved through testing the effects of certain types of packaging on specific

products, as conducted at Morrisons Supermarkets' Packaging Laboratory, or may look at design features such as re-sealable packaging, interactive films, oxygen scavengers and modified atmospheres.[69]

- **Regulatory measures**

Regulatory measures such as public policies have enormous potential for preventing food waste, but at present very few have been identified. In Ireland, a regulation requiring that food waste from major commercial premises be segregated for separate collection will not only contribute to Ireland's achievement of Landfill Directive requirements, but as frequently discussed, will raise employee awareness of the food waste their business generates on a large scale. Furthermore, Commission Regulation (EC) No 1221/2008 of 5 December 2008, which entered into force on *1st July 2009,* and reduces the aesthetic requirements for many fruits and vegetables, should dramatically reduce food waste by allowing consumers to buy odd-shaped produce.[70]

Approaches other than reduction at the source

- **Food redistribution activities**

Food redistribution programmes, such as FareShare in the UK, collect food that would otherwise be discarded by retailers, because it is damaged or nearing expiry, and distribute it to a variety of groups in need, including the homeless, the elderly, children and other communities in food poverty. As highlighted in section 1.2 of Chapter 1, quantities of edible food waste in the Wholesale/Retail sector are very large and present enormous opportunities to increase this sort of critical activity.

For-profit enterprises that collect unsellable food from retailers and resell it in other venues, such as discount stores, also effectively minimise food waste and its associated environmental impacts.

- **Industrial uses**

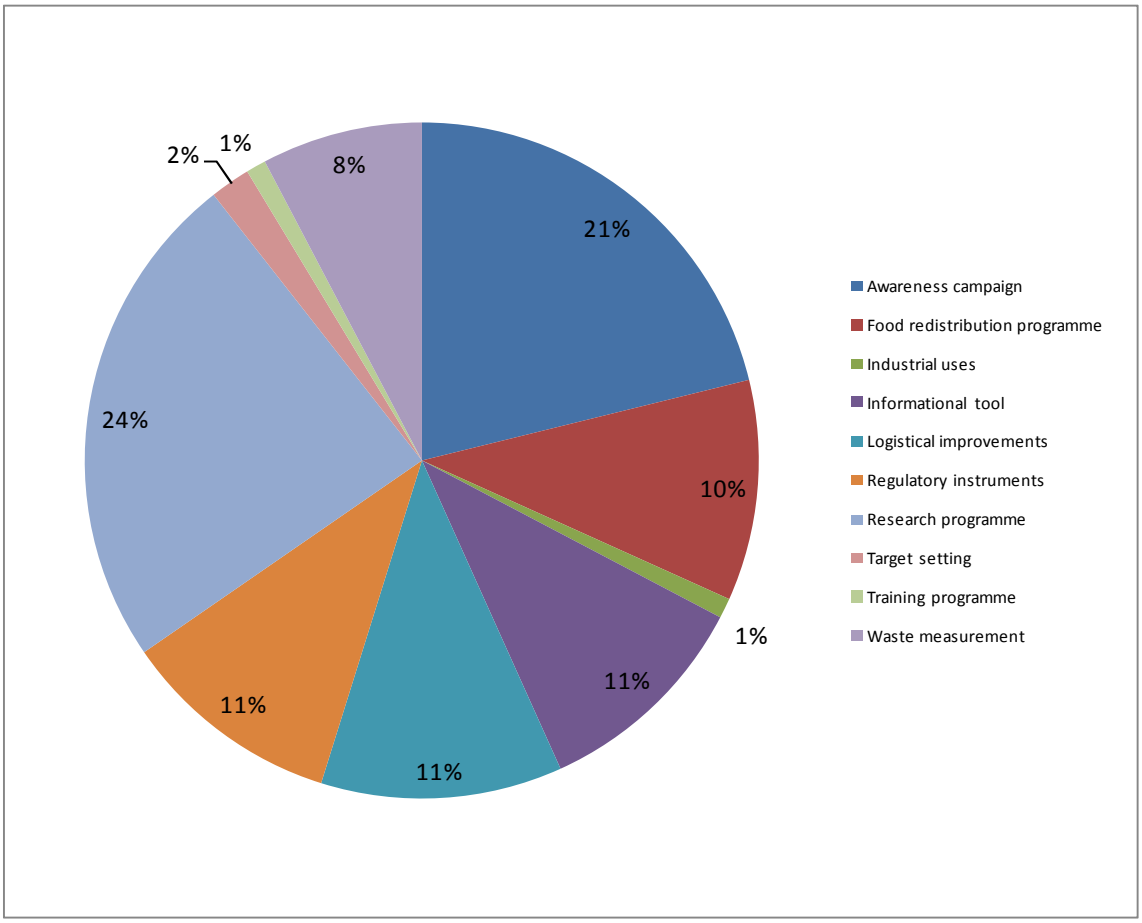
Several initiatives that converted waste food oil into biofuel were excluded from this study as this is a recycling process rather than waste prevention. However, industrial uses of otherwise inedible food might tentatively be included. An example here would be the Fish Chips created in Denmark, using inedible fish matter to create a marketable Omega 3 fatty acid rich snack; there are potentially many similar examples.

Please find a breakdown of the types of instruments used in Figure 16, and the initiative description in Appendix II.

[69] WRAP 'Household Food Waste': www.wrap.org.uk/retail/food_waste/index.html

[70] COMMISSION REGULATION (EC) No 1221/2008 of 5 December 2008 : eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:336:0001:0080:EN:PDF

Figure 16: Types of instruments used to prevent food waste (%)



ii. RESULTS ACHIEVED

Few initiatives gave concrete results; it is not always simple or expected that measurement be part of the initiative, and as accurate measurement presents an added cost, the benefits of measurement must be clear.

Among results documented, certain awareness campaigns have proven effective; the highly visible WRAP Love Food Hate Waste Campaign for example has prevented the production of 137,000 tonnes of food waste since 2008 and the UK schools initiative achieved a 35% reduction in food waste

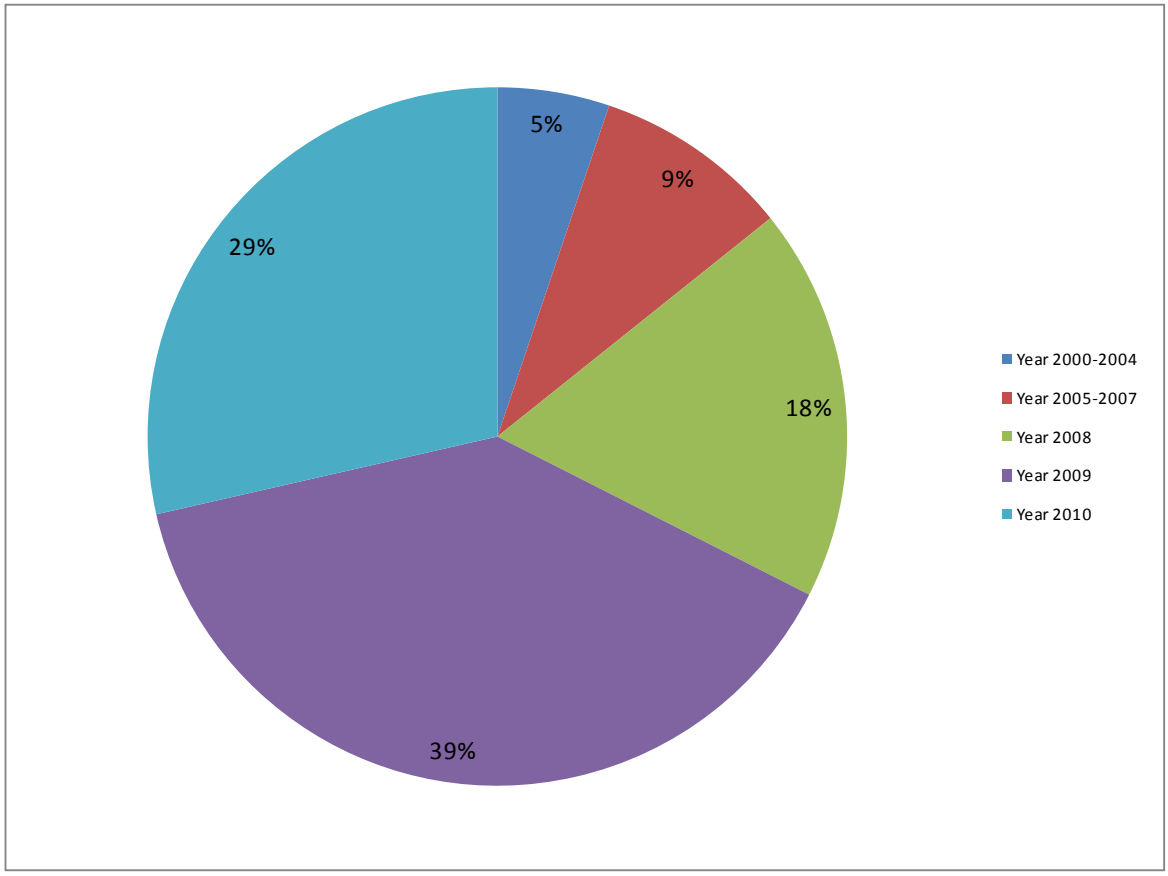
Informational tools are also notable among the initiatives identified, and are complementary to awareness campaigns, often providing more specialised guidance. Existing guides and informational materials could be synthesised and built upon to provide targeted guidance by sector for the EU.

Food redistribution programmes (food banks, for example) are also very effective at preventing food waste, and, with examples in many EU (Austria, Denmark, Spain, Italy, UK) and non-EU (Argentina, Brazil, Canada, United States) countries, have demonstrated their replicability and ability to adapt to local circumstances and business opportunities.

While there are many examples of food redistribution programmes, they remain predominantly on a small scale. In the UK, for example, retailer Sainsbury's donates 400kg of food products to food redistribution programmes for every £1 million pounds (or €1.1 million Euros) in sales, similar to donation levels in the United States. However, this appears

to be only around 10% of Sainsbury's discarded food waste.[71] Regulatory instruments, such as the requirements or incentives to disclose food waste data, can encourage competition among retailers for good performance in this area, offering both substantial environmental and social benefits.

Figure 17: Start dates of initiatives identified (%)



The predominance of awareness campaigns and informational tools further underlines that food waste prevention is at an early stage of development. Indeed, 39% of the initiatives identified were launched in 2009, a majority of those in the autumn, and the fact that twenty-two initiatives beginning in 2010 have already been identified, shows that this issue strongly resonates with stakeholders at the present time and is growing rapidly (see above table).

iii. BEST PRACTICES

A range of best practices have been selected in order to highlight the breadth of existing initiatives in food waste prevention, and these are presented below in the form of mini factsheets.

[71] According to calculations by Tristram Stuart, p35; Stuart, T. (2009) *Waste: Uncovering the Global Food Scandal*

Love Food Hate Waste

Promotion and awareness raising

Actor responsible for the initiative:	WRAP
Type of actor responsible for the initiative:	NGO
Type of initiative:	Awareness campaign
Main type of stakeholder targeted:	Households
Country:	United Kingdom
Geographic level of implementation:	National
Year of implementation:	2008

Love Food Hate Waste, an awareness campaign, sponsored by WRAP in the UK, aims at raising awareness on the need to reduce food waste, via the dissemination of information on reducing consumer and household food waste to achieve environmental and economic benefits. The focus of the campaign is on easy practical everyday activities which can lead to waste reduction. Since the campaign launched in 2008, WRAP estimates that 137,000 tonnes of food waste have been prevented.

New Irish legislation on separate food waste collection (SI 508 of 2009)

Separate collection of food waste

Actor responsible for the initiative:	Ministry of the Environment
Type of actor responsible for the initiative:	Public authority
Type of initiative:	Public policy
Main type of stakeholder targeted:	Businesses
Country:	Ireland
Geographic level of implementation:	National
Year of implementation:	2009

Designed to promote the segregation and recovery of food waste arising in the commercial sector, this regulation sets up the source separation of food waste from major commercial premises. The regulation facilitates the achievement of the targets set out in Directive 99/31/EC on the landfilling of waste notably as regards the diversion of biodegradable municipal waste (BMW) from landfill sites to composting and anaerobic digestion plants and to other forms of biological treatment.

Approved Food

Food redistribution programme

Actor responsible for the initiative:	Approved Food & Drink Company
Type of actor responsible for the initiative:	Business
Type of initiative:	Food redistribution programme
Main type of stakeholder targeted:	Households
Country:	United Kingdom
Geographic level of implementation:	National
Year of implementation:	2009

Approved Food and Drink Company, a UK-based food redistribution programme, specialises in selling dry food products that are near or past their "best before" date at a discounted rate through their website. While sales and revenue figures are not available, the company has received a large amount of mass media publicity, indicating an impact on consumer awareness. The company represents an innovative private-sector approach to avoiding food waste via resale.

'Buon Samaritano' (Good Samaritan)

Food redistribution

Actor responsible for the initiative:	Comune di Torino and Azienda Multiservizi Igiene Ambientale Torino SpA (Amiat), Associazione Banco Alimentare del Piemonte e Valle d'Aosta, Auchan, Sorico
Type of actor responsible for the initiative:	Multi-stakeholder
Type of initiative:	Food redistribution programme
Main type of stakeholder targeted:	Schools, retailers
Country:	Italy
Geographic level of implementation:	Local
Year of implementation:	2005

Comune di Torino and Amiat have implemented the "Good Samaritan" project, which collects uneaten meals from school canteens and products that are still edible from supermarkets and donates them to charity organisations to prevent them from being sent to landfill sites. According to the organisation, every day it is possible to recover 150 kilos of bread and 50 kilos of fruit to prepare approximately a thousand meals. Over the years the amount of food recovered has increased significantly, reaching more than 25,000 kilograms of bread and nearly 13,500 kg of fruit in the school year 2007 to 2008. In total in 2008, the organisation recovered over 81,000 kg of food.

Cooperative framework for supply chain improvement

Voluntary agreements

Actor responsible for the initiative:	Wageningen University and Research Centre
Type of actor responsible for the initiative:	Multi-stakeholder
Type of initiative:	Voluntary agreement, logistical improvement
Main type of stakeholder targeted:	Manufacturers, retailers
Country:	Netherlands
Geographic level of implementation:	National
Year of implementation:	2006

In 2006, there was a commitment from industry of 20 million euros to work on food waste issues. To fulfil this commitment, Wageningen University and Research Centre works with government actors and businesses to optimise supply chain processes for private sector companies, using a process of monitoring, modelling, fact finding, scenario analysis and business model integration. Wageningen University, among other research organisations, provides expertise to help businesses to understand the primary opportunities for waste reduction in their supply chains and to incorporate long-term processes for waste reduction in their production activities.

Eurest restaurant food waste campaign

Waste data disclosure

Actor responsible for the initiative:	Eurest
Type of actor responsible for the initiative:	Food service
Type of initiative:	Waste measurement programme, awareness campaign
Main type of stakeholder targeted:	Business
Country:	Sweden
Geographic level of implementation:	National
Year of implementation:	Not available

150 units of the Eurest catering organization are participating in efforts to quantify food waste, publicise results to staff and customers, and explain the impacts of food waste and how it can be prevented, including using a spreadsheet to measure waste, with a graph entitled "so much waste we produce every single day" which is available to guests and staff. Through these types of initiatives and by having units measure waste once a month, Eurest has reached 22,055 guests. The initiative, which has been continuing for over half a year, has lead to a reduction of 23% in food waste quantities produced.

During the European Week for Waste Reduction, 25 Eurest restaurants and 2 coffee shops in 15 different locations in Sweden weighed and measured the waste resulting from food preparation and made available this information to staff and guests.

Réduisons nos déchets

Awareness campaign

Actor responsible for the initiative:	ADEME (Environmental Agency)
Type of actor responsible for the initiative:	National authority
Type of initiative:	Awareness campaign
Main type of stakeholder targeted:	Households
Country:	France
Geographic level of implementation:	National
Year of implementation:	2005

ADEME's national awareness campaign aimed at informing households about waste production and prevention has been in place since 2005 and uses multiple communication channels: online resources, radio broadcasts, etc. The website offers specific practical tips for food waste-related reduction at home and while shopping. No specific results are available but the stated goal is to target the reduction of the 390 kg of waste produced annually in France via individual adoption of simple behavioural changes.

'Great Taste, Less Waste'

Awareness campaign

Actor responsible for the initiative:	Morrisons Supermarkets
Type of actor responsible for the initiative:	Retailer
Type of initiative:	Awareness campaign
Main type of stakeholder targeted:	Households
Country:	United Kingdom
Geographic level of implementation:	National
Year of implementation:	2009

Following on a survey conducted of their customers, Morrisons Supermarkets found that two thirds of UK households are allowing fruit to go to waste by keeping it in the fruit bowl instead of the refrigerator, where it can last up to fourteen days longer. The same survey found that customers wanted to help more to reduce food waste, with 67% of customers stating that supermarkets have a duty to ensure the right packaging so that food stays fresh, but only 12% believing that supermarkets "get packaging right".

The survey led Morrisons Supermarkets, in 2009, to instate a campaign to help customers reduce food-related waste. The initiative has included providing storage advice, offering 'market street' portion choice, providing information on labelling, distributing tips for leftover cooking and 'packaging laboratory: keep it fresh' tests to identify what type of packaging can extend the life of specific fruit and vegetables. Activities are coordinated in-store and information is disseminated in the store as well as through the supermarkets' website and magazine. The campaign has the stated goal of helping customers reduce the on average £600 of food thrown out per household annually.

Fish Chips

Industrial uses

Actor responsible for the initiative:	Hospitality industry partnership
Type of actor responsible for the initiative:	Business
Type of initiative:	Industrial uses
Main type of stakeholder targeted:	Manufacturers
Country:	Denmark
Geographic level of implementation:	National
Year of implementation:	2009

Hospitality and restaurant sector players in Denmark formed a partnership, using state and EU fisheries development funds, to develop an Omega 3 rich fish chip product from otherwise inedible fish waste. As of the end of 2009, the team was in the final stages and testing, having already negotiated agreements with manufacturers and buyers. While concrete results are not yet available, given that over 50% of fish is discarded as inedible waste in Denmark, according to a 2010 CRI study, this is an excellent use for a product that would otherwise be food waste.

72

'Calling Time on Waste'

Informational tool

Actor responsible for the initiative:	National Waste Prevention Programme by EPA
Type of actor responsible for the initiative:	National authority
Type of initiative:	Informational tool
Main type of stakeholder targeted:	Business
Country:	Ireland
Geographic level of implementation:	National
Year of implementation:	No start date identified

The widely-disseminated brochure titled 'Calling Time on Waste', prepared and published by the National Waste Prevention Programme run by Ireland's EPA, is a guide on resource efficiency in the bar trade. The document, which spans approximately twenty pages, breaks down various waste streams which occur in bar/restaurant settings, explains their impact, provides practical tips for their reduction and prevention, and offers a succinct waste management checklist. The brochure also frames waste prevention in economic terms, offering examples such as "By re-tendering for waste collection, implementing a source segregation scheme and reducing food waste a pub saved €4000 per annum on waste charges".

[72] Danish Environmental Protection Agency (2010) *Feasibility study of food waste in Denmark*

'Anti-waste workshops' - Cooking Classes

Training program

Actor responsible for the initiative:	Bruxelles Environnement
Type of actor responsible for the initiative:	Local authority
Type of initiative:	Training program
Main type of stakeholder targeted:	Households
Country:	Belgium
Geographic level of implementation:	Local
Year of implementation:	2009

Bruxelles Environnement, a local authority in Brussels, has put in place a training program geared at helping households to reduce their food waste production via cooking training. The cooking workshops are offered for free to the local community and highlight techniques for and benefits of reducing food waste. 1000 people were trained in 2009.

Green Hospitality Award Scheme

Waste measurement programme

Actor responsible for the initiative:	National Waste Prevention Programme by EPA
Type of actor responsible for the initiative:	National authority
Type of initiative:	Waste measurement programme
Main type of stakeholder targeted:	Hospitality
Country:	Ireland
Geographic level of implementation:	National
Year of implementation:	2008

The Green Hospitality Award (GHA) Scheme, for the hotel and catering sector, organised by the National Waste Prevention Programme, a part of the Irish EPA, involves waste measurement and waste reduction targets, with a specific focus on food waste, with an award for top-performers.

GHA now has a membership of 150 hotels and 10 major catering businesses all working to reduce waste/energy/water use including food waste. 100 of these will achieve award status in 2010. 120 properties were surveyed in 2009 and showed a 6,000 tonne reduction in waste; while no breakdown of this figure is available in relation to food waste, food waste does compose a large percentage of waste produced in this sector.

Phasing out of EU Commission Regulation (EC) No 1221/2008

Public policy

Actor responsible for the initiative:	European Commission
Type of actor responsible for the initiative:	Public authority
Type of initiative:	Public policy
Main type of stakeholder targeted:	Businesses
Country:	Europe
Geographic level of implementation:	European
Year of implementation:	2009

With Commission Regulation (EC) No 1221/2008 of 5 December 2008, the European Commission approved the phasing out of regulations on the size and shapes of fruit and vegetables. This legislative change reduces the aesthetic requirements for many fruits and vegetables thereby preventing the unnecessary discard of various types of produce, which are aesthetically imperfect but perfectly edible. This change should lessen the burden of legislation as well as allowing shoppers more choice by ensuring that fruits and vegetables with slight abnormalities will not be thrown away.

The current list of fruit and vegetables impacted are: apricots, artichokes, asparagus, aubergines, avocadoes, beans, Brussels sprouts, carrots, cauliflowers, cherries, courgettes, cucumbers, cultivated mushrooms, garlic, hazelnuts in shell, headed cabbage, leeks, melons, onions, peas, plums, ribbed celery, spinach, walnuts in shell, water melons, and witloof/chicory. The exception from marketing standards could be extended to another ten products such as apples, citrus fruit, kiwi fruit, lettuces, peaches and nectarines, pears, strawberries, sweet peppers, table grapes and tomatoes to further reduce the production of food waste due to aesthetical concerns.

FareShare

Food redistribution programme

Actor responsible for the initiative:	FareShare
Type of actor responsible for the initiative:	NGO
Type of initiative:	Food redistribution programme
Main type of stakeholder targeted:	Multi-stakeholder
Country:	United Kingdom
Geographic level of implementation:	National
Year of implementation:	2004

In place since 2004, the FareShare charity promotes the message that "no food good should be wasted", diverting edible food and drink products from industry organisations to disadvantaged populations. The organisation also provides warehouse training for the unemployed and helps food industry businesses to track and reduce their greenhouse gas emissions.

The organisation redistributed food contributing to 7.4 million meals in 2008/9, and helped businesses reduce their CO_2 emissions by 13,950 tonnes during the same period. FareShare's future goal is to redistribute 20,000 tonnes of food annually and to support 100,000 vulnerable people every day.

Tesco 'Buy One Get One Free Later'

Logistical improvements

Actor responsible for the initiative:	Tesco
Type of actor responsible for the initiative:	Retailer
Type of initiative:	Logistical improvements
Main type of stakeholder targeted:	Business
Country:	United Kingdom
Geographic level of implementation:	National
Year of implementation:	2010

As part of their pledge to not send any waste to landfill this year and specifically to target food waste reduction, grocery retailer Tesco launched a 'Buy One Get One Free Later' initiative to allow customers buying perishable goods to collect their free item the following week. The programme works through a voucher system; products included in the initiative are those which are considered "short-code life-perishable products" with short sell dates such as yoghurts, salads, vegetables and cheese. The initiative does not include products with longer sell dates such as cans of beans and pasta sauce. While specific results are not available, a Tesco spokesperson highlighted the double benefit of food waste reduction for the supermarket and its customers as well as increased customer flexibility.

'A la carte' menu

Logistical improvements

Actor responsible for the initiative:	Hvidovre Hospital
Type of actor responsible for the initiative:	Hospital
Type of initiative:	Logistical improvements
Main type of stakeholder targeted:	Hospitals
Country:	Denmark
Geographic level of implementation:	Local
Year of implementation:	2008

Hvidovre Hospital, in Denmark, led by chef Mogens Pedersen Fonseca, changed how food services are operated to reduce food waste produced via the previously rigid patient catering system. Following on four years of extensive work to modify the kitchen and hospital facilities and rethink the cooking strategy, Mogens Fonseca Pedersen and his one hundred employees were able to offer anytime 'à la carte' order options to patients, while remaining within budget limitations. The programme has helped the hospital avoid 40 tonnes of food waste per year, and the 'à la carte' style encourages portion management; money saved through the initiative has been reinvested to further reduce food waste and improve quality of hospital food services.

Food and Drink Federation's Five-fold Environmental Ambition

Multi-project

Actor responsible for the initiative:	Food and Drink Federation, WRAP
Type of actor responsible for the initiative:	Association
Type of initiative:	Multi-project
Main type of stakeholder targeted:	Business
Country:	United Kingdom
Geographic level of implementation:	National
Year of implementation:	2007

The Food and Drink Federation's Five-fold Environmental Ambition started with member commitments to play a role in tackling climate change by reducing CO_2 emissions by 20% by 2010 against a 1990 baseline, sending zero food and packaging waste to landfill from 2015, making significant reductions in levels of packaging reaching households in line with WRAP's Courtauld Commitment, embedding environmental standards into food transport practices and reducing overall transportation and reducing waste use.

The association has already made progress on the waste portion of the Ambition, to send zero food and packaging waste to landfill from 2015. Members established baselines from their 2006 waste volumes and have since this initial reporting prevented more than half a million tonnes of food waste from being created. The project has also included a joint initiative with WRAP to carry out waste prevention reviews at thirteen member company sites across the UK, working closely with FareShare, to encourage member food redistribution and encouraging members to sign up for the original Courtauld Commitment which seeks to reduce domestic food waste by 155,000 tonnes by 2010 as compared to 2008.

3. FORECAST BASED ON CURRENT SCENARIO

INTRODUCTION

Chapter 3 involves the forecasting of future food waste volumes based on the current scenario and taking into account impacting factors such as population growth, disposable income, policy and prevention initiatives as well as environmental impacts. The chapter comprises the following sections:

- **3.1**: Food waste and population growth – the baseline scenario
- **3.2**: Food waste and disposable income
- **3.3**: Food waste and policy impact
- **3.4**: Food waste and prevention initiatives
- **3.5**: Food waste and environmental impacts
- **3.6**: Other environmental impacts

KEY FINDINGS

Chapter 3 involves forecasting future food waste production and related environmental impact based on the baseline scenario of food waste quantities developed in Chapter 1.

Using available EU statistics the chapter shows that food waste quantities overall and on a per capita basis are anticipated to increase significantly due to population growth and increasing affluence. In the baseline year – 2006 - food waste produced in the EU was approximately 89.3 million tonnes; **by 2020 estimates suggest this will increase to 126.2 million tonnes**, presenting an increase of 36.9 million tonnes.

Earlier findings of this study, notably that food waste prevention initiatives are often at a local level and that there is a lack of information regarding the level of impact achieved, result in a serious difficulty in forecasting the impacts resulting from these activities. The majority of initiatives are indeed very recent and very few have measured results. On this basis, no impact due to food waste prevention initiatives has been applied to the data in the forecasting.

Accompanying the increasing quantities of food waste will be **positive growth in greenhouse gas emissions, accounting for an additional 70.2 million tonnes of carbon dioxide equivalent gases emitted in 2020**, in comparison with 2006 levels. This brings the total annual food waste related emissions to 240Mt in 2020.

Policies to divert food waste from landfill will not tackle the big issue of food waste generation. The impact of waste policy on food waste generation is neutral in terms of the absolute amounts of waste being generated. Waste policy does however, have a considerable impact on the treatment of food waste once it has been generated. This work predicts that by 2020 the amount of food waste sent to landfill will decrease from 40.4 million tonnes to 4.0 million tonnes in compliance with policy. Based on the forecasts, this leaves an estimated 122.2 million tonnes of food waste across the EU27 by 2020 to manage via other residual treatment technologies. This is a significant quantity of waste, all of it generating substantial amounts of greenhouse gas emissions. A key issue for the future is

thus how to treat this 122.2 million tonnes of food waste via other technologies or whether to expend considerable and sustained efforts to secure the benefits of waste prevention.

A major conclusion drawn from the exercise is the **importance and necessity of statistical data and time series for all MS** to provide reliable data on food waste, thereby allowing for more robust and reliable estimations and forecasting.

METHODOLOGY

In order to consider the future growth and impact of food waste and its economic, environmental and social impacts, Task 3, presented in this chapter, involved the projection of food waste arisings in the EU over a 15 year period (2006-2020). In order to complete this task a Microsoft Excel model was built, based on the available statistics, namely: food waste, social-economic and environmental impact data. The model has been built taking into account the estimated impact of four sets of factors on food waste tonnages:

- Anticipated socio-economic changes (such as disposable income and population growth)
- Potential impacts of existing European policy instruments
- Impacts of food waste prevention activities already in place
- Environmental impacts of anticipated food waste treatment options

Reliability, accuracy, robustness, uncertainty

The data is in many cases based on estimates. Waste generation projections are based on the EUROSTAT food waste generation data for 2006 and from other studies on food waste data identified in section 1.2 of Chapter 1. Some data on population and disposable income have been calculated on the basis of data found in the literature including OECD reports and UNEP publications).

In general, the lack of frequent, consistent and reliable food waste data remains a serious problem for the identification of trends. The currently available data may be questioned as it appears to have been collected by individual MS using a variety of methods and operating under different assumptions. Data may not necessarily be comparable or reflect the real situation. Therefore, the data that form the basis for the forecast are often "best educated guesses" of the current and future status of food waste generation within the EU27. The order of magnitude is probably broadly correct, but the details remain very uncertain.

Key uncertainties and assumptions

- The forecast is based on 2006 food waste data as determined in 1.2. (The only historical data available via EUROSTAT was for 2004). This figure was scaled up using EUROSTAT population growth estimates through to 2020, and is used as a baseline scenario for the forecast. As there is no historical food waste data available and estimates are based mainly on 2006 data points, there is inevitably a degree of uncertainty with the estimates.
- In all projections, similar estimates and projections for disposable income[73], policy impacts, etc. have been assumed for EU12 and EU15 countries, i.e. a uniform increase in disposable income for both EU12

[73] EUROSTAT: epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

and EU15 countries. It is understood that this is an assumption warranting closer scrutiny (as current economic conditions across Europe make accurate economic predictions highly uncertain) and further research would be needed to improve the estimates and to establish the extent and impact of regional variations.

3.1 FOOD WASTE AND POPULATION GROWTH – THE BASELINE SCENARIO

As mentioned previously, 2006 was used as the baseline year for this study. The data used in this chapter was presented in detail in section 1.2; scenario 1 has been used for 'Other Sectors'.

The historical population data, as well as annual population projections until 2020, are from the EUROSTAT statistics database. As Task 1, presented in Chapter 1 of this study, did not collect historical data, the baseline scenario is based on 2006 food waste levels per capita (x kg/person), adapted to anticipated changes in population presented in EUROSTAT projections. EUROSTAT population projections show that there will be an increase in the EU population of 20.6 million people (4.2%) by 2020, in comparison with 2006. This overall increase masks a projected population decrease for the EU12 (of approximately 1.4 million) and an increase for the EU15 (of approximately 22.0 million).

On this basis, the projections show that the overall increase in food waste tonnages is expected to be 3.7 million tonnes in EU27 by 2020 (4.1%), taking into account the population increase of nearly 21 million. In this scenario the impact of any other factors, such as policies, prevention initiatives or growth in disposable income are not considered. The data assumes that individuals will continue to generate the same amount of food waste year on year over the period.

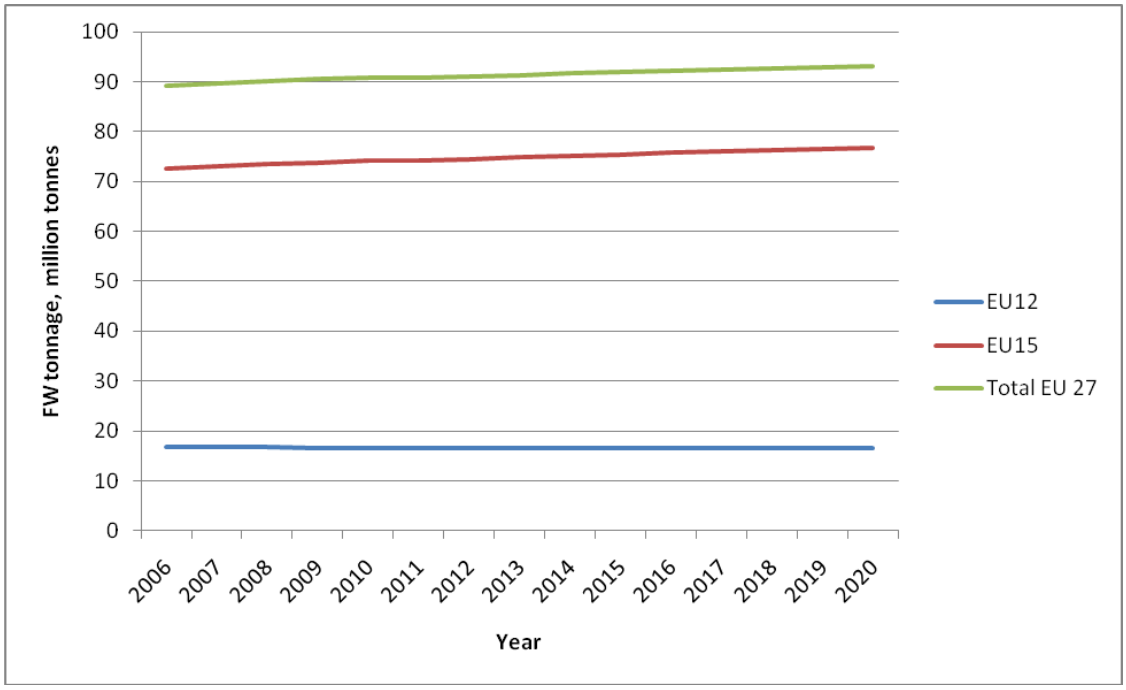
Table 25: Population projections and food waste forecast for EU27

Year	Population, *million people*	Food waste, *million tonnes*
2006	493.2	89.3
2007	495.3	89.7
2008	497.6	90.1
2009	499.7	90.5
2010	501.2	90.7
2011	501.2	90.7
2012	503.0	91.1
2013	504.6	91.4
2014	506.2	91.6
2015	507.7	91.9
2016	509.1	92.2
2017	510.4	92.4
2018	511.6	92.6
2019	512.8	92.8
2020	513.8	93.0

Source: EUROSTAT data; AEA

Table 25 shows the influence of anticipated population growth on food waste generation in the EU countries over a 15 year period.

Figure 18: Food waste trends in the EU27, 2006-2020



Source: EUROSTAT data; AEA

3.2 FOOD WASTE AND DISPOSABLE INCOME

The UNEP Environmental Food Crisis report (UNEP, 2009), highlights, along with rising population, the issue of the increasing incomes of a large fraction of the world's population, which results in increasing consumption of food per capita as well as changes in diets towards a higher proportion of meat (UNEP, 2009). With growing incomes, consumption – and the quantity of waste or discarded food – also increases substantially (Henningsson et al, 2004). This is confirmed by the EUROSTAT data for 2004 and 2006 which shows that the quantities of food waste generated in the European Union (EU27) increased in 2006 by nearly 23%, in comparison with 2004. This is in step with an increase in the population's disposable income, by 1.2 trillion Euros or 11.1% (approximately 2,500 Euros per head of population (EU27) in the same time period according to EUROSTAT statistics).

There is, however, some evidence to the contrary - the WRAP study of 2008, The Food We Waste, while obtaining variable results, does suggest that those with higher disposable incomes and higher levels of education waste less food per capita. According to the study, professional management people waste 5kg of food a week and semi-skilled and unskilled workers waste 6.1kg a week. The implication is that, beyond a certain point, increased disposable income (as a measure of economic or societal development) may have a depressing effect on food waste but there may be a number of factors at work (for example, eating more meals in restaurants etc) and the extent to which this observation can be extrapolated across the EU is unknown.

Assumptions

Based on the UNEP report (cited above) and on the EUROSTAT statistical trends, together with the WRAP evidence, the **assumption made here is that there is a link between levels of disposable income and food waste generation.**

Disposable income data is taken from the EUROSTAT statistics database where it is provided up to the year 2011. The data for 2012-2020 are forecasts made taking into account historical changes in disposable income data and the current recession. According to the EUROSTAT data, disposable income grew steadily until the year 2009 (see Table 26) when it dropped by 4.2% due to the recession. From 2010, disposable income will, according to EUROSTAT, start growing again, albeit slowly. Based on EUROSTAT data and taking into account a slow recovery from the current recession in EU countries, it is assumed that there is an annual increase of 1.5% in disposable income in 2011 and 2012 compared to 2010. This is assumed to gradually increase to 5% by 2015 (2.5% in 2013, 3.5% in 2014, and 5% in 2015) - the maximum pre-2006 increase in disposable income according to the available EUROSTAT data - after which, growth in disposable income is assumed to stay at the same level until 2020 (again, due to the anticipated slow recovery after the current recession).

Forecasting methodology

Using the assumptions above and those that follow, the projections in Figure 18 below were developed. They show with a steady annual growth of disposable income (of between 1.5% to 5%), there will be an increase of 36.9 million tonnes of food waste in EU27 by 2020. Most of this (28.6 million tonnes or 77%) will be due to growth in food waste generation in EU15 countries.

The methodology incorporates growth of food waste for EU12 and EU15 at different rates as each group (EU12 and EU15) has different types of economies: as a result, some will grow more quickly at first and then begin to slow down and stabilise towards 2020 (as they 'mature') whilst others will have a more linear growth.

- The EU12 is more likely to show a quick growth to begin with as levels of disposable income increase (in line with the UNEP report) and then begin to stabilise as higher disposable incomes and better education result in less food being wasted (in line with the WRAP study).
- The EU15 however, being the more developed economies with higher levels of disposable income, is more likely to show a more steady growth to begin with and also to stabilise as higher levels of disposable income and education influence the behaviour of society and individuals.

In terms of the projections, disposable income is used as an indicator of economic activity and the relationship between food waste generation and disposable income can vary. For this study an important consideration is the relationship between food waste generation and disposable income and the degree to which it can be decoupled. In this context, the concept of decoupling, as defined by the OECD, distinguishes between:

- **No decoupling:** food waste production and the economy grow at the same speed (linear relationship)

- **Negative decoupling:** food waste production grows faster than the economy
- **Relative decoupling:** food waste production grows more slowly than the economy
- **Absolute decoupling:** while the economy is growing, food waste production is diminishing

To show the differences in the relationship between disposable income and food waste generation the following assumptions were applied:

- **EU12 -** negative decoupling followed by relative decoupling where waste generation grows more quickly than the economy (5.4.2 Scenario 1, Arcadis Bio-waste Final Report, 2009) and then more slowly;
- **EU15 -** no decoupling has been assumed overall where waste generation grows at the same speed as economic activity. In reality, this is based on a slight decoupling in the first phases and a stabilisation period at the end in which relative decoupling is achieved (5.4.2 Scenario 2, Arcadis Bio-waste Final Report, 2009).

Table 26 (below) shows the changes in disposable income in EU27 compared to the corresponding growth in food waste using the aforementioned assumptions.

Table 26: Changes in disposable income for EU27, trillion Euros

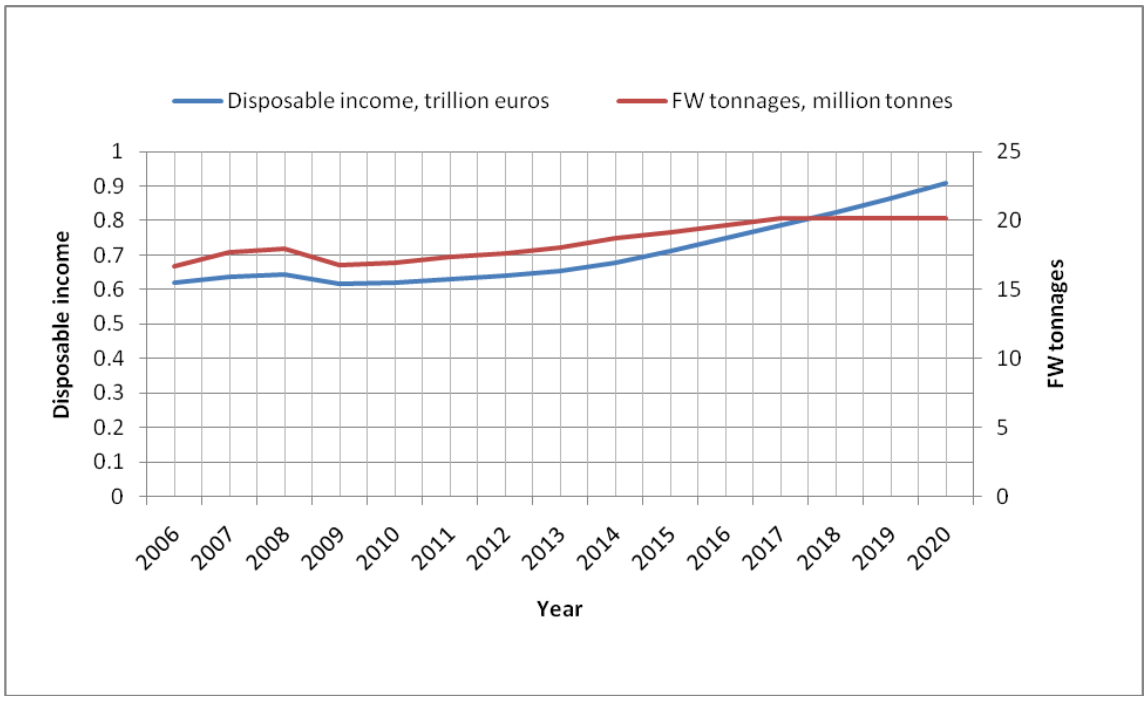
Year	Disposable income, *trillion Euros*	Food waste, *million tonnes*
2006	11.4	89.3
2007	12.0	95.5
2008	12.4	100.1
2009	12.0	95.2
2010	12.1	96.1
2011	12.3	98.1
2012	12.5	99.9
2013	12.7	103.1
2014	13.2	107.6
2015	13.9	111.9
2016	14.6	116.4
2017	15.3	121.1
2018	16.0	122.8
2019	16.8	124.5
2020	17.7	126.2

Sources: EUROSTAT data; 5.4.2 Scenario 1 and 2, Arcadis Bio-waste Final Report

The charts, for EU12, EU15 and EU27, take into account food waste growth, associated changes in disposable income and the associated decoupling.

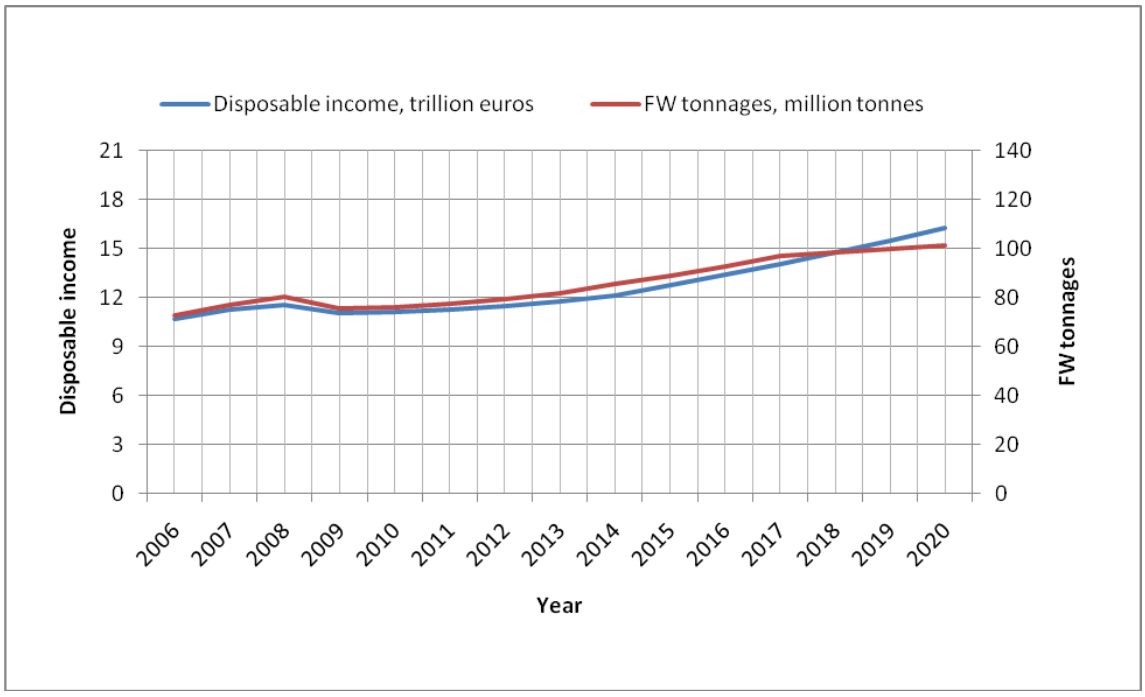
It should be noted that the EUROSTAT data for disposable income for EU27 is not the sum of the data of EU12 and EU15 extracted from the same database. This explains the slight differences between Figure 19 and Figure 20 in comparison with Figure 21.

Figure 19: Correlation between food waste generation and change in disposable income, EU12



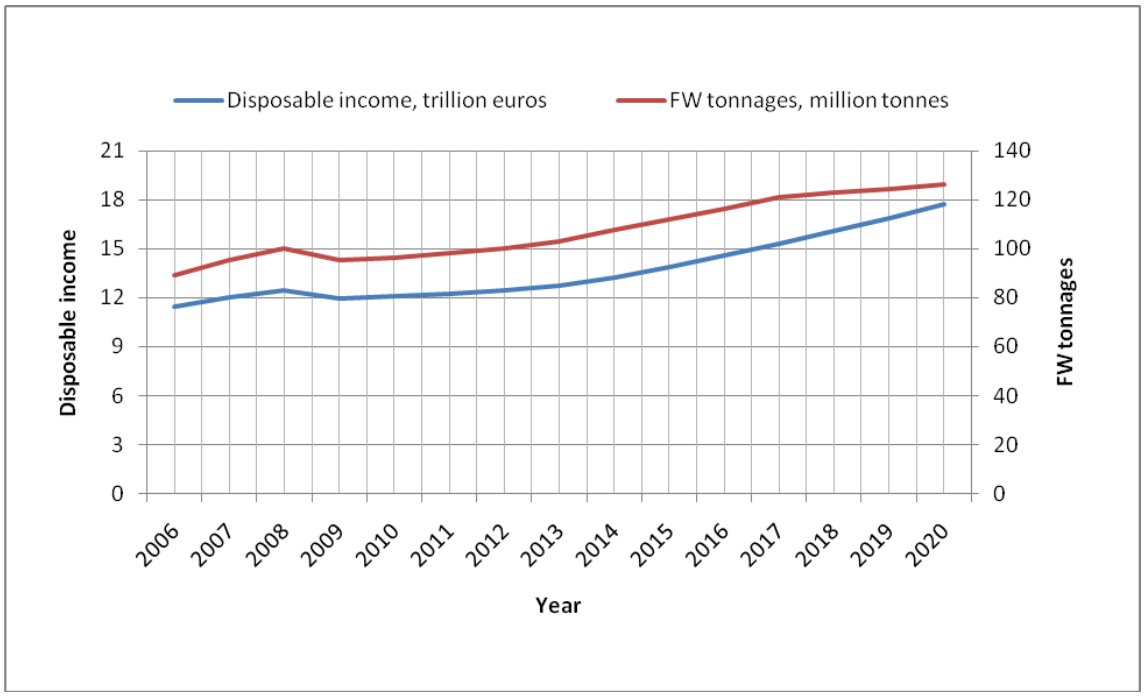
Sources: EUROSTAT data; 5.4.2 Scenario 1 and 2, Arcadis Bio-waste Final Report

Figure 20: Correlation between food waste generation and change in disposable income, EU15



Sources: EUROSTAT data; 5.4.2 Scenario 1 and 2, Arcadis Bio-waste Final Report

Figure 21: Correlation between food waste generation and change in disposable income, EU27



Sources: EUROSTAT data; 5.4.2 Scenario 1 and 2, Arcadis Bio-waste Final Report

Note: EUROSTAT data for disposable income for EU12 and EU15 does not add up to EU27 which explains slight differences in this graph when compared to Figure 22

3.3 FOOD WASTE AND POLICY IMPACT

The overall aim of EU waste management policies is, ultimately, to prevent the generation of waste. The data, however, show that the quantity of food waste is increasing. This, as mentioned above, may be explained by a close link between population growth, economic growth (affluence) and waste generation. The implication therefore, is that **the impact of waste policy on food waste generation is neutral in terms of the absolute amounts of waste generated**. Waste policy does however have a considerable impact on the treatment of food waste once it has been generated. This is discussed in more detail in Section 3.6.

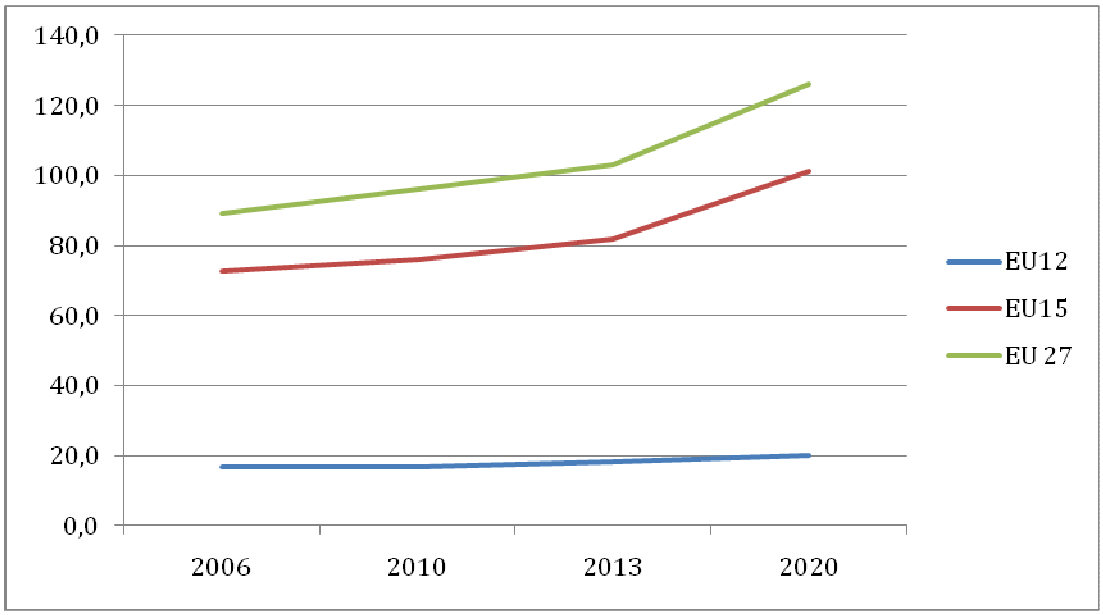
3.4 FOOD WASTE AND PREVENTION INITIATIVES

The concept of waste prevention, or, rather, embedding waste prevention into legislation is relatively new and has, in many cases, not yet been transposed into national law by MS. The consultation has demonstrated that food waste prevention in particular, is an increasingly important issue for a wide range of stakeholders.

Following earlier findings of this study (that food waste prevention initiatives are often at a local level and that there is a lack of information regarding the level of impact actually achieved), the forecast of impacts due to waste prevention activities is difficult to assert as the vast majority of initiatives are very recent and very few have measured results. On this basis, **no reduction from the current scenario has been applied.**

Again, 2006 food waste data was taken as a baseline and the disposable income scenario outlined in Section 1.2 used to produce the forecast. The forecast indicates positive growth in food waste generation, accounting for an additional 36.9 million tonnes of food waste generated across the EU-27 in 2020, compared to 2006 (126.2 million tonnes of food waste generated in 2020 compared to 89.3 in 2006).

Figure 22: Food waste (FW) arisings taking account of the impact of population growth and disposable income

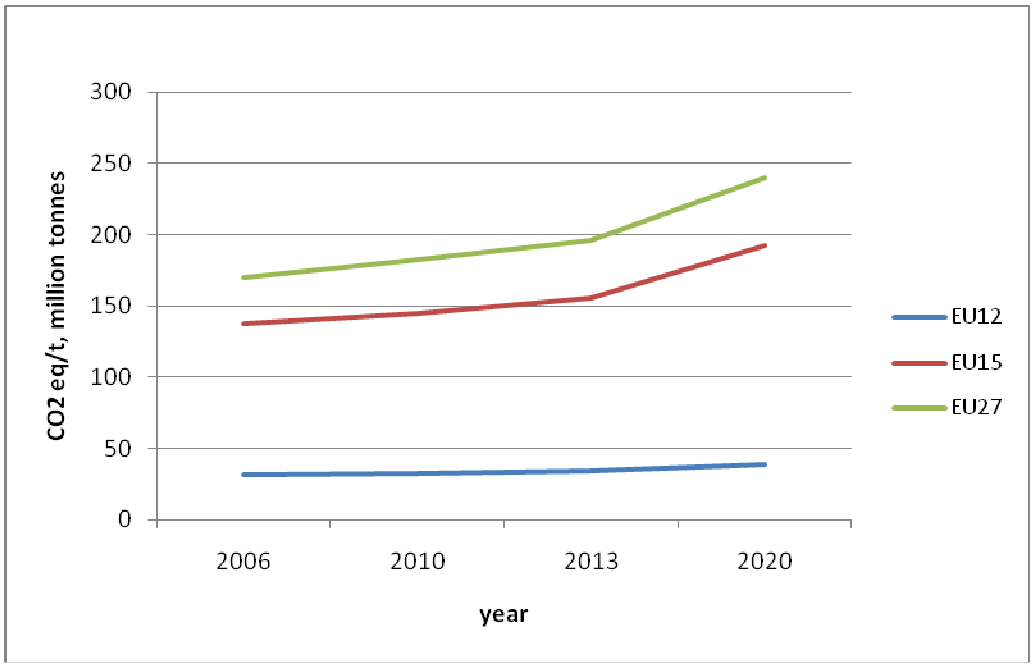


Source: EUROSTAT data

3.5 FOOD WASTE AND ENVIRONMENTAL IMPACTS

The main environmental impact considered is emissions of greenhouse gases measured in tonnes of CO_2 equivalent (t CO_2 eq./t). The methodology draws on previous work undertaken by BIO in section 0 of Chapter 1 of this report which indicates the total impact per tonne of food waste across the sectors studied is **1.9t CO_2 eq./t**. This figure has then been taken and multiplied by the food waste forecast which includes forecasts for population and disposable income to give an estimate of the likely greenhouse gas emissions through to 2020. Due to considerable uncertainties and the complexities of forecasting emissions it has not been possible to undertake more detailed analysis. Furthermore, as mentioned previously, despite quantitative results from the WRAP Love Food Hate Waste campaign, there is simply not enough data available to extrapolate the scale of potential food waste prevention to the EU-27, hence the impact of waste prevention initiatives is considered to be neutral.

Figure 23: Estimated greenhouse gas emissions from food waste



Source: EUROSTAT data

Figure 23 takes into account the impact of both population growth and growth in disposable income and shows **there is a positive growth in greenhouse gas emissions, accounting for an additional 70.2 million tonnes of carbon dioxide equivalent gasses emitted in 2020, in comparison with that in 2006**.

3.6 OTHER ENVIRONMENTAL IMPACTS

As stated in Section 3.3, the impact of waste policy (namely the Landfill Directive and the updated Waste Framework Directive (WFD)) as well as the recommendations contained in the EC communication on future steps in bio-waste management in the European Union on food waste generation is neutral. In other words it has no impact on the actual amount of food waste being generated. Waste policy does however, have a considerable impact on the treatment of food waste once it has been generated and this section looks briefly at the potential impacts of likely treatment scenarios.

For this forecast, the potential effects were investigated and the changes in the mix of treatment options for food waste over 15 years were anticipated based on the Landfill Directive requirements for diversion of biodegradable waste from landfill:

- by 2010 to reduce Biodegradable Municipal Waste (BMW) landfilled to 75% (by weight) of that produced in 1995
- by 2013 to reduce BMW landfilled to 50% (by weight) of that produced in 1995
- by 2020 to reduce BMW landfilled to 35% (by weight) of that produced in 1995

Assumptions

The forecast is based on 2006 food waste data. Despite the fact that the targets of the Landfill Directive are based on the 1995 tonnages of biodegradable food waste, 2006 was taken as a baseline year for two reasons: to ensure a comparability of the data and because there was no EU27 in 1995.

The impacts of policy measures on food waste tonnages are based on the assumption that the targets are fully met and that the impact of prevention activities on food waste growth is neutral.

It has been assumed that 45% of food waste generated in 2006 was disposed of to landfill based on:

- the data provided in the Green Paper on bio-waste management in the EU (Green Paper on the Management of Bio-waste in the European Union, Commission of the European Communities, 2008)
- OECD reports that estimate approximately 45% of total generated biodegradable waste was being disposed of at landfill in EU27 at the end of the 1990s

The WFD sets no specific targets for biodegradable/food waste per se, but outlines a clear strategy towards the separate collection and treatment of bio-waste. The Directive also has provisions for prevention measures. Article 29 of the WFD requires MS to establish National Waste Prevention Programmes and recommends the use of targets for waste prevention, so modelling should anticipate the potential prevention impact here. As the WFD will not be transposed into national laws before December 2010, its impact is assumed to be 10% reduction in food waste going to landfill by 2013 (in comparison with 2006) and 15% reduction by 2020. These figures have been estimated based on literature reviews and reflect expert judgement on the most likely scenarios.

The impacts of implementing the recommendations in the EC communication on future steps in bio-waste management in the European Union, released May 2010, are even more difficult to predict. Under the WFD, Member States are obliged to develop national waste management plans in line with the waste hierarchy. In addition they have to develop national waste prevention programmes not later than end 2013 with benchmarks that make progress measurable. The inclusion of national bio-waste prevention targets in these programmes could have a significant impact in the future. Therefore, the impact of the Directive on food waste tonnages is assumed to be zero for 2010 and 2013 and to lead to 10% reduction in food waste tonnages going to landfill by 2020. It is further assumed that the targets and their achievement will be cumulative. Again, these assumptions have been derived based on the background reading and desktop research done for this study.

Thus, the combined impact of waste diversion policies on the quantity of food waste going to landfill is estimated as:

- **25% reduction in food waste going to landfill by 2010**, in comparison with that produced in 2006 (based on Landfill Directive targets)
- **60% reduction in food waste going to landfill by 2013**, in comparison with that produced in 2006 (based on Landfill Directive (50%) and WFD targets (10%))

- **90% reduction in food waste going to landfill by 2020**, in comparison with that produced in 2006 (based on Landfill Directive (65%), WFD (15%) and future bio-waste legislation following from the EC communication on future steps in bio-waste management in the European Union (10%))

The percentage breakdown of the policy impacts on the food waste tonnages going to landfill is presented in Table 27 below.

Table 27: Percentage (%) impact of EU policies on food waste tonnages going to landfill (x% less waste going to landfill in comparison with that in 2006)

	2010	2013	2020
Landfill Directive, %			
EU12	25	50	65
EU15	25	50	65
EU27	25	50	65
Waste Framework Directive, %			
EU12	No impact	10	15
EU15	No impact	10	15
EU27	No impact	10	15
Future bio-waste legislation following on the EC communication on future steps in bio-waste management in the European Union, %			
EU12	No impact	No impact	10
EU15	No impact	No impact	10
EU27	No impact	No impact	10
Total combined policy impact. %			
EU12	**25**	**60**	**90**
EU15	**25**	**60**	**90**
EU27	**25**	**60**	**90**

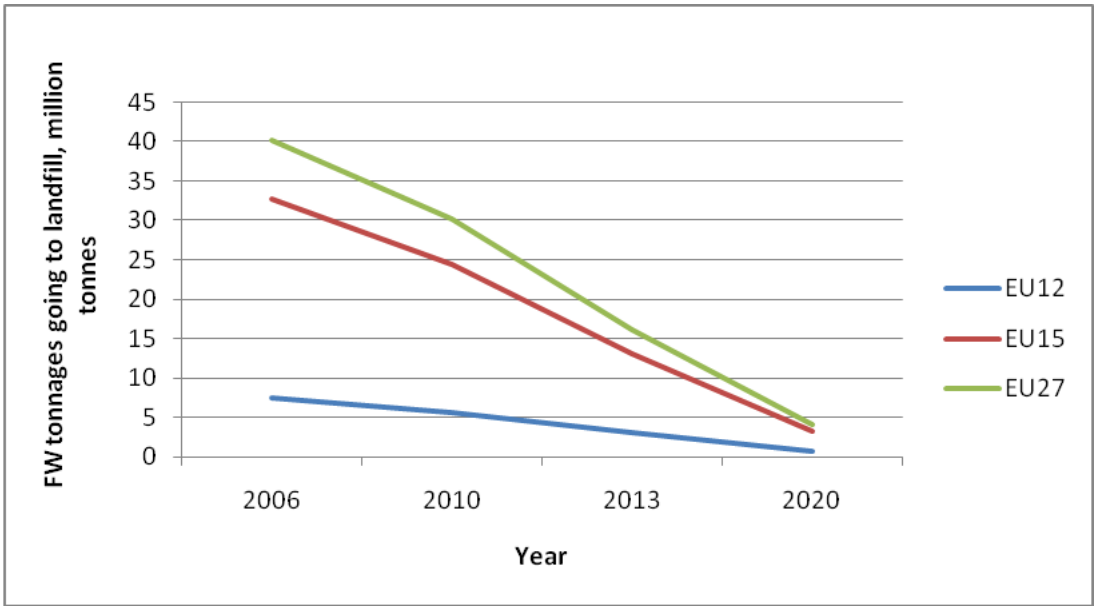
Source: EUROSTAT data

Table 28: Total impact of policies on food waste tonnages going to landfill, million tonnes (based on 2006 figures, not taking into account socio-economic changes)

	2006	2010	2013	2020
EU12	7.5	5.6	3.0	0.8
EU15	32.7	24.5	13.1	3.2
EU27	40.2	30.1	16.1	4.0

Source: EUROSTAT data

Figure 24: Impact of EU policies on food waste tonnage going to landfill (no impact on food waste generation from growth in population and disposable income)



Source: EUROSTAT data

Figure 24 is based on the 2006 figures from the baseline scenario. However, it does not take into account population/economic growth. The reason for this is that the targets in both the Landfill Directive and the WFD are set without considering population/economic growth.

As we can see in Figure 24, as a result of policy measures, there is an estimated 36 million tonne reduction in food waste going to landfill in the EU27 in 2020 compared to 2006, based on the assumption that all targets are met.

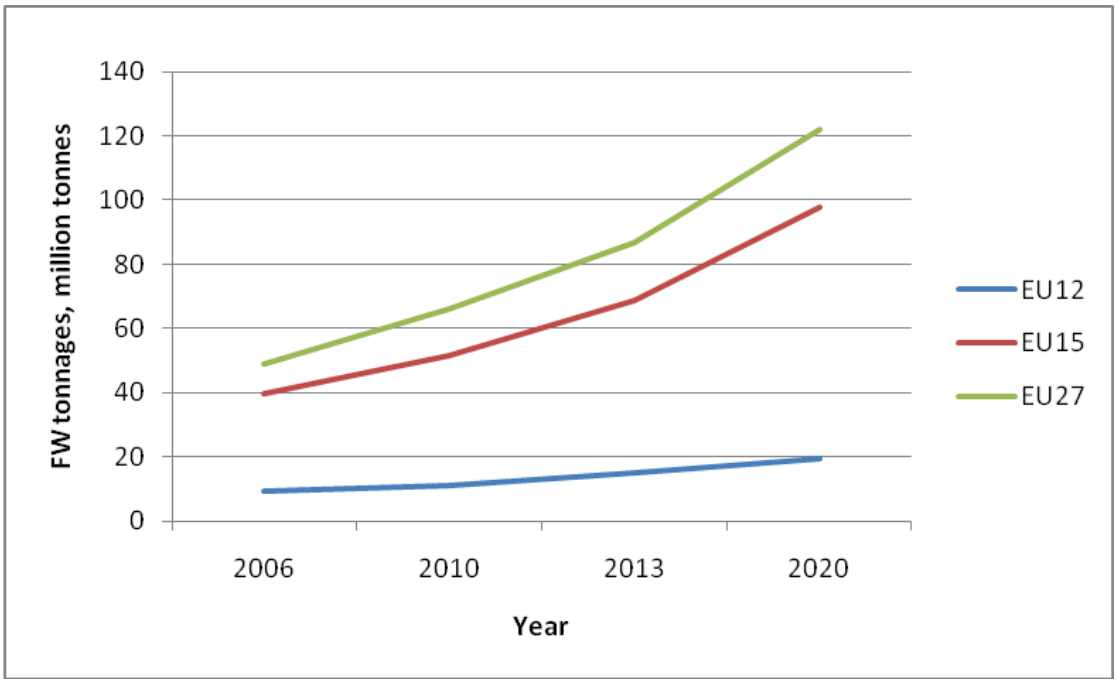
Whilst policy dictates that less food waste is sent to landfill, as reported above, the forecasting suggests the amount of food waste generated is anticipated to increase through to 2020 from 89.3 to 126.2 million tonnes for the EU27. **This means the food waste arisings that cannot be landfilled and need to be treated will reach 122.2 million tonnes in 2020** since the policy forecast states only 4.0Mt can be landfilled (see Figure 25).

Table 29: Food waste requiring treatment upon achieving expected landfill diversion targets

	2006	2010	2013	2020
EU12	9.2	11.3	15.1	19.4
EU15	39.9	51.6	68.6	97.9
EU27	49.1	66.0	87.0	122.2

Source: EUROSTAT data

Figure 25: Food waste arisings requiring treatment other than landfill



Source: EUROSTAT data

Consequently the plant capacity required to deal with these arisings and successfully divert material away from landfill in 2020 will need to more than double unless major prevention initiatives are undertaken. The extent to which this poses issues for planning consent, raising capital, etc. warrants further investigation.

Conclusions

Food waste quantities forecast

Working with available EU wide statistics, this work has shown that food waste arisings are anticipated to increase significantly due to population growth and increasing affluence (as shown by disposable income data). In 2006 the estimated food waste arisings were 89.3 million tonnes - by 2020 this study suggests this could increase to 126.2 million tonnes.

In predicting the impacts of current prevention initiatives, due to the fact that the vast majority of initiatives are very recent and very few have measured results, no impact on forecasted food waste generation due to food waste prevention initiatives has been applied.

Environmental impacts

The main finding is that alongside increasing quantities of food waste there will be positive growth in greenhouse gas emissions, accounting for an additional 70.2 million tonnes of carbon dioxide equivalent gasses emitted in 2020, in comparison with that in 2006.

Policy and other issues

Policies to divert food waste from landfill will not tackle the big issue of food waste generation. The impact of waste policy on food waste generation is neutral in terms of the absolute amounts of waste generated. Waste policy does however, have a considerable impact on the treatment of food waste once it has been generated. This work predicts that by 2020 the amount of food waste sent to landfill will decrease from 40.4 million tonnes to 4.0 million tonnes in compliance with policy. This leaves an estimated 122.2 million tonnes of food waste across the EU27 by 2020 still to manage via other residual treatment technologies. This is a significant quantity of waste, all of it generating substantial amounts of greenhouse gas emissions and a key issue for the future is how this 122.2 million tonnes of food waste will be treated via other technologies or whether to expend considerable and sustained efforts to secure the benefits of waste prevention.

This study indicates that waste prevention has failed to gain enough momentum at anything other than a local level and that much more must be done to secure potential levels of food waste prevention in order to achieve the associated benefits.

Without successful long-term pan-EU waste prevention activities securing notable behaviour change in the way people buy and use food, the treatment capacity required to handle food waste will need to increase by more than a factor of two. The challenge this poses for raising capital, securing permission to build and planning (or extending existing facilities) will be considerable.

Further work required

The main conclusion that can be drawn from this exercise is that statistical improvement and time series are needed in all MS to provide reliable data on food waste generation that could form a basis for more robust and reliable estimations and forecasting.

4. IDENTIFICATION & ANALYSIS OF ADDITIONAL POLICY MEASURES

INTRODUCTION

In this chapter, five additional policy measures for implementation at the EU-level for food waste prevention are identified and analysed. The chapter involves an assessment of the five options and concludes with a selection of the three best options. The chapter comprises the following stages:

- **4.1**: Identification of five policy options and their pros and cons
- **4.2**: Environmental and economic costs and benefits of policy options
- **4.3**: Comparison of three best policy options with forecast

This study has shown food waste to be a new issue gaining momentum. Current prevention activities predominantly focus on awareness-raising as a preliminary step in effecting behaviour change, with some good practices identified at national and local level. An array of good practices were demonstrated in Chapter 2, though they are concentrated in particular MS that have actively taken up food waste as a challenge and opportunity to be seized.

Chapter 3 demonstrates that EU policy is not yet stimulating food waste prevention in an active way. Regulatory measures are currently centred lower in the waste hierarchy, requiring diversion from landfill for example. While waste prevention and separate collection of food waste are promoted, and while National Waste Prevention Programmes are required, there has not yet been a regulatory policy response targeted at food waste, despite the 170 Mt of carbon dioxide equivalent that food waste represents in Europe.

The policy options assessed in this chapter deal with the main problem for the EU in effectively targeting a food waste policy response: the lack of reliable data. Data reporting requirements were thus prioritised. EU and MS level targets were subsequently assessed, as they create a framework for a European response, and stimulate Member States to develop national measures to address the idiosyncrasies of avoidable food waste generation strategically.

The need for increased awareness of the issue became apparent in Chapter 2, and the volume and impacts of food waste underlined the need for long-term behaviour change. A European measure on awareness-raising was thus considered and it links to national awareness efforts discussed.

Having identified households as the principle generators of avoidable food waste, new research highlighted date labelling confusion as a cause linked to over 20% of household food waste (WRAP, see page 117). EU efforts to harmonise date labelling and increase clarity for consumers was thus assessed.

As a result of a wide nine month consultation with stakeholders and the opportunity to interview many experts currently involved in food waste prevention, a concrete action in triggering long-term behaviour change stood out. Separating food waste from other refuse in households, restaurants and cafeterias was a measure frequently seen on local level during research on prevention actions. This single act drew the attention of participants to the amount of edible food loss they were personally responsible for. Stakeholders repeated

the catalytic effect of this process in changing behaviours, particularly when accompanied by awareness campaigns and/or bin characterisation analysis to better understand which foods they were wasting. The substantial concomitant benefits of separating and separately treating food waste, a valuable resource in itself, prompted this study's investigation of separate collection as a policy option.

The results of the analysis are described below.

KEY FINDINGS

This chapter uses the previous intelligence gathered on current food waste prevention initiatives in chapter 0 and on food waste quantities and forecasts developed in sections 1.2 and 3. **Five policy options were identified** for implementation at EU level to strengthen existing efforts to prevent food waste:

- **Business as usual**
- **Option 1: EU food waste reporting requirements**
- **Option 2: Date labelling coherence**
- **Option 3: EU targets for food waste prevention**
- **Option 4: Requirement on separate collection of food waste in the MS**
- **Option 5: Targeted awareness campaigns**

The **environmental and economic costs and benefits** of the five policy options and the business as usual scenario were assessed via an **impact assessment matrix,** enabling the delineation of three options providing important waste prevention benefits at limited cost.

This demonstrated that **option 1** had limited food waste reduction potential, but facilitated the development of targets and strategies that would not be possible without robust baseline data. Costs for MS and industry were identified as moderate, in most cases focusing on the harmonisation of methodologies rather than the sourcing of previously uncollected data.

Option 2 was selected for its expected food waste prevention potential, based on its capacity to improve consumer information on food edibility across the EU and the evidence on existing uncertainty in this area. The potential reduction of avoidable food waste, the comparatively limited cost of this policy option, and the possibility to integrate it into the Food Information Regulation currently being debated, were also taken into consideration.

Option 5 was selected due to stakeholder agreement on its necessity and essential role in behaviour change. Its potential to reduce food waste will be linked to the budget invested in awareness-raising, though this is expected to be consistently less than the potential financial savings to households through more efficient use of purchased food.

Option 3 was not selected at this time, as it depends upon the effective implementation of option 1, which as EUROSTAT suggested, may not be able to be put in place until the next round of requirement changes. However, it should be noted that this policy option could be integrated into the national waste prevention programmes required to be developed by MS not later than the end of 2013, under Article 29 of the revised Waste Framework Directive.

Option 4 was not selected because robust quantitative evidence on the "waste prevention effect" of separate collection is lacking, although this has been widely observed by stakeholders. This is a costly policy option, though it is potentially economically profitable in the long-term and offers major environmental benefits. The practical nature of separating food waste from general household or workplace waste reminds individuals regularly of the quantities of food waste they are responsible for. This increased consciousness of food wasting behaviours can lead to prevention at source, according to several stakeholders. Additionally, the subsequent environmental benefits of food waste separation and proper treatment are ample, providing a clear method of using waste as a resource. However, as proving the prevention at the source characteristics of such a policy, currently remains difficult, it has been left open to development by other avenues for its substantial recycling opportunities.

4.1 IDENTIFICATION OF FIVE POLICY OPTIONS AND THEIR PROS AND CONS

Policy options were identified, based on the work presented in the previous chapters, notably in Task 1 on the causes of food waste and in Task 0 on current initiatives in place for preventing and reducing food waste. Among these, food redistribution guidelines for MS, food waste prevention targets for the Manufacturing and/or Wholesale/Retail sector through voluntary agreements, research programmes on packaging innovation or by-product exploitation for food waste minimisation, a cooperative framework for food waste prevention across the supply chain, and Food Service sector training programmes were considered, in addition to the options selected below. Previous research on potential policy options and approaches for addressing bio-waste in the EU were examined, to ensure continuity, including notably the Arcadis study on options for improving the management of bio-waste[74], the EC green paper on bio-waste management prepared and the EC communication on future steps in bio-waste management in the European Union.[75]

These potential options identified were narrowed to five in close cooperation with the European Commission.

Policy Option 1: EU food waste data reporting requirements

- **Overview**

Option 1 entails EUROSTAT reporting requirements for MS on food waste and a standardisation of methodologies for calculating food waste quantities at MS level to ensure comparability. A feature of this is the clear exclusion of by-products from food waste data reporting.

- **Core elements**

Option 1 targets the lack of reliable baseline food data available and includes the following elements:

- The addition of a sub-category to the EUROSTAT database under 09 'Animal and vegetal waste' that is specifically entitled 'Food waste'.

[74] Arcadis (2009) *Assessment of the options to improve the management of bio-waste in the European Union*
[75] EC (2008) *Green Paper on the management of bio-waste in the European Union*, Brussels, Belgium

- The addition of sub-sectors for the 09 'Animal and vegetal waste' category that are 'Retail/Wholesale' and 'Food Service/Catering', maintaining 'Other Sectors' for anything that cannot be included in the new sectors, or agricultural, manufacturing or household food waste.

- The clear, standardised definition of food waste, particularly as distinct from by-products, and the provision of a clear methodology for calculating food waste in each sector.

➢ **Reasoning**

Robust baseline data is needed to set targets and track progress on food waste prevention. Chapter 1 has shown that:

- Definitions of food waste and of sectors (such as Manufacturing, Wholesale/Retail, Food Service/Catering, Households etc.) are not standardised across MS

- Methodologies of calculating food waste vary widely

- Some MS do not disclose food waste data to EUROSTAT at all

➢ **Pros and cons**

Policy option 1, while involving administrative costs, would provide a clearer picture of food waste quantities, sources and treatment, thereby raising awareness of food waste issues and allowing for targeted analysis to identify and address problem areas for food waste generation and treatment. Targets for food waste prevention, furthermore, need reliable baseline data in order to be effective. The availability of more detailed and comparable food waste data would, in the long term, lead to more effective food waste prevention and treatment.

Pros

- Initial step for setting targets and tracking progress on food waste
- Separate food waste reporting increases awareness of issue
- On a smaller scale, reporting food waste quantities separately has led to a reduction in food waste generation
- Allows for clearer understanding of food waste-related issues (e.g. how much each sector is producing, possible causes, etc)
- Addresses all sectors

Cons

- Administrative cost associated with sourcing and cataloguing new data
- Specialised skills needed for the clarification of definitions and the standardisation of measurement methods
- National differences in maturity of measurement capabilities
- National differences in political issues and motivation surrounding food waste and measurement methods
- Implementation costs for MS
- Measurement costs for industry can be significant

Synergies with and impacts on other options

- Potential building block for Policy Option 3 (EU targets for food waste prevention)
- Methodological work on defining food waste could contribute to the selection of separate collection practices in Option 4 (Requirement on the separate collection of food waste in the MS)

Policy Option 2: Date labelling coherence

➢ Overview

Option 2 involves the clarification and standardisation of current EU-mandated food date label application, such as "best before", "best before end" and "use by" as well as voluntary labels such "display until" dates, and dissemination of this information to the public, the food industry and enforcement agencies to increase awareness of food edibility criteria, thereby reducing food waste produced due to date label confusion or perceived inedibility.

➢ Core elements

- Addition of a requirement to the Proposal for a Regulation of the European Parliament and of the Council on the provision of food information to consumers (2008), which is currently being debated by the European Parliament and the Council of Ministers.

- Stipulation, in the above-mentioned proposal, on the creation and diffusion of guidance for businesses on how to ensure food label compliance and good practice in using date labels consistently.

- Recommendation by the EC of a joint initiative on the part of the EU, the food industry and enforcement organisations to raise awareness on date labels, notably aimed at consumers, including increased emphasis on proper storage instructions and their link to the lifespan of the product and the validity of its date label.

- Dissemination of information on harmonised date labels, so that the public understand their meaning. This includes an understanding that "best before" dates are primarily related to quality rather than safety, and that using their own judgement (visual, olfactory and taste) is often more than adequate.

➢ **Reasoning**

- **The function of food product labelling is to ensure consumer safety and inform their decision making.** WRAP research on date labelling in the UK shows that 45-49% of consumers misunderstand the meaning of the date labels "best before" and "use by".[76] Food waste expert at BOKU University Felicitas Schneider reinforced the astonishing lack of public understanding of date labels when commenting on this study's policy options, based on experiences in Austria. This evidence suggests that date labels are not adequately fulfilling their function at this time.

- Date label confusion is a significant cause of household food waste, contributing to "food not used in time" issues identified by WRAP, which make up in total 2.9 Mt or nearly 60% of avoidable household food waste in the UK, as shown below in

  Figure 26.

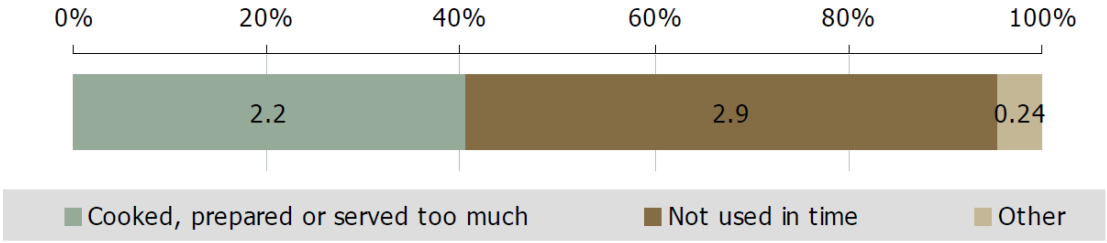
- WRAP's 2010 Date label Q&A shows in particular that 255,000 tonnes of food is discarded "before it has even reached its use by or best before date, and much of this could have been avoided if the food had been stored correctly, and through consumers having confidence in date labels".[77]

- WRAP's Household Food Waste Programme Manager, Andrew Parry, has estimated that 1 million tonnes of food waste or over 20% of avoidable food waste in the UK is linked to date label

[76] WRAP (2010) *Improving the application and understanding of date labels and storage guidance: Activity brief*
[77] WRAP (2010) *Date label Q&A document*

confusion[78], making the issue a principle factor in household food waste prevention.

Figure 26: Weight of avoidable food and drink waste generated in the UK, split by reason for disposal



Figures within bar state waste in millions of tonnes per year

Source: WRAP

- Section 1.2 of Chapter 1 identified households as the largest food waste generating sector, accounting for approximately 40% of food waste generated in the EU.
- Uniform action by the EU assures equity for citizens in terms of health protection through proper understanding of date labels and cost savings by reducing household food waste. A consistent approach by the EU also minimises the burden on manufacturers, who often operate in multiple MS. The Proposal for a Regulation of the European Parliament and of the Council on the provision of food information to consumers of 2008 (Food Information Regulation hereafter) suggests that over 60% of companies surveyed favour harmonisation of general food labelling through European legislation[79].

➢ **Pros and cons:**

Policy option 2 addresses manufacturers (responsible for setting date labels), retailers (responsible for setting "display until" labels and some own-brand date labels) and households, who frequently decide whether or not food is edible based on its date label. Retailers could play an important role in raising awareness and helping consumers understand harmonised date labels.

The policy has the possibility to lead to long term behaviour change; cons are primarily linked to potential implementation costs for MS and industry.

[78] WRAP Interview, July 2010; total avoidable food waste produced by households in the UK accounts for 4.5 million tonnes of food waste, as calculated in WRAP (2009) *Household food and drink waste in the UK*

[79] Regulation of the European Parliament and of the Council on the provision of food information to consumers: http://ec.europa.eu/food/food/labellingnutrition/foodlabelling/publications/proposal_regulation_ep_council.pdf

Pros

- Protects consumer safety through clearer food labelling
- Household food waste avoidance through better decision making of food edibility (Households generate the largest proportion of EU food waste)
- Household cost savings through food waste avoidance
- Greater clarity for manufacturers on food date labelling; harmonised labelling requirements across the EU reduces administrative burden for manufacturers operating in multiple MS

Cons

- Guidance for industry on date labels for relevant food categories could present an EU research cost
- Implementation of harmonised date labels could present a slight cost for manufacturers, depending on the time frame for implementation

Synergies with and impacts on other options

- Most effective when combined with consumer education and awareness raising activities (Policy Option 5) to ensure consumers use date labels appropriately

Policy Option 3: EU targets for food waste prevention

➢ **Overview**

Option 3 is the creation of specific food waste prevention targets for MS, as part of the waste prevention targets for MS by 2014, as recommended by the 2008 Waste Framework Directive. This policy option relies upon improved MS food waste data reporting (as proposed in policy option 1).

➢ **Core elements**

- Setting of a percentage target for food waste reduction for MS, based on existing levels. An essential requirement for the development of this policy option is the establishment of validated baseline data on food waste generation by MS (see policy option 1).

➢ **Reasoning**

- Chapter 3 has shown that food waste generation will continue to rise in the EU27 to 2020.
- Achievements in food waste prevention via concrete targets would contribute to the overall goals of the revised Waste

Framework Directive and support the proper implementation of the waste hierarchy.

- Chapter 0 showed that household food waste is particularly effectively targeted by policy options at the MS level, and thus the setting of EU targets would be an effective means to encourage MS to develop national actions and to stimulate innovation in this area.

➢ **Pros and cons**

Option 3 aligns with other EU legislation/targets and presents an effective method for addressing household waste quantities; however, feasibility rests entirely on the existence of validated food waste generation data (policy option 1).

Pros

- Targets household waste at MS level, considered particularly effective level for targeting household sector
- Quantitatively addresses anticipated increase in food waste quantities
- Aligns with other legislation/targets (e.g. Waste Framework Directive)
- Allows for country-specific and culture-specific adaptability; methods for achieving targets would be decided at the MS level

Cons

- Costs for MS for carrying strategies for food waste prevention, through National Waste Prevention Programmes
- Implementation costs for industry, determined by the food waste prevention strategies utilised to meet targets
- Feasibility rests on establishment of validated food waste generation data (Policy option 1)

Synergies with and impacts on other options

- Relies upon improved national food data reporting as proposed in policy option 1 (EU food waste data reporting requirements)

Policy Option 4: Recommendation and subsidy on the separate collection of food waste in the MS

➢ **Overview**

Option 4 is a recommendation of MS adoption of separate collection of food waste or biodegradable waste, namely for the Household and/or Food Service/Catering sector. Subsidy for the development of separate collection and treatment infrastructure.

- **Core elements**

  - This policy could be applied at different levels, via a requirement for the separate collection of food or biodegradable waste, via targets for MS on separate food waste collection, or via a recommendation to MS on separate food waste collection accompanied by a subsidy for the development of food waste treatment facilities. In this study the latter option is focused on.

  - Should target both the Household and Food Service sectors to maximise impact.

  - Should target food waste; could include small green waste (flowers, grass, leaves) as this takes advantage of the infrastructure and provides further environmental benefits.

- **Reasoning**

  - WRAP and other stakeholders have referenced their experience that the separation of food waste by households and by cafeteria/restaurant staff, especially when linked to food waste awareness-raising, leads to a reduction in food waste and stimulates behaviour change, as participants are confronted by the sheer quantity of food waste that their household or workplace generates.

  - Supports the Thematic Strategy on the Prevention and Recycling of Waste objective to "use waste as a resource". This policy option allows food waste which is unavoidable or is otherwise not prevented to be used to generate high quality compost, which contributes to healthy soil and biodiversity. Healthy soil furthermore provides climate change benefits through carbon sequestration.

  - Recital 35 of the revised Waste Framework Directive furthermore states the importance of separate collection of bio-waste for the purpose of avoiding greenhouse gas emissions from waste disposal at landfill. Article 22 subsequently requires that MS manage bio-waste in accordance with the waste hierarchy, by promoting separate collection with a view to the composting and anaerobic digestion of bio-waste, taking measures to ensure a high level of environmental protection.

  - MS are developing responses to bio-waste treatment at different levels, and some MS do not have a plan in place to manage bio-waste at all. New MS participants in the Bio-waste Coalition for example are asking for drivers to develop bio-waste solutions. This policy option offers MS the opportunity to better manage bio-waste through separate collection and treatment investment, regardless of their current level of development in this area.

➢ **Pros and cons**

The combined environmental benefits of this policy option are substantial. It is presented here for the principal purpose of food waste reduction at source, as the practical nature of food waste separation in the home or workplace provides regular reminders of food wasting behaviours. However, the subsequent environment benefits of food waste separation and proper treatment are ample, as described above.

The major synergy with other policy options is the accompanying use of awareness campaigns.

Pros

- Targets household waste at MS level, considered most effective level to target for household sector
- Significant environmental benefits in terms of greenhouse gas emissions, soil quality and biodiversity
- Aligns with aims of EU waste legislation, helps MS meet Landfill Directive targets
- Allows for country-specific and culture-specific adaptability
- **Separate collection and treatment of food waste, especially the production of high quality compost, is profitable for MS and industry.**

Cons

- Costs for the EU in terms of subsidies for infrastructure development
- Implementation and infrastructure development costs for MS
- Administration costs for municipalities or waste management authorities
- Feasibility rests on establishment of validated food waste generation data (Policy option 1)
- The prevention benefits of source separation have not yet been measured: this rests upon stakeholder experience.

Synergies with and impacts on other options

- Depends on improved national food data reporting as proposed in policy option 1 (EU food waste data reporting requirements)
- Accompanying use of awareness campaigns (Policy option 5)

Policy Option 5: Targeted awareness campaigns

➢ **Overview**

Option 5 involves the usage of targeted awareness campaigns, largely geared towards the household sector and the general public, to raise awareness on food waste production, environmental and other impacts of biodegradable waste, prevention methods and practical tips to encourage behaviour change and a long-term reduction in food waste production.

➢ **Core elements**

- EU offering a forum for stakeholder engagement and best practice sharing.
- MS developing national level awareness campaigns for maximum impact, tailored to national specificities in terms of food waste generation, environmental engagement, tips for taking advantage of purchased food specific to national diets, etc.
- Geared primarily at the Household sector, since households produce approximately 40% of food waste; could also be linked with a similar campaign geared towards the Wholesale/Retail sector and the Food Service/Catering sector to create synergies with household behaviour change.
- Possible integration with European Week for Waste Reduction.[80]
- According to WRAP research, 60% of household food waste is avoidable; awareness campaigns target this portion of food waste generated by focusing on controllable factors, in terms of:
  - → Lack of awareness of own food waste generation
  - → Lack of knowledge on methods for avoiding food waste/reusing food
  - → Misunderstanding/confusion over date labels[81]
  - → Inappropriate storage
  - → Portion mis-sizing
  - → Buying too much/lack of shopping planning
- Awareness raising activity should apply current consumer behaviour literature to maximise the impact of the effort. DEFRA's framework for pro-environmental behaviours, for example, uses a model with twelve headline behaviour goals and segments the public into seven clusters based on distinct attitudes and beliefs towards the environment, environmental issues and behaviours.[82] DEFRA's consumer behaviour research has shown that common motivators for pro-environmental behaviour include: 'feel good factor', social norms, individual benefits (e.g. health, financial outlay), ease and being part of something. Common barriers include: external constraints (infrastructure, cost, working patterns, demands on time), habit, scepticism and disempowerment. These can be adapted usefully to address the identified causes of food waste.

[80] European Week for Waste Reduction: www.wastereductionweek-pilotedition.eu/index.php?lang=en www.ewwr.eu

[81] WRAP (2009) *Household food and drink waste in the UK*

[82] DEFRA (2008) *A framework for pro-environmental behaviours: Report*

➢ **Reasoning**

- The Household sector accounts for 40% of food waste produced and 60%[83] of this food waste is considered avoidable, hence there is a potential for a sizable impact, particularly via synthesis with the Wholesale/Retail and Food Service sectors to increase consumer awareness and behaviour change.

- As Chapter 3 has shown that food waste generation will continue to rise in the EU27 to 2020, due to a number of factors, including disposable income and population growth, long-term prospects for reduction of food waste and its environmental impacts hinge on long-term behaviour change.

- The most effective food waste-related awareness campaigns have taken a practical approach and used multiple communication channels; one of the most successful, WRAP's Love Food Hate Waste campaign has prevented 137,000 tonnes of food waste since its launch in 2008.[84]

- The EU already finances awareness-raising for behaviour change; the Flick the Switch campaign for example, supported by the Agency for Competitiveness and Innovation (EACI), encourages schoolchildren to turn off unnecessary lights, with the aim of supporting the EU climate change targets for 2020.[85]

- By targeting specific issues related to food waste and using a multi-channel approach, national-level campaigns have made significant impacts, indicating that campaigns could be particularly effective if priorities were set at an EU level but campaigns were run at a national level.

➢ **Pros and cons**

While sometimes difficult to measure results, policy option 5 could involve cross-sector synergies and bring about long-term behaviour change.

[83] Ibid (81)
[84] Love Food Hate Waste website: www.lovefoodhatewaste.com
[85] Flick the Switch: www.flickpartners.eu/unregproject.php

Pros

- Possibility for synergies with household, wholesale/retail and restaurant/catering sector
- Aligns with other legislation/targets (e.g. Waste Framework Directive)
- Possibly synergies with policy option 2 on date labelling to increase effectiveness of date standardisation
- Management on the national level would provide country and culture-specific tailoring to make campaigns more effective
- Contributes to long-term behaviour change to reduce food waste volumes

Cons

- Implementation costs for MS
- Implementation costs for industry
- Difficult to measure campaign impacts
- Efficacy of campaigns may be linked to budget invested

Synergies with and impacts on other options

- Possible overlap and synergies with policy option 2 (Date label coherence)
- Potential usage in conjunction with policy option 3 (EU targets for food waste prevention)
- Potential usage in conjunction with policy option 4 (Recommendation and subsidy on the separate collection of food waste in the MS)

4.2 ENVIRONMENTAL AND ECONOMIC COSTS AND BENEFITS OF POLICY OPTIONS

i. METHODOLOGY

The main objective of this task is to assess policy option impacts, in order to assist the European Commission in selecting three effective policy options for promulgating food waste prevention and reduction.

The impact assessment will focus notably on economic, social and environmental considerations as well as practicability and enforceability indicators. The impact assessment seeks to compare potential policy options costs and benefits against a baseline business as usual or no action scenario.

The business as usual scenario is delineated below, followed by an explanation and definition of indicators used in preparing an impact matrix to assess the five possible policy options.

Policy Option 0: Business as usual i.e. non-action

➢ **Overview**

Option 0, **business as usual (BAU),** assumes the continuation of current EC legislation related to food waste, with no additions or changes to its application. Notably, this scenario would involve the continued unmodified application of the policies and principles in the Landfill Directive 1999/31/EC, the Waste Framework Directive 2008/98/EC, the Thematic Strategy on the Prevention and Recycling of Waste, the green paper on bio-waste management in the EU and the EC communication on future steps in bio-waste management in the European Union.

➢ **Core elements**

Option 0 is a baseline scenario, involving the continued implementation of current EU policy impacting food waste, such as the:

- **Landfill Directive 1999/31/EC:** Continued application of the Biodegradable waste diversion targets, which oblige MS to reduce the amount of biodegradable waste (BMW) in landfill by 65% by 2016 compared to 1995 levels. As of 2006, MS were restricted to landfilling a maximum of 75% of the total amount by weight of BMW produced in 1995, a target which increased to 50% in 2009 and will increase to 35% in 2016. However, the Landfill Directive does not submit countries to binding specifications on methods for disposing of BMW not sent to landfills, a situation which has led, and will most likely continue to lead most MS to opt for incineration.

- **Waste Framework Directive 2008/98/EC:** Continuation of the principles and policies outlined in the Waste Framework Directive, the new recycling targets set for 2020, the strengthened provisions on waste prevention through an obligation for MS to develop national waste prevention programmes and a commitment from the EC to report on prevention and set waste prevention objectives, the establishment of a five-step hierarchy of waste management options and the clarification of definitions such as recycling, recovery and waste, as well as a delimitation between waste and by-products and end-of-life criteria. This also includes the application of Article 22 of the Directive which encourages the separate collection and treatment of bio-waste.

- **Thematic Strategy on the Prevention and Recycling of Waste:** Continued reference to guidance document on reducing waste and its environmental impacts throughout the product lifecycle.

- **Green paper on bio-waste management in the EU:** Ongoing reference to this analysis report, published in December 2008,

which examines the necessity of a stand-alone EU Bio-waste Directive.

- **Communication on future steps in bio-waste management in the European Union:** Continued reference to the recommendations and positions laid out in this communication, published May 2010, including the promotion of separate collection and municipal composting, as well as the encouragement of Waste Management Planning according to the waste hierarchy.

The continuation of this status quo also assumes the non-implementation of an above-mentioned possible Bio-waste Directive. While MEPs issued a resolution July 6th 2010 on the necessity of creating a Bio-waste Directive including provisions on compulsory separate collection and recycling of bio-waste, a draft of such a document will not be brought forward until the end of 2010 and the future of such a legislative document remains unclear. A Bio-waste Directive would also most likely involve a quality-based classification of the different types of compost from bio-waste and could include guidelines on raising public awareness on recycling and prevention of bio-waste as well as encouraging and supporting scientific research and technological innovation in relation to bio-waste management. The introduction of such measures could contribute to achieving targets for recycling and renewable energies, thereby helping in achievement of the goals in the EU 2020 strategy, in particular, resource efficiency.

Additionally, this status quo assumes no specification or requirement on taking bio-waste into account in the setting and implementation of the above-mentioned national waste prevention programmes and waste prevention objectives, required for MS as outlined in the revised Waste Framework Directive.

Even without the creation of a separate Bio-waste Directive, the full implementation and enforcement of the existing bio-waste legislation is estimated to result in additional environmental and financial benefits in the order of €1.5 billion to €7 billion [86]. A part of the potential benefits of more strictly enforcing current legislation or implementing increasingly rigorous legislation measures would come from reducing methane production in landfill, as methane is estimated to be over twenty times more environmentally harmful than carbon dioxide.

The waste stream covered by such a legislative measure would include biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants. Waste materials which would fall outside of this definition include forestry or agricultural residues, manure, sewage, sludge or other biodegradable waste, such as natural textiles,

[86] 'Call for bio-waste directive': www.eucommerz.com/a/0481_call_for_bio_waste_directive

paper or processed wood.[87] Bio-waste, using this definition, accounts for approximately 30% to 45% of municipal solid waste produced in Europe[88].

➢ **Reasoning**

The scenario in policy option 0 presents the future state of EU food waste related legislation without any modifications to current policies and guidelines and provides a context for the five following pro-active policy options and their impacts.

➢ **Pros and cons**

Policy option 0, involves no additional administrative or legislative burdens; however, non-action, or business as usual, represents a missed opportunity to reduce environmental impacts.

Pros

- No additional burdens from additional legislative requirements

Cons

- Missed opportunity to use this valuable waste stream as a resource, and to reduce environmental impacts
- Leaves MS the freedom to determine the best method to achieve the landfill directive targets for biodegradable waste: possible inconsistency of approaches between MS/regions, leading to impacts on competition among European manufacturers

Definition of assessment indicators

The indicators chosen for assessing the environmental, economic and social benefits of the policy options assessed were selected using the expert judgement of the project team in order to capture as succinctly as possible the potential costs and benefits of the five policy options and their suitability for implementation at the EU level. Table 30, below, details the assessment indicators used as well as their definitions.

[87] 'EP calls for EU biowaste directive': www.organics-recycling.org.uk/index.php?option=com_content&view=article&id=808:ep-calls-for-eu-biowaste-directive&catid=1:latest-news&Itemid=18

[88] Ibid (87)

Table 30: Definition of assessment indicators used

Impact category	Indicator	Definition	Unit
General Issues	Targeted sector(s)	Among 4 sectors examined: Manufacturing & Processing, Wholesale & Retail, Food Service & Restaurants, Households. "All" indicates all 4 sectors are impacted.	N/A
	Legislative change	Whether or not the policy option involves a modification to existing EC or MS legislation for implementation.	N/A
	Mandatory	Indicates obligatory or voluntary nature of the policy proposed. Mandatory indicates required implementation while voluntary indiciates suggested or encouraged implementation.	N/A
Environmental	Potential food waste reduction (magnitude)	Estimated reduction in tonnes of food waste.	Tonnes
	Potential GHG reduction (magnitude)	Estimated reduction in tonnes of GHG emissions.	Tonnes
Economic	Implementation costs for EU institutions	Estimates any costs necessarily expended by the EU for the implementation of the policy option, notably staff, operational costs and administrative/overhead costs. Costs include those expended by the EU Commission or at the EU-level through a partner organisation.	Euros
	Implementation costs for MS	Estimates any costs necessarily expended at the MS level for the implementation of the policy option, particularly staff, operational costs and administrative/overhead costs. The indicator seeks to capture possible variability of implementation costs of a given policy at an MS level due to, for example, differing levels of waste management infrastructure maturity.	Euros
	Implementation costs for facilities/industry	Estimates costs necessary on the part of facilities/industry for the implementation of a given policy. While specific costs are difficult to assess, notably due to the range of players and types of facilities which could be impacted, an effort has been made to approximate the scale of impact for staff and investment costs as well as cost avoidance via the reduction of fees such as landfill taxes due to food waste reduction.	Euros
	Impact on the economic sector (loss in turnover/sales)	Captures estimated potential economic impact of reduction in food sales due to food waste reduction achieved via the implementation of a given policy option.	Euros
Social	Effects on household income via avoidance of food waste	Impact on household income in euros (reduction in spending on food, increase in disposable income), due to avoidance of food waste.	Euros
	Effects on job creation	Impact of policy implementation on job creation for public authorities and the private sector.	Number of employees
	-Public authorities	Requirement or possibility for increase (or decrease) in public authority staffing needs as a result of policy option implementation. Public authorities include all governmental and public bodies on a MS and EU level, including for example EUROSTAT, local governments, public waste management	Number of employees
	-Private sector	Requirement or possibility for increase (or decrease) in private staffing needs following policy option implementation. Private sector includes manufacturers, retailers, other business organisations as well as private waste management firms.	Number of employees
Other Issues	Practicability: is it practical to implement?	Ease and practicality of implementation. Considering factors including: number of stakeholders involved, length of timeline for implementation.	N/A
	Clarity and consistency (e.g. with other EU legislation)?	Alignment of policy option with other EU legislation, for example the Waste Framework Directive, the Thematic Strategy on the prevention of waste, the Landfill Directive etc.	N/A
	Degree of risk/uncertainty	Degree of uncertainty in terms of results achievable.	N/A
	Is it enforceable?	Possiblity for regulation of policy option and strictness of enforcement following implementation.	N/A

The five policy options selected were compared against these impact indicators, using a semi-quantitative score matrix, found below in Table 31.

Table 31: Semi-quantitative score matrix

+++	Very high benefit
++	Significant benefit
+	Moderate benefit
0	No effect
-	Moderate cost
--	Significant cost
---	Very high cost
Y, N, Y/N	Yes, No, Yes/No
N/A	Not applicable

If needed, a range may be used, for example "0 to –" or "- to +". Such scores will be clarified by commentary provided in the overall analysis of each policy option, found in section 6.3.3 Assessment of each policy option.

ii. Overall Assessment

The results of this impact analysis are presented in an ***impact matrix*** (policy options against impacts) found in Table 32 on the following page and commented further in **section iii** titled **Assessment of each policy option**.

Table 32: Impact Assessment Matrix

	Option 1: EU food waste reporting requirements	Option 2: Date labelling coherence	Option 3: EU targets for food waste prevention	Option 4: Requirement on separate collection of food waste in the MS	Option 5: Targeted awareness campaigns
General Issues					
Targeted sector(s)	All	All	All	Households and Food Service	Households
Legislative change	Y	Y	Y	Y	N
Mandatory	Y	Y	Y	N	N
Environmental impact indicators					
Potential food waste reduction (magnitude)	0 to +	+ to ++	+ to ++	+	+
Potential GHG reduction (magnitude)	0 to +	+ to ++	+ to ++	+ to ++	+
Economic impact indicators					
Implementation costs for EU institutions	0 to -	-	-	-- to ---	-
Implementation costs for MS	-	-	- to --	-- to ---	- to --
Implementation costs for facilities/industry	-	- to --	- to --	- to +	0
Impact on the economic sector (eg loss in turnover)	0	-	- to +	- to +	- to +
Social impact indicators					
Effects on household income via avoidance of food waste	0	+ to ++	0 to +	+	+
Effects on job creation					
Public authorities	0 to +	0 to +	+	+	0 to +
Private sector	0	0 to +	++	+	0
Other indicators: Practicability and Enforceability					
Practicability: is it practical to implement?	Y	Y	Y	Y	Y
Clarity and consistency (e.g. with other EU legislation)?	Y	Y	Y	Y	Y
Degree of risk/uncertainty	Low	Medium	Low	Medium	Medium
Is it enforceable?	Y	Y	Y/N	Y/N	N

iii. ASSESSMENT OF EACH POLICY OPTION

Policy Option 1: EU food waste reporting requirements

Policy option 1, involving the implementation of EU food waste reporting requirements, addresses all sectors and would necessitate a legislative change.

- General issues and environmental impacts

As this policy option requires the collection of essential baseline data on food waste, which then facilitates target setting and the definition of future food waste policy, it does not serve in and of itself as a prevention measure, and thus has no direct impact on food waste reduction per capita or greenhouse gas emission generation.

- Economic impacts - EU

Implementation of such a policy option would involve limited costs for the EU, MS and for industry. Potential implementation and ongoing administrative costs would primarily impact Member States. Reporting requirements might also impact the private sector, notably waste management facilities, in terms of administration costs. However, Hartmut Schrör, a member of the EUROSTAT waste and hazardous substances statistics team, indicated that implementation costs for a change in the way food waste is reported would be minor, as currently EUROSTAT data includes food waste quantities data, although they are not currently delineated separately or specified for all four sectors examined.

- Economic impacts - MS

Stakeholders highlighted various challenges involved in this policy option. Tarja-Riitta Blauberg of the Finnish Ministry of Environment noted that increased reporting requirements present a potential burden to MS administrators and industry actors.

Lone Lykke Nielsen, of the Danish Ministry of the Environment, stated that every ten years, Denmark undertakes a major study, costing approximately two million Danish kroner (€ 268,457) to analyse the contents of household waste volumes. This analysis could serve as a basis for the calculation of household food waste volumes, although reporting every two years, as required by EUROSTAT, would require the usage of extrapolation or forecasting.

Even for industry, measuring food waste could be challenging. According to Ms. Nielsen, approximately 50% of organic waste produced by the Manufacturing sector in Denmark is sent directly to farmers as compost, and hence does not pass through waste treatment facilities where measurements are taken for national level waste reporting. Ms. Nielsen noted that if required to report on avoidable food waste, the Ministry of Environment would likely need to commission further research.

Dr. Jonathan Derham, Senior Inspector at the Irish Environmental Protection Agency, indicated that changes in reporting would not necessarily create further expense for MS if included with the current data reporting questionnaire[89]. However, depending on the complexity of the change, up to 10 to 15 days of

[89] Interview, August 2010.

additional staff time could be required for completing modified data reporting. Dr. Derham highlighted the importance of capturing consumption (e.g. households) and production (e.g. manufacturing) food waste separately, as causes, impacts and prevention tactics for their reduction differ. However, in terms of attempting to capture avoidable versus unavoidable food waste, Dr. Derham noted that this would most likely be done via the bin characterisation study on municipal solid waste, completed in Ireland every four years and costing approximately €30,000. Any reporting on a more frequent basis of avoidable versus unavoidable food waste to EUROSTAT would be based on projections or extrapolations from this data.

- Social impacts

In this policy option, impacts on turnover in the food industry are considered to be neutral, as waste quantities would not be impacted. For the same reason, household income via avoidance of food waste would not be impacted. The implementation of this policy could have a negligible potential impact on job creation for public authorities and a negligible impact for the private sector, in connection with implementation costs.

- Practicability and enforceability

Ms. Nielsen, of the Danish Ministry of the Environment, highlighted the potential difficultly in separating out food and bio-waste related data, depending on their definitions[90]. She cited the challenge of separating by-product volumes from food and bio-waste volumes as well as assessing avoidable versus unavoidable food waste.

The policy option is fairly straightforward to implement, provides an important source of baseline data to further the understanding of causes of food waste and to guide future EU efforts to reduce and prevent food waste. The policy option involves low risk/uncertainty; however, a clear definition of food waste and a standardised method for calculation would be important to ensure the comparability and usefulness of data. If introduced as a mandatory requirement, hence necessitating a change to the EUROSTAT legal framework for data collection, the policy option would be enforceable.

As the waste team at EUROSTAT has recently completed a two year process of revisions to their legal framework and data reporting requirements, it is unlikely that any additional changes related to food waste reporting would be possible for approximately another five years[91]. The most realistic option would thus be to include food waste data categories during the next revision of the legal framework for waste data reporting, most likely in the next five to eight years. In the meantime, the EU could introduce a voluntary reporting section for food waste quantities. Such an action could serve as a pilot action for clarifying and codifying definitions and calculation methodology in anticipation of future integration into the EUROSTAT legal framework.

[90] Interview, July 2010.

[91] Interview with Hartmut Schrör, a member of the EUROSTAT waste and hazardous substances statistics team, July 2010.

Table 33: EU food waste reporting requirements - Estimated impacts and costs for EU27

Environmental Impacts (in % of food waste produced in the EU-27)		
Potential food waste reduction	Negligible	Source: Multiple stakeholders
Implementation Cost (in Euros)		
EU Institutions	Negligible	Source: EUROSTAT[92]
Member States	Administrative costs for Ministries based on increased reporting (per MS): € 1 000 – € 3 000	Source: Irish EPA[93] *Provides an outline of the scale of investment for MS*
	Bin characterisation study (per MS): € 30,000	Source: Irish EPA
	Major national food waste study (per MS): € 270,000	Source: Danish Environment Agency[94]
Facilities/Industry	€ 300 per reporting site	Source: Danish Environment Agency[95]

Policy Option 2: Date labelling coherence

- General issues

Policy option 2 involves a harmonisation of date labels on food products at EU level via a requirement in the Food Information Regulation, so that the Manufacturing and Wholesale/Retail sectors are able to send clear and consistent messages to consumers on food safety, quality and optimum storage conditions, accompanied by the dissemination of information on date labels to the public, in order to reduce wastage due to confusion and uncertainty.

- Environmental impacts

The environmental benefits of this policy option are based on its potential to help households avoid food waste, by making better decisions on food edibility. While the impact of date labels on food waste is difficult to measure, Andrew Parry, Household Food Waste Programme Manager at WRAP, has indicated that food waste resulting from date label confusion accounts for up to **1 million tonnes of food waste**, approximately one fifth of the avoidable food waste produced by households in the UK[96].

For example, WRAP estimates that at least:

[92] Ibid

[93] Interview with Dr. Jonathan Derham, Senior Inspector at the Irish Environmental Protection Agency, August 2010.

[94] Ibid and Interview with Lone Lykke, Danish Environmental Agency

[95] Ibid.

[96] Communication with WRAP, July 2010; total avoidable food waste produced by households in the UK accounts for 4.5 million tonnes of food waste, as calculated in WRAP (2009) *Household food and drink waste in the UK*

- 450,000 tonnes of food is thrown away because it has passed a 'best before' date, perhaps because it has not been stored correctly or because the 'best before' is treated as a 'use by' date;
- 380,000 tonnes of food is thrown away because it has passed a 'use by' date, but this waste could have been avoided had the date been checked earlier and either cooked or frozen before that time;
- And, 255,000 tonnes of food is thrown away before it has even reached its 'use by' or 'best before' date, and much of this could have been avoided if the food had been stored correctly and through consumers having confidence in date marks including 'display until'.

Furthermore, WRAP research shows that:

- 54% of avoidable food waste is due to issues associated with food "not used in time", among which date label confusion is a highlighted factor;
- 45-49% of households surveyed do not correctly understand the meaning of "best before" and "use by" date labels.

➢ Economic impacts - EU

The implementation costs of adding a date label coherence requirement to the Food Information Regulation proposal is considered to be limited, assuming the change would involve the dissemination of increased guidance on label usage, while leaving the fundamental "best by", "best before end" and "use by" date structure in place. The requisite information for clarifying date labelling standards appears to be currently available, as indicated by a UK Food Standards Agency consultation document, discussed in more detail below[97]. The cost for the EU of providing guidance to manufacturers on date label harmonisation by food category would therefore centre on research costs, if the EU chooses to maximise its input in this area. Research would involve identifying which type of date label is most appropriate for different types of foods.

➢ Economic impacts - MS

There may be minor costs for MS in terms of adapting any national legislation to reflect this labelling harmonisation.

➢ Economic impacts - Industry

Implementation costs for manufacturers may be more significant based on the magnitude of changes required to packaging and production chains as a result of date labelling changes or standardisation efforts. However, Dr. Theresa Ekong of DEFRA, who recently led a consultation by the Food Standards Agency (FSA) in the UK, noted that the significance of these costs would be dependent on whether a change was involved in the text used on the label, such as "best by" or the date portion of the label; the latter is easier and less costly to change than the former [98]. Additionally, if a suitable amount of time were allowed for manufacturers to transition to the new labels over a period of a few years, this would minimise potential industry costs, allowing manufacturers to make the changes along with other periodic packaging updates.

[97] Food Standards Agency Consultation (2010) *Food Standards Agency guidance on the application of date marks to food*

[98] Interview, August 2010.

Staff time, due to the need for familiarisation with the new system[99], is an additional issue highlighted by both David Bellamy of the Food and Drink Federation and Andrew Parry of WRAP. A consultation by the Food Standards Agency (FSA) in the UK completed in 2010 on the application of date marks to food estimated one-off familiarisation costs at approximately £150,000 for the UK (approximately €180,000)[100]. The method of calculation used assumed that the regulatory affairs or production manager would be responsible for interpreting and integrating the recommendations of the guidance into the business; the average hourly wage rate for this position was estimated at £19.38 (€23.37), up-rated by 30% to £25.19 (€30.37) to account for overhead. It is estimated that it would take a production manager approximately one hour to read and become familiar with the new guidance, resulting in a rounded UK-wide familiarisation cost of £150,000. A final cost consideration in the application of such a change across the EU27, highlighted by Dr. Ekong, is the required translation of labels as well as related guidance documents into all the languages used across the EU27 to ensure ease of consumer understanding, a potential cost at EU level.

- Social impacts

The financial savings for households from throwing away less food were estimated by WRAP as £12 billion (€14 billion) per year in the UK, or an average £199 (€233) per person per year, by calculating the value of the avoidable fraction of food waste.[101] Using the estimated 1 million tonnes of food waste triggered by date labelling confusion, representing approximately 20% of avoidable food waste generated in the UK, potential savings to consumers can be estimated at up to £39.80 (€46.60) per person via the harmonisation of date labels on food products. Extrapolating from this UK data to the EU, this represents a potential €22,982 million in savings to European households, extrapolating from the per capita savings in the UK. Varying potential savings and costs of food products across the EU have not been taken into account.

Additional economic benefits of date label harmonisation are anticipated for businesses in terms of simplification, reduced legal costs and enhanced customer loyalty, which cannot currently be quantified. Research by WRAP on household food waste indicates that retailer involvement and awareness-raising on food waste prevention increases brand value (see option 5 below).

This estimation represents the maximum potential impact on food waste of this policy option. The biggest impact would be achieved by combining the date label coherence policy with awareness raising measures (as described in option 5), in order to effectively minimise date label confusion.

The impact of date labelling coherence on job creation is likely to be negligible, particularly in the long term, though there might be a moderate impact during the process of implementation, in terms of research, awareness raising and any changes to existing labels.

- Practicability and enforceability

This policy option is considered practical to implement, as it entails an addition to an existing policy proposal already in debate. The risk would be that there is a lack

[99] Ibid

[101] WRAP (2009) *Household food and drink waste in the UK*

of time to include this addition before the proposal is approved. Consistency with other EU legislation is considered high, given that it supports the Food Information Regulation objective of providing "clear, understandable information" to consumers via food labelling.[102]

The policy option is in line with the proportionality principle because it offers all EU consumers access to appropriate information that enables them to make informed, safe and sustainable choices. The absence of harmonisation may create additional labelling burdens for manufacturers and retailers operating in multiple MS. The policy option is enforceable in line with other provision in the Food Information Regulation.

Table 34: Date Labelling Coherence: Estimated costs and impacts for EU27

Environmental Impacts (in % of food waste produced in the EU-27)		
Potential food waste reduction	Up to 20% of avoidable food waste	Source: WRAP
Implementation Cost (in Euros)		
EU Institutions	Negligible	
Member States	Negligible	
Industry	Familiarisation costs (for the UK): €183,000	Source: Food Standards Agency[103]
	Average cost for EU15 MS: € 232,000 Average cost for EU12 MS: € 47,000 (Provides an outline of the scale of investment for MS)	Based on ILO hourly wage information and EUROSTAT data on number of enterprises, persons employed and turnover in the manufacturing of foodstuffs[104]
Total for EU27	Approximately € 5 million to € 6.3 million[105]	Source: ILO, EUROSTAT

Policy Option 3: EU targets for food waste prevention

- General issues

Policy option 3, EU targets for food waste prevention, addresses all sectors under consideration but could be applied to target one or more specific areas depending

[102] Press Release: ec.europa.eu/food/food/labellingnutrition/foodlabelling/publications/ip-08-112_en.pdf
[103] Food Standards Agency (2010) *Food Standards Agency guidance on the application of date marks to food*
[104] Calculation, based on methodology used by UK Food Standards Agency in consultation on date marks to food; ILO (2007) 5B Wages in manufacturing; EUROSTAT (2006) "Total Number of Food Related Businesses" Dataset: Food_act5 - Number of enterprises, persons employed and turnover in the manufacturing of foodstuffs
[105] Ibid.

on MS implementation. The policy option involves the setting of a common EU target (set as a percentage) for food waste prevention, as well as an obligation for MS to set national targets. The policy option would require a legislative change, assuming it is mandatory in nature.

- Environmental impacts

Food waste prevention targets offer moderate to significant potential benefits in food waste reduction and GHG production, dependent on the aggressiveness of the targets adopted.

- Economic impacts - EU

The main cost for the EU in setting targets on food waste should be covered by policy option 1 (data reporting requirements), as more reliable data is essential to effective target setting. A follow-up assessment on the potential impact of food waste prevention measures would help refine target selection, if carried out when prevention measures in Europe are more mature. A consultation with MS and stakeholders on target definition would provide further support. The costs are likely to be negligible to moderate.

- Economic impacts - MS

Similarly, costs accompanying target setting in MS will focus on securing more robust data, scoping the potential of food waste prevention more accurately, and consulting key stakeholders on achievable goals. Data costs again should have been undertaken in response to policy option one, so MS costs should be negligible to moderate.

Costs associated with meeting targets will depend on the prevention strategy adopted by the MS. However, as MS are already obliged to develop National Waste Prevention Programmes by the revised Waste Framework Directive, and any food waste prevention achieved positively contributes to MS' Landfill Directive goals, so any costs incurred in relation to food waste targets would overlap with efforts to meet other objectives.

- Economic impacts - Industry

Implementation costs to industry would vary depending on the national strategy adopted to meet the target and the way in which this impacts industry.

- Practicality and enforceability

The implementation of such a policy necessitates the existence of robust food waste data as a baseline for future improvements and progress towards targets, hence, the potential necessity of implementing policy option 1 as a requisite to implementing policy option 3. Clarifying the definition of food waste is also an important aspect of this policy option. David Bellamy of the UK Food and Drink Federation highlighted the importance of ensuring the separation of food waste from by-product data, in accordance with Article 5 of the revised Waste Framework Directive. Dr. Jonathan Derham of the Irish Environmental Protection Agency highlighted the importance of baseline data for setting potential food waste prevention targets, which he envisaged as being set on a per capita basis[106]. He also indicated that setting realistic targets would involve identifying a minimum percentage of food waste which was unavoidable, a figure which could

[106] Interview, August 2010.

vary greatly across the EU27. Such a figure could be identified by bin characterisation studies; however, without a solid baseline, Dr. Derham characterised such prevention targets as very difficult to set.

The Courtauld Commitment's food waste prevention target was set in consideration of existing data and the expected impact of prevention measures, in order to create a challenging but achievable target.[107] Similar efforts by the EU and MS to require robust data, and to consider policy and prevention measures, will aid in the development of effective targets.

Table 35: EU targets for food waste prevention: Estimated costs and impacts for EU27

Environmental Impacts (in % of food waste produced in the EU-27)	
Potential food waste reduction	Depends on % target adopted and success achieving target
Implementation Cost (in Euros)	
EU Institutions	Negligible
Member States	Variable, dependent on national strategy adopted to meet target
Facilities/Industry	Variable, dependent on national strategy adopted to meet target
Total for EU27	Highly variable, across the EU27, depending on specific clauses of targets and selected treatment methods

Policy Option 4: Requirements on separate collection of food waste in the MS

- General issues

Policy option 4 involves the recommendation on separate food waste collection by the EU, accompanied by a subsidy for the development of MS separate collection and treatment infrastructure. This policy increases public awareness of food waste by confronting households and Food Service sector employees with the quantity of food waste being generated in their home or workplace. It works in coordination with policy option 5, awareness campaigns.

This policy option targets the Household and the Food Service sector and would require a legislative change to put in place a subsidy for the development of separate collection and treatment infrastructure.

[107] Communication with WRAP, August 2010.

- Environmental impacts

The Arcadis Eunomia study on bio-waste reinforces the waste prevention effect of separate collection, noting that "there are good reasons to believe that the way in which bio-waste is collected will influence the quantities of waste generated". The study adds that this approach to behaviour change has become the norm in Austria, Belgium, Czech Republic, Germany, Ireland, Italy and the Netherlands. [108]

Time series data on separate collection of food/bio-waste data is available in Austria, Belgium, Denmark and Spain. Under examination, while it is possible to show diversion from landfill and other potential benefits such as the creation of high quality compost[109] quantitatively, it has not however been possible to demonstrate a prevention effect, due to increased annual uptake of the opportunities for separate collection and to changes in the scope of bio-waste collected. Reductions in the quantity of food waste separately collected may also point to increasing levels of home-composting. The prevention effect of this policy option thus relies upon consistent anecdotal evidence from the stakeholders involved in relevant separate collection programmes.

Observations included Dr. Jan Buysse, the executive manager of INTERZA[110], who described examples of families that improved their food management by buying less food in advance or by using recipes re-using food from previous days, as a result of raised awareness of their food production due to separate collection. INTERZA reported a decrease in organic waste collected (38% since 2004), but could not rule out the impact of increased home-composting. Teresa Guerrero of ARC reported a similar finding in relation to the separate collection system for organic waste in Catalonia[111]. Ms. Guerrero added that the weight of organic waste collected reduced consecutively via the combined use of an aerated bucket and a compostable bag, due to the evaporation of the water contained in the organic matter.

In addition to potential food waste generation avoided through the awareness-raising prevention aspect of this policy option, greenhouse gas emissions reductions due to the proper treatment of food waste that is collected as a separate bio-waste fraction are significant.[112] In addition to the possibility of creating high quality, soil enriching compost and facilitating bio-gas production, the diversion of food waste from landfill enhances the calorific value of remaining municipal solid waste for the purpose of energy recovery.[113]

The difficulty proving a quantitative relationship between separate collection and food waste prevention, however, largely contributed to the favouring of other policy options in this analysis.

- Economic impacts

[108] Arcadis/Eunomia (2009) *Assessment of the options to improve the management of bio-waste in the European Union,* Brussels, Belgium

[109] European Commission – Directorate-General for the Environment (2000) *Success stories on composting and separate collection*

[110] Communication with INTERZA, August 2010 ; INTERZA is a public company responsible for the waste management of the suburban region of Zaventem, near Brussels, in Belgium, an area containing approximately 30 000 households and 76 000 inhabitants.

[111] Ibid (**Erreur ! Signet non défini.**); Communication with Waste Agency of Catalonia, July 2010.

[112] Ibid (108)

[113] EC (2008) *Green Paper on the management of bio-waste in the European Union*, Brussels, Belgium

Economic costs for the EU would depend on the level of subsidy selected.

Investment in separate collection and bio-waste treatment infrastructure on the part of Member States is likely to occur in the coming years as a result of the Landfill Directive diversion targets. An EU subsidy would support this investment.

The total cost for municipalities or waste management agencies would depend on the collection method and level of treatment selected.[114] The cost in terms of separate collection has been identified as the following, based on data from two MS:

Table 36: Estimated costs of food waste separate collection

Costs of implementing separate food waste collection	
Household containers 10 litres	1 € per inhabitant
Compostable bags	0.82 € per inhabitant (for 30 units)
Communication campaign	1-5 € per inhabitant, depending on density of municipality
Collection vehicles	80,000 € per vehicle[115]
Cost of separate collection followed by composting	35-75 €/tonne
Cost of separate collection of bio-waste followed by anaerobic digestion	80 to 125 €/tonne
Compared with landfill and incineration	
Cost of landfill of mixed waste	55 €/tonne
Cost of incineration of mixed waste	90 €/tonne[116]

Source: Eunomia, ARC Catalan Waste Agency

This includes both implementation costs, in terms of new vehicles, new staff training, information dissemination to residents and administration costs. Costs for EU MS may vary somewhat from those costs logged in Spain and the UK.

It should be noted however that separate collection and treatment is often a profitable business venture. The Eunomia 2007 study cites for example that where a separate collection system was carried out in a way that optimised costs, the net private cost increase for the waste management authority could be minimal or negative. The EC Green Paper on Bio-waste Management notes that "in all regions where separate collection has been introduced it has been considered a successful waste management option", and examples in Catalonia, Flanders, Italy, Austria, the Netherlands, Denmark and Sweden are ample.

[114] Arcadis (2009) *Assessment of the options to improve the management of bio-waste in the European Union*

[115] ARC Catalan Waste Agency – Written response to stakeholder consultation 2010.

[116] Eunomia (2007) *Managing Biowastes from Households in the UK: Applying Life-cycle Thinking in the Framework of Cost-benefit Analysis, A Final Report to WRAP*

The cost structure presented above in Table 36 is intended to be indicative of potential costs for MS in the EU27; however, actual costs linked to the implementation of this policy would vary based on multiple factors, as represented in Table 37. Firstly, the cost for EU institutions would depend on the amount of the subsidy agreed upon. Secondly, cost for MS would vary depending on the subsidies provided by the EC as well as the current maturity of their waste management infrastructure. It is hoped that providing subsidies for the implementation of separate collection systems for organic waste would even the playing field for MS across the EU27. Thirdly, private cost impacts on facilities and industry of the implementation of such a policy would be dependent on whether regional waste management is handled publicly or by private waste management services in a given MS.

While the Arcadis (2009) report indicates that "Bio-waste collection (in the context of integrated collection systems) can be undertaken with zero additional costs," not all MS currently have a fully implemented integrated collection system in place. A subsidy would thus address differences in waste management infrastructure maturity across the EU27 to facilitate a comprehensive implementation of bio-waste separate collection across the EU.

It is important to note that there are numerous approaches possible for bio-waste collection, which are, as highlighted by the Arcadis (2009) study, associated with varying cost. Key factors impacting the cost for implementing and running a separate collection scheme for bio-waste are:

- Scope of materials collected (e.g. garden waste, food waste, cardboard)
- Frequency of collections
- Type of collection vehicle (e.g. compacting or non compacting trucks, load size)
- Containment methods (e.g. bins, buckets, paper sacks, kitchen caddies, etc)

While waste infrastructure must already be constructed to meet requirements of the Landfill Directive, this policy would guide the construction of such needed infrastructure to address bio-waste prevention, collection and treatment.

➢ Social impacts

This policy option has significant job creation potential. The EC Green Paper on Bio-waste Management states that separate collection is three times more labour intensive than collecting mixed waste. The Catalan Waste Authority ARC stated in an interview that the number of collection workers increases only slightly in their experience, as municipal and biodegradable waste can be collected at the same time, but that new jobs were also created around communication campaigns, optimising the integrated management of all waste fractions and operating composting and anaerobic digestion facilities. Jobs created will be public or private depending whether public authorities are responsible for regional waste management.

➢ Practicability and enforceability

Given the wide number of MS and regions that have successfully implemented separate collection and treatment, this option can be considered relatively practical to implement. The main obstacle highlighted by stakeholders during this

study is the financial investment for initial development of infrastructure and operations, resulting in this study's proposal of a subsidy for investment.

This **policy is strongly consistent with EU waste legislation,** supporting the Thematic Strategy on the Prevention and Recycling of Waste's emphasis on using waste as a resource, the revised Waste Framework Directive's recommendation on the separate collection of bio-waste for the purpose of greenhouse gas emissions avoidance, the Landfill Directive targets for diversion from landfill, as well as the recent recommendations on promoting separate collection for bio-waste and aiming for 'zero landfilling' of untreated bio-waste, as laid out by the EC on the Communication on future steps in bio-waste management in the European Union COM(2010)235.

This policy builds upon the current EC recommendation on separate collection, via the addition of a subsidy. The policy thus encourages the more rapid development of separate collection and treatment infrastructure, and facilitates a levelling of the playing field by supporting infrastructure development in MS where it is currently lacking.

The degree of risk or uncertainty involved is moderate; examples across the EU have demonstrated separate collection of biodegradable waste to be an effective, practical implementation of the waste hierarchy, although its prevention potential has yet to be concretely proven. As this is a voluntary policy option, it is not enforceable, but the business case for separate collection is fairly strong given the examples of its effective operation and profitability, and the subsidy for start-up costs directly addresses the main obstacle to its implementation. Lastly, it complements the Landfill Directive targets, which are non-voluntary, and supports a transition to more sustainable waste management and fuller implementation of the EU waste *acquis*.

Table 37: Requirements on separate collection of food waste in the MS: Estimated costs and impacts for EU27

Environmental Impacts (in % of food waste produced in the EU-27)	
Potential food waste reduction	Unknown
Implementation Cost (in Euros)	
EU Institutions	Variable; linked to MS subsidy for policy implementation
Member States	Variable; dependent on maturity of waste management infrastructure
Facilities/Industry	Variable; dependent on whether waste management is handled by public or private organisation

Policy Option 5: Targeted awareness campaigns

- General issues

Policy option 5 involves targeted awareness campaigns to reduce and prevent food waste production. This policy option specifically addresses households, but

would benefit from the involvement of the Wholesale/Retail sector to further encourage household behaviour change. The implementation of targeted awareness campaigns in MS would not require a legislative change.

- Environmental impacts

Reductions in food waste generation can be expected as a result of awareness raising and efforts to effect long-term consumer behavioural change. WRAP's 'Love Food Hate Waste' campaign has prevented 137,000 tonnes of food waste, thereby achieving a nearly 3% reduction in avoidable household food waste (or 1.8% of total food waste) throughout the UK over a one year period[117]. A reduction in greenhouse gases could be expected to be at a similar level.

- Economic impacts – EU

Arcadis-Eunomia note in the Bio-waste study that "it would be very difficult to imagine a public campaign exceeding the value of the avoidable food waste", or indeed 10% of that value.[118]

The suggested EU role would involve the development of a reference website on food waste, supporting Article 29 (5) of the Revised Waste Framework Directive, which states that "the Commission shall create a system for sharing information on best practices regarding waste prevention".[119] The website would include sample communications materials, good practice examples, and informational tools for specific sectors. This might build upon the existing website for the European Week for Waste Reduction, and could act as a hub for food waste communication stakeholders across MS. While the strategy for targeted awareness campaigns would likely be set at MS level, as part of National Waste Prevention Programmes, the European Commission would nevertheless facilitate the development of national awareness initiatives through the provision of informational tools and good practices.

The creation of a website for practice and information sharing could potentially link with the creation of an EU-level network for policy makers and those in charge of communication activities with a targeted interest in food waste and waste prevention, similar to the Green Spider Network. The necessary budget for the creation of such a website with a possible accompanying network is estimated at around 50,000 to 100,000 Euros, with an ongoing budget of 40,000 to 80,000 Euros depending on the level of support to be provided[120].

- Economic impacts - MS

The UK's best practice awareness campaign, Love Food Hate Waste, provides an outline of the costs of this policy option. As demonstrated in Figure 27 below, the cost structure for the Love Food Hate Waste campaign consisted of approximately £600,000 (€705,000) in initial research to identify sources and causes of food waste, enabling an effective targeting of communication efforts. On-going running costs total approximately £2 million (€2.4 million) per year, including advertising,

[117] Love Food Hate Waste: www.lovefoodhatewaste.com/; WRAP (2009) *Household Food and Drink Waste in the UK,* United Kingdom

[118] Arcadis (2009) *Assessment of the options to improve the management of bio-waste in the European Union*

[119] DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 November 2008: eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:312:0003:0003:EN:PDF

[120] Cost estimated based on consultation with the Green Spider Network.

public relations, events, website maintenance and the production of new communication materials.

Figure 27: Love Food Hate Waste awareness campaign costs (WRAP, UK)[121]

	in Pounds (£)	in Euros (€)
Initial costs		
Research	600 000	705 189
Running costs (annual)		
Advertising	1 000 000 - 1 500 000	1 175 170 - 1 762 579
PR/events	200 000 - 400 000	235 051 - 470 102
Website/related material	200 000	235 051
Total running costs	**2 000 000**	**2 350 513**

Source: Interview, WRAP – Love Food Hate Waste

Any costs to industry will be determined by their voluntary participation or organisation of awareness raising activity.

- Social impacts

Job creation in public authorities at national or local level, linked to campaign activity, would likely be moderate. There is scope for the Manufacturing and Retail sectors to get involved in national awareness initiatives, with potential brand loyalty benefits for the businesses involved. Consumers are not expected to buy less as a result of using food purchased more efficiently, but to reallocate savings to products of higher quality. Turnover is thus not expected to be impacted.[122]

WRAP adds that financial benefits are cited as a significant motivation for consumers in reducing their food waste generation. Awareness campaigns that highlight this aspect of waste prevention are therefore likely to broaden the range of consumers they impact.

- Practicability and enforceability

Awareness campaigns are frequently used vehicles for effecting behaviour change. The practicability of this policy option at EU level is demonstrated by the range of similar initiatives which the EU leads or contributes to, such as the Green Spider Network, the Change awareness campaign for behaviour change related to climate change[123], and the European Week for Waste Reduction website.

As a policy option of a voluntary nature, targeted awareness campaigns are not enforceable, and could present a higher degree of uncertainty, in that results achieved across MS might be variable. This demonstrates the need for MS to develop national campaigns, to respond to regionally variable causes of food waste.

In targeting long term behaviour change, the policy option aligns with existing EU legislation, linking with concepts in the revised Waste Framework Directive and the Thematic Strategy on the prevention of waste, the European recycling society

[121] Interview, July 2010.

[122] Andrew Parry, WRAP, Interview, July 2010.

[123] Change: http://ec.europa.eu/environment/climat/campaign/index_en.htm

concept in particular. The initiative also links positively with the creation of national waste prevention programmes mandated for all MS in Article 29 of the revised Waste Framework Directive.

- Additional insights

Ensuring maximum impact of such a policy option rests on clearly identifying the causes of food waste generation specific to different MS, so as to target actions and messages effectively. Andrew Parry has described WRAP's double sided approach: informing consumers and encouraging behaviour change while simultaneously working with industry actors and related stakeholders to make it easier for consumers to not throw away food, through for example the introduction of improved packaging in supermarkets.

Dr. Jonathan Derham of the Irish Environmental Protection Agency also highlighted the potential benefits of synergies due to parallel campaigns directed at actors from various sectors. In Ireland, for example, customised sector-specific communication and awareness efforts related to food waste have been targeted towards the Household sector, the Retail sector and the Food Service sector, one programme focusing on public houses[124].

Grigor Stoyanov of the Ministry of Environment and Water of Bulgaria, cited the increased necessity of awareness activities related to separate collection and food waste for urban areas, indicating that rural populations, where agricultural employment predominates, were already more aware of such issues.[125] Such input underlines the necessity of targeting campaign activities based on national and regional specificities to have a maximise impact on behaviour.

A number of consumer awareness campaigns are already in place across MS which could serve as potential models for those MS currently lacking this type of initiative. The EU could offer support by creating a typology of MS maturity related to consumer awareness, considering for example, the dimensions of level of issue awareness and type of retail supply chain, in order to tailor resources to national situations. Using an integrated multi-channel approach, coordinating with food sector stakeholders and emphasising community involvement are other key factors in building an effective campaign.

[124] Interview, August 2010.
[125] Interview, August 2010.

Table 38: Targeted awareness campaigns: Estimated costs and impacts for EU27

Environmental Impacts (in % of food waste produced in the EU-27)		
Potential food waste reduction	1.8% + (3% avoidable food waste)	Source: WRAP[126]
Implementation Cost (in Euros)		
EU Institutions	€ 90,000 to 180,000	Based on website and network costs of Green Spider Network[127]
Member States	€ 0.04 per inhabitant hence approximately € 20,000,000 for EU27	Source: WRAP[128]
Facilities/Industry	Dependent on voluntary industry participation	
Total for EU27	Approximately € 20 million	Source: Estimated total cost of awareness campaigns in all MS, in addition to the development of an EU level website and support

[126] Of avoidable household food waste, based on results from WRAP's Love Food Hate Waste campaign in the UK: http://www.lovefoodhatewaste.com/

[127] Reflecting the creation and maintenance of a centralised website and communication network related to food waste; see above section 'Economic costs – EC' for Green Spider Network cost estimates.

[128] See Figure 27 for detailed cost breakdown; this figure is used as indicative of potential costs for MS across the EU27.

4.3 COMPARISON OF THREE BEST POLICY OPTIONS WITH FORECAST

i. METHODOLOGY AND SELECTION

The three most promising policy options were selected using the impact assessment matrix, which is synthesised on the following page in Figure 29.

The following key explains the cost and benefit assessment in Figure 28.

Table 39: Semi-quantitative score matrix

+++	Very high benefit
++	Significant benefit
+	Moderate benefit
0	No effect
-	Moderate cost
--	Significant cost
---	Very high cost
Y, N, Y/N	Yes, No, Yes/No
N/A	Not applicable

Figure 29: Synthesis of policy analysis

	Sectors targeted	Cost inputs			Summary of cost inputs	Estimated food waste prevention potential	Additonal expected benefits
		Implementation costs for EU institutions	Implementation costs for MS	Implementation costs for industry			
Option 1: EU food waste reporting requirements	All	0 to -	-	- to --	Principle costs linked to research and enforcement required to achieve standardisation	0 to +	Possible business prevention effect; makes subsequent strategies possible
Option 2: Date labelling coherence	All	-	-	- to --	Principle costs for industry for potential repackaging	+ to ++	Financial savings for households
Option 3: EU targets for food waste prevention	All	- to --	- to --	- to --	Costs fall primarily to MS for implementation of national food waste prevention initiatives to meet targets	+ to ++	Financial savings for households
Option 4: Requirement on separate collection of food waste in the MS	Households and Food Service	-- to ---	-- to ---	- to +	Costs for the EU and for MS will depend upon the level of subsidy and investment. Implementation costs to industry may be followed by profits from separate bio-waste treatment in the longer term.	+	Separates a valuable waste stream from municipal waste, with significant opportunities for environmental benefits
Option 5: Targeted awareness campaigns	Households	-	- to --	0	Costs are primarily linked with use of various communication mediums such as advertising, website development etc.	+	Financial savings for households; targets behaviour change; potential brand advantage for retailers

Using the results of the policy analysis in Chapter 4, section 4.2, it was possible to delineate three options providing important waste prevention benefits at limited cost.

Option 1 (EU food waste reporting requirements) was selected for its foundational importance for future progress in this area, in addition to its comparably limited cost.

Option 2 (Date labelling coherence) was selected for its expected food waste prevention potential, estimated at approximately 20% of avoidable food waste produced by the Household sector, based on its capacity to improve consumer information on food edibility across the EU, and the evidence on existing uncertainty in this area[129]. The comparatively limited cost of this policy option, and the possibility to integrate it into the Food Information Regulation currently being debated, were also important factors in its selection.

Option 5 (Targeted awareness campaigns) was selected due to stakeholder agreement on its necessity and essential role in behaviour change. Its potential to reduce food waste will be linked to the budget invested in awareness-raising as well as effective campaign targeting, although this is expected to be consistently less than the potential financial savings to households through more efficient use of purchased food.

Option 3 (EU targets for food waste prevention) was not selected at this time, as it depends upon the effective implementation of option 1, which as EUROSTAT suggested, may not be able to be put in place until the next round of requirement changes, at a time horizon of five or more years. However, it should be noted that this policy option could be integrated into the future in the national waste prevention programmes required to be developed by the revised Waste Framework Directive.

Option 4 (Requirement on separate collection of food waste in the MS) was not selected at this time due to a lack of robust evidence on the "waste prevention effect" of separate collection, although it has been widely observed (by the Irish EPA, by WRAP and in the Arcadis Bio-waste study, for example). This is a costly policy option, though it is potentially economically profitable in the long-term and offers major environmental benefits. In addition to the potential for prevention due to increased awareness because the practical nature of food waste separation in the home or workplace provides regular reminds of food wasting behaviours, the subsequent environmental benefits of food waste separation and proper treatment are ample. However, as proving the prevention at the source characteristics of such a policy currently remains difficult, it has been left open to development by other avenues for its substantial recycling opportunities.

ii. Three Most Promising Measures

Data disclosure

This policy option forms the basis for any major action on food waste prevention in the EU. A notable conclusion of this study has been the limited availability of reliable data on food waste, which necessitated extrapolation and hypothesising in section 1.2 of Chapter 1.

Accurate baseline data would enable the EU to set targets for food waste prevention, which could have a significant impact on EU climate goals given the greenhouse gas emissions embedded in the supply chain for food products and generated at landfill. Target-setting is strongly supported by the separate collection of food waste, which allows changes in food

[129] Communication with WRAP, July 2010

waste generation to be monitored more effectively. Thus this policy option provides a foundation for the two previously discussed options not selected at this time.

Robust data disclosure in the major sectors addressed would allow the Commission, furthermore, to more accurately prioritise next actions on food waste, and in particular which sectors to address with targeted measures (such as food redistribution programmes to the needy of the variety of fresh, edible food products discarded by the Retail and Food Service sectors[130]).

This policy option's impact on food waste generation is deemed negligible to moderate, in comparison to the fifteen year baseline scenario, as there may be a waste prevention effect inspired by more accurate data-gathering, particularly in the Manufacturing, Retail and Food Service sectors. As data becomes more readily available, this may stimulate competition between businesses to advance their environmental credentials by demonstrating their lack of wastefulness to consumers. Chapter 0 demonstrated the exponential development of food waste prevention measures since 2008: interest in this area among policy-makers and increased consumer awareness is likely to secure the incentive for business to improve performance in this area.

Date labelling coherence

This policy option improves consumer understanding of food safety and edibility, enabling households to make the most of the food they purchase. It provides for consistent food product labelling across Europe, standardising obligations for food manufacturers and providing Europeans with equal access to clear information.

This policy option may not generate results immediately given time necessary for harmonious implementation and will be most effective where accompanied by awareness-raising initiatives to ensure that consumers take advantage of the simplified labels. However, once fully implemented, this policy option is anticipated to have the possibility to reduce generation of avoidable food waste in the Household sector by up to 20%[131].

Targeted awareness campaigns

This policy option aims at raising awareness across Europe on the environmental impacts of food waste, the simple measures that can be undertaken to prevent it, and the financial benefits that this prevention represents.

The efficacy of this policy option annually and over fifteen years will be linked to the investment in the campaign made at EU and/or MS level. WRAP has achieved a 3% reduction in avoidable household food waste generation in a one year period, though none of the other awareness campaigns identified in the EU had measured results. It is difficult to extrapolate across EU and across 15 years from this one source, but this policy option's impact on food waste generation is deemed moderate based on WRAP results and stakeholder agreement upon its central role in achieving behaviour change on this issue. Furthermore, raising awareness among households will assert pressure throughout the supply chain, as consumers demand that the Retail and Food Service sector demonstrate leadership on this issue and take actions to provide waste-resistant products.

[130] As highlighted by Tristram Stuart in Waste : Uncovering the Global Food Scandal
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6. APPENDICES

1. STAKEHOLDER LIST

Food Waste Stakeholders		
Name of Organisation	Type of Organisation	Country
Manufacturing & Processing		
Alliance for Beverage Cartons and the Environment	Packaging association	Belgium
ANIA	Association	France
Bel	Food company	France
CIAA	Food Industry Association	Belgium
CLITRAVI	Food Industry Association	Europe
CONAI	Packaging association	Italy
Danone	Food company	France
EUROCOMMERCE	Association	Europe
EUROPEN (European Association for Packaging and the Environment)	Packaging association	Belgium
FOST PLUS and PRO EUROPE	Packaging association	Belgium
Kraft	Food company	France
Leroux	Food company	France
SABMiller Breweries	Beverage company	UK
Distribution & Wholesale		
BusinessEurope	Association	Europe
FECD	Association	Europe
CELCAA - European Liaison Committee for the Agricultural and Agri-Food Trade	Association	Europe

Food Waste Stakeholders		
Name of Organisation	Type of Organisation	Country
Retailers		
Asda	Retailer	UK
Auchan	Retailer	France
British Retail Consortium	Retail Association	UK
Carrefour	Retailer	France
Casino	Retailer	France
COOP Italy	Retailer	Italy
COOP Switzerland	Retailer	Switzerland
Delhaize	Retailer	Belgium
E. Leclerc	Retailer	France
El Corte Ingles	Retailer	Spain
EUROCOOP	Association	Europe
European Retail Roundtable	Retail Association	Europe
Marks & Spencer	Retailer	UK
Mc Donald's France	Retailer	France
Mercadona	Retailer	Spain
Monoprix	Retailer	France
Morrisons	Retailer	United Kingdom
Sainsbury's	Retailer	UK
Système U	Retailer	France
Tesco	Retailer	UK
Businesses/Institutions		
Compass Group	Food service/catering	France
Fédération Européenne de la Restauration Collective Concédée	Food service/catering	Europe

Food Waste Stakeholders		
Name of Organisation	Type of Organisation	Country
Consultants/experts		
Beyond Waste	Consultant/expert	United Kingdom
BOKU (University of Natural & Applied Sciences)	University	Austria
BOKU (University of Natural & Applied Sciences)	University	Austria
ERICA	Consultant/expert	Italy
JMS	Consultant/expert	Belgium
TU-Wien (Technical University of Vienna)	University	Austria
Public authorities		
Food SCP Round Table	Stakeholder Platform on Food	Europe
European Environment Agency	EU Agency	Denmark
Cleaner Greener Production Programme	Government Agency	Ireland
Green Hospitality Award	Government Agency	Ireland
Angers Loire Metropole	Local Authority	France
Bruxelles Environment	Local Authority	Belgium
Bruxelles Environnement	Local Authority	Belgium
Bruxelles Environnement	Local Authority	Belgium
Helsinki Metropolitan Area Council	Local Authority	Finland
Helsinki Metropolitan Area Council	Local Authority	Finland
Vienna Waste Prevention Programme	Local Authority	Austria
Cabinet du Ministre Président du Gouvernement wallon	Regional authority	Belgium
ARC Catalan Waste Agency	Regional authority	Spain
IHOBE, Basque Government	Regional authority	Spain
OVAM Flanders	Regional authority	Belgium
SVIM	Regional authority	Italy
ADEME	National authority	France
Belgium Interregional Environmental Agency	National authority	Belgium

Food Waste Stakeholders		
Name of Organisation	Type of Organisation	Country
Public authorities		
Croatian Environment Agency	National authority	Croatia
Czech Environmental Information Center	National authority	Czech Republic
Danish EPA	National authority	Denmark
Danish EPA	National authority	Denmark
DEFRA	National authority	United Kingdom
DEFRA	National authority	United Kingdom
Environment Administration	National authority	Luxembourg
Environment Agency	National authority	United Kingdom
Environmental Agency	National authority	Slovenia
EPA WasteWise Program	National authority	USA
Hellenic Ministry of the Environment	National authority	Greece
Italian Environmental Protection Agency	National authority	Italy
Latvian Environment Agency	National authority	Latvia
Malta Environment and Planning Authority	National authority	Malta
Ministry for Environment and Water, Department of Waste Management	National authority	Hungary
Ministry of Agriculture, Natural Resources and Environment	National authority	Cyprus
Ministry of Ecology, Energy, Sustainable Development and Sea	National authority	France
Ministry of Environment	National authority	Poland
Ministry of Environment	National authority	Portugal
Ministério do Ambiente e do Ordenamento do Território	National authority	Portugal
Ministry of Environment	National authority	Slovakia
Ministry of Environment	National authority	Lithuania
Ministry of Environment and Sustainable Development	National authority	Romania
Ministry of Environment and Water	National authority	Bulgaria
Ministry of Environment and Water	National authority	Bulgaria

Food Waste Stakeholders		
Name of Organisation	Type of Organisation	Country
Public authorities		
Ministry of Housing, Spatial Planning and Environment	National authority	Netherlands
Ministry of the Environment	National authority	Finland
Ministry of the Environment	National authority	Japan
National Waste Prevention Committee, EPA Ireland	National authority	Ireland
National Waste Prevention Programme, EPA Ireland	National authority	Ireland
NVRD, Dutch Solid Waste Association	National authority	Netherlands
Scottish Environment Protection Agency	National authority	United Kingdom
Spanish Ministry of the Environment	National authority	Spain
Swedish Environmental Protection Agency	National authority	Sweden
UBA (Federal Environment Agency)	National authority	Germany
Waste Department, Ministry of Environment	National authority	Estonia

Food Waste Stakeholders		
Name of Organisation	Type of Organisation	Country
NGOs/Associations		
ACR+	NGO	Belgium
ASBL	Association	Belgium
Association des Maires de Grandes Villes	Association	France
Association Française du Conseil des Communes et Régions d'Europe	Association	France
BEUC European Consumers' Association	Association	Europe
Community Recycling Network for Scotland	NGO	United Kingdom
COPA-COGECA	Association	Europe
Eco-Emballages	NGO	France
Ecomaires	Association	France
European Environmental Bureau	NGO	Belgium
Federambiente	Association	Italy
National Industrial Symbiosis Programme	NGO	United Kingdom
New Zealand Zero Waste Program	NGO	New Zealand
Resource Recovery Forum	NGO	United Kingdom
Rreuse	NGO	Belgium
Slow Food	NGO	International
UEAPME	Association	Europe
Waste Prevention Alliance (HUMUSZ)	NGO	Hungary
WRAP	NGO	United Kingdom
ZeroWaste Zelena-Akcija Friends of the Earth	NGO	Croatia

Food Waste Stakeholders		
Name of Organisation	Type of Organisation	Country
Waste management agencies		
BSR	Waste management company	Germany
California Integrated Waste Management Board	Waste management authority	USA
Confindustria	Waste management company	Italy
DAKOFA	Association	Denmark
Lipor	Waste management company	Portugal
SuperDrecksKëscht	Waste management company	Luxembourg
Waste Denmark	Waste management company	Denmark

2. INITIATIVES INVENTORY

Awareness Campaigns

Inventory of Food Waste Prevention Initiatives										
Initiative Name	**Initiative Description**	**Actor responsible for the**	**Type of actor responsible for the initiative**	**Country**	**Geographic level of implementati**	**Type of Initiative**	**Main type of stakeholder targeted**	**Year of Implementation**	**Source**	**Summary of results**
Green Cook	Campaign against food waste, taking a very broad approach, linking food waste to health, social actions, and economic development. The aim is to create a new dynamic among all food-actors. Actions will focus on the four main food consumption venues : home, restaurant (including at work), school canteen, and supermarket.	Espace Environnement	NGO	France / Belgium	EU	Awareness campaign	All	Starting 2010	Sophie Marguliew smarguliew@espace-environnement.be	The project has not started yet.
Feeding the 5,000	Action Aid UK fed 5000 people with the food that normally would have been wasted. The point was to highlight the quantity of food wastage. Between 12pm and 2pm on Wednesday 16th December 2009, the organisation served food to 5,000 strangers.	Action Aid UK	NGO	United Kingdom	Local	Awareness campaign	Households	December 2009	http://www.feeding5k.org/	None avaliable.
Competition for schools on waste prevention in school	Schools ("collèges") must design and put into action a waste reduction and prevention plan; the three best schools are awarded prizes. Also a competition for making a video on waste prevention and its importance; one winner is selected.	Conseil Général des Landes	Local authority	France	Local	Awareness campaign	Schools	2005	http://www.preventiondechets40.net/index.php/ppd/actions/education_a_l_environnement/concours_pour_les_collegiens	Winning video http://www.preventiondechets40.net/index.php/ppd/content/view/full/607.
"Gaspillage alimentaire - les yeux plus gros que le ventre " (food waste - your eyes are bigger than your stomach)	Activity for school children 8-10 yrs, with tips and practical description on food wastage.	Bruxelles Environnement	Local authority	Belgium	Local	Awareness campaign	Schools	No start date identified	http://documentation.bruxellesenvironnement.be/documents/IF_Ecoles_prof_GA8-10_Gaspillage_alimentaire_FR.pdf?langtype=2060	No specific results cited but activity description encourages review of principles discussed just after lunch time for (visual) reinforcement.
Menu Dose Certa	Initiative created for restaurants by a Porto waste management company, LIPOR, with a view to getting them to serve portions that match what people can eat. As a result of adhering to the intiative's criteria, restaurants are eligible to receive the campaign's official seal 'Menu Dose Cer-ta "(the right size), which provides both advertising for the restaurant and an economic benefit to the municipality in the form of less food waste. The project also includes a competition to design the best recipe in relation to portion size and nutritional value.	LIPOR	Regional authority	Portugal	Local	Awareness campaign	Food service	2008	http://ec.europa.eu/environment/waste/prevention/pdf/MenuDoseCerta_Factsheet.pdf	In the region LIPOR serves, the average person generates 500 kilos of waste per year, so the company's 100 kilo reduction target is an ambitious goal, though it is too early to report on their progress.
Awareness campaign on food waste at school canteens	Trials in which children are made aware of how much food they leave on the plate.	Schools	Schools/universities	United Kingdom	Local	Awareness campaign	Schools	2009	http://www.tristramstuart.co.uk/	Waste reduced by 35%.
Poubelle.org ("bin.org")	Fake supermarket website that pretends to sell packaged food (waste). Provides tips and explanations of food waste production and options for sustainable consumption, corresponding to each section of the supermarket.	Réseau Idée	NGO	Belgium	Local	Awareness campaign	Households	Ongoing	www.poubelle.org	Ongoing inititiave, difficult to assess specific impacts.

Inventory of Food Waste Prevention Initiatives										
Initiative Name	**Initiative Description**	**Actor responsible for the**	**Type of actor responsible for the initiative**	**Country**	**Geographic level of implementati**	**Type of Initiative**	**Main type of stakeholder targeted**	**Year of Implementation**	**Source**	**Summary of results**
Love Food Hate Waste	An awareness campaign aiming at raising awareness on the need to reduce food waste. It involves practical tips on how to reduce consumer and household food waste to achieve environmental and economic benefits.	WRAP	NGO	United Kingdom	National	Awareness campaign	Households	2008	www.lovefoodhatewaste.com	Since its launch in 2008, WRAP estimates that 137,000 tonnes of food waste have been prevented.
'Great Taste, Less Waste'	Campaign to help customers reduce waste, including storage advice, 'market street' portion choice, labelling information, leftover cooking advice and 'packaging laboratory: keep it fresh' tests.	Morrisons Supermarkets	Retailer	United Kingdom	National	Awareness campaign	Households	2009	http://www.morrisons.co.uk/Corporate/Press-office/Corporate-releases/Morrisons-launch-Great-Taste-Less-Waste-campaign-to-save-families-up-to-600-per-year-/	While specific results have not been announced, the grocery store chain stated that is targetting the £600 worth of waste produced per year by the average household due to incorrect food storage.
Réduisons nos déchets	French national campaign for waste prevention using multiple communication channels: online resources, radio broadcasts, etc. The website offers specific tips for waste reduction at home and while shopping.	ADEME (Environment Agency)	National authority	France	National	Awareness campaign	Households	2005	http://www.reduisonsnosdechets.fr/index.html	No specific results avaliable but stated goal is to target the reduction of the 390 kg of waste produced annually.
Zero Waste Programme	Waste Prevention Alliance (HuMuSz) launched a waste reduction campaign geared towards a range of stakeholders, with a dedicated website providing tips for waste prevention and reduction.	Waste Prevention Alliance	NGO	Hungary	National	Awareness campaign	Multi-stakeholder	2009	http://www.humusz.hu/hirek/zero-waste-program-has-begun/4386	No specific results are avaliable but the campaign has a "road show" portion with a nation-wide reach.
Stop food waste	This website launched by the National Waste Prevention Programme includes information for local authorities to disseminate to households; this information is also accessible to the public. A major information dissemination campaign is planned for 2010, using the website www.greenhome.ie website and an outreach programme.	National Waste Prevention Programme by EPA	National authority	Ireland	National	Awareness campaign	Local authorities / households	2010	www.stopfoodwaste.ie www.greenhome.ie	Difficult to assess specific impacts but initiative is ongoing.
Sensible Fresh Food Guide	This guide aims at raising consumer awareness and influencing consumer behaviour. The campaign is directed at all consumer behaviour that may lead to food waste and is intended to encourage better food purchasing, storage and preparation behaviour by the Dutch public.	Netherlands Nutrition Centre	Research centre	Netherlands	National	Awareness campaign	Households	No start date identified	CIAA document on food waste in the netherlands	None avaliable.
Appetite for Action	Appetite for Action is a new, free educational website for all Primary Schools in the UK and Ireland that helps schools tackle a range of sustainability issues through the topic of food. Developed in conjunction with teachers, the website offers schools access to free resources, from lesson plans and fact sheets through to activity ideas and films, helping pupils to reduce food waste, grow their own fruit and vegetables, understand composting and reduce waste to landfill. Plus the opportunity to take part in a school challenge to reduce their schools CO2 impact and potentially win £3000 and Sky News visiting their school for the day.	Sky and Global Action Plan	NGO + Business	United Kingdom	National	Awareness campaign	Households/schools	2009	http://schools.appetiteforaction.org.uk/about/	Multiple competitions with quantitative goals figure into the awareness campaign, although results of waste reductions and modifications acheived have not been published.

Inventory of Food Waste Prevention Initiatives										
Initiative Name	**Initiative Description**	**Actor responsible for the**	**Type of actor responsible for the initiative**	**Country**	**Geographic level of implementati**	**Type of Initiative**	**Main type of stakeholder targeted**	**Year of Implementation**	**Source**	**Summary of results**
Education implementation plan: 'Food Waste, Value of Food in the Chain'	Preparatory work for a two-year education initiative across all educational levels. Two tracks: • raising awareness of food waste in secondary and higher education institutions (from pre-vocational to university) • raising awareness of food waste in general education (primary and secondary)	EduDelta Onderwijsgroep (Wellant College, INHolland Delft, Wageningen UR) and others	University	NL	National	Awareness campaign	Schools of all education levels	Implementation starting 2009	www.lei.wur.nl/UK	Unable to assess specific impacts, but part of larger program to reduce food waste by 20% by 2015.
Competition for successful examples of food waste reduction	Idea for a competition to highlight existing initiatives in which businesses and consumers can submit ideas on how to reduce or avoid food losses. The 5 or 6 best solutions will receive a prize from the Minister of Agriculture, Nature and Food Quality with extensive media attention. (Part of Impulse programme for sustainable agrochains.)	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Awareness campaign	Business/ Household	2010	http://www.se2009.eu/polopoly_fs/1.24471!menu/standard/file/Roland%20Th%C3%B6nissen.pdf	Unable to assess specific impacts, but part of larger program to reduce food waste by 20% by 2015.
Public campaign to promote awareness about food and food losses (e.g. 'VersWijzer')	Public campaign by the Netherlands Nutrition Centre aimed at consumer behaviour and awareness. Focuses on: informed food purchasing, storage and preparation, and also includes the development of a fresh food information brochure: Verswijzer.	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Awareness campaign	Households	From 2008	www.voedingscentrum.nl	Ongoing inititiave, difficult to assess specific impacts.
Best Practices in agrochain collaboration	Wageningen University and Research Centre have recorded a number of best practices for agrochain collaborations which successfully reduced food losses. These have been included in the 'Experience box' (website), developed to promote innovation in the agrochain sectors. Particular attention has been given to activities initiated by agrochain collaboration.	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Awareness campaign	Business/Retail	Started in 2008	www.experiencebox.nl www.wur.nl/UK	Ongoing inititiave, difficult to assess specific impacts.
Mass media campaign on Food waste	Campaign aimed at consumers on food waste.	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Awareness campaign	Households	2010	http://www.se2009.eu/polopoly_fs/1.24471!menu/standard/file/Roland%20Th%C3%B6nissen.pdf	Ongoing initiative, difficult to assess specific impacts, but part of larger program to reduce food waste by 20% by 2015.
Compilation of experiences regarding food waste created by the Dutch Foundation for AgroChain Competence (AKK)	Description of the Foundation's experiences on what makes collaborations in the food agrochain successful in achieving reduction in food losses.	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Awareness campaign	Business/Retailers	2008	http://www.se2009.eu/polopoly_fs/1.24471!menu/standard/file/Roland%20Th%C3%B6nissen.pdf	Ongoing initiative, difficult to assess specific impacts, but part of larger program to reduce food waste by 20% by 2015.
Campaigns by the Netherlands Nutrition Centre	Food waste included as part of nationwide campaigns organised by the Nutrition Centre.	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Awareness campaign	Households	Fall 2009	www.voedingscentrum.nl	Unable to assess specific impacts, but part of larger program to reduce food waste by 20% by 2015.

Inventory of Food Waste Prevention Initiatives										
Initiative Name	Initiative Description	Actor responsible for the	Type of actor responsible for the initiative	Country	Geographic level of implementati	Type of Initiative	Main type of stakeholder targeted	Year of Implementation	Source	Summary of results
Combined factsheet on consumer-produced food waste	Development of a factsheet on food waste by consumers combining several sources.	Ministry of Agriculture, Nature and Food Quality	Multi-stakeholder	NL	National	Awareness campaign	Households	2010	http://www.se2009.eu/polopoly_fs/1.24471!menu/standard/file/Roland%20Th%C3%B6nissen.pdf	Unable to assess specific impacts, but part of larger program to reduce food waste by 20% by 2015.

Food redistribution programmes

Inventory of Food Waste Prevention Initiatives										
Initiative Name	**Initiative Description**	**Actor responsible for the**	**Type of actor responsible for the initiative**	**Country**	**Geographic level of implementati**	**Type of Initiative**	**Main type of stakeholder targeted**	**Year of Implementation**	**Source**	**Summary of results**
Food Bank	A food bank was established as a non-profit organization with support from the Ministries of Social Security and the Interior. The organization distributes food from food producers, retail and social organizations. The Food Bank is an organisation approved by the Food Agency.	Food rebanken	NGO	Denmark	Local	Food Redistribution Programme	Multi-stakeholder	Autumn 2009	www.eurofoodbank.org	Since September 2009, 18 tonnes of food have been distributed to social organizations in Copenhagen and the Frederiksberg municipalities.
Collaboration between the Catalan Waste Agency and the Barcelona Food Bank	The Catalan Waste Agency now collaborates intensively with the Food Bank, giving them technical and economical support to promote their activities. The technical support includes support for awareness campaigns, or the indentification of food industries that are destroying their food remains. The economic support consists in an annual economic subsidy for the Bank allowing them to keep on staff a specific person for contacting companies that could donate food to the bank.	Catalan Waste Agency + Food Bank	Multi-stakeholder	Spain	Local	Food Redistribution Programme	Multi-stakeholder	2007	Barcelona Food Bank: http://www.bancdelsaliments.org/default.asp?idSeccio=home&idIdioma=2 Annual report 2008: http://www.bancdelsaliments.org/pdf/esl/memoria08.pdf Website of Catalan Waste Agency: http://www.arc.cat/en/home.asp	In 2009, the Barcelona Food bank diverted 7.402 tones from disposal (7.043 tones in 2008, which represents around 15,2 Ml). In 2008, the food collected was distributed to 144.695 people in the province of Barcelona, through 566 collaborating entities. In 2008, the Food Bank had a budget of 430.683,92 l, and calculated that for each euro invested by the Bank, they effectively prevented the disposal of 35 l of food. Every 1l of donation of subsidy prevents the disposal of 16,3 kg of food.
"Buon Samaritano" (Good Samaritan)	Comune di Torino and Amiat have implemented the "Good Samaritan" project, which collects uneaten meals from school canteens and products that are still edible from supermarkets and give them away to charity organisations to prevent them from being sent to landfill sites.	Comune di Torino and Azienda Multiservizi Igiene Ambientale Torino SpA (Amiat), Associazione Banco Alimentare del Piemonte e Valle d'Aosta,	Multi-stakeholder	Italy	Local	Food Redistribution Programme	Schools/Retailers	Since 2005	http://www.amiat.it/interno.cfm?SEZ_ID=20&SS_ID=14&PAG_ID=40 http://www.amiat.it/interno.cfm?SEZ_ID=20&SS_ID=14&PAG_ID=40&PD_ID=12 http://www.amiat.it/interno.cfm?SEZ_ID=20&SS_ID=14&PAG_ID=40&PD_ID=11 http://www.amiat.it/interno.cfm?SEZ_ID=20&SS_ID=14&PAG_ID=40&PD_ID=13	Every day it is possible to recover 150 kilos of bread and 50 kilos of fruit to prepare approximately a thousand meals a day. Over the years the amount of food recovered has increased significantly, reaching more than 25,000 kilograms of bread and nearly 13,500 kg of fruit in the school year 2007 to 2008. From 21st March 2005 the Good Samaritan Project is also operational at the Auchan
Initiative to reduce food-processing waste in London	On March 23rd 2010, Boris Johnson, the mayor of London, announced that the London Waste and Recycling Board would be working with an organisation specialised in the collection of food-processing-related waste to collect food products which are past their date limit. FareShare Community Food Network, a charity, will be constructing a warehouse to hold the food products and distribute meals to the underprivileged population of London.	London Waste and Recycling Board, FareShare Community Food Network	Government + NGO	United Kingdom	Local	Food Redistribution Programme	Households, Businesses	2010	http://www.journaldelenvironnement.net/article/londres-valorise-les-dechets-agro-alimentaires,15351	This operation will help London avoid landfilling 300,000 tonnes of food waste per year (for which the price will increase by 25% between now and 2013. With the food collected, FareShare Community Food Network hopes to be able to distribute 800,000 meals to the underprivileged population of London.
Last Minute Market	Provides a service to enterprises (supply) and institutions in order to prevent and reduce food and non-food waste production. LMM enhances, also, the recovery of unsold goods in favor of charity institutions (demand). One of the objectives of LMM is to create a contact between supply (for-profit organizations) and demand (non-profit organizations): the scheme in which the exchange is performed works throughout as a gift transfer between the profit and non profit organizations.	Last Minute Market S.R.L.	Business	Italy, Brasil, Argentina	National	Food Redistribution Programme	All	1998	www.lastminutemarket.it	In 2009, with LMM, it has been possible to recover food for the preparation of 2.400.000 meals in Italy.In 2009, with LMM, 1.100 t of food have been recovered in Italy, 1.300 t of CO2 eq have been produced in less. In the supermarkets and ipermarkets where LMM works, 95% of food waste has been recovered. After LMM's intervention food waste

Inventory of Food Waste Prevention Initiatives										
Initiative Name	**Initiative Description**	**Actor responsible for the**	**Type of actor responsible for the initiative**	**Country**	**Geographic level of implementati**	**Type of Initiative**	**Main type of stakeholder targeted**	**Year of Implementation**	**Source**	**Summary of results**
Approved Food	Specialised in selling dry food products that are near or past their "best before" date.	Approved Food & Drink Company	Business	United Kingdom	National	Food Redistribution Programme	Households	Since 2009	http://www.approvedfood.co.uk/static/About_Us	Received lots of mass media publicity, indicating an impact on consumer awareness but unable to assess sales and revenues, etc.
Social Supermarkets	Organisations that gather and sell fresh food that would otherwise be destroyed by agricultural organisations, food producers and retailers. Food is sold for one-third of the original price, making it not entirely a social/charity venture.	?	Business	Austria	National	Food Redistribution Programme	Multi-stakeholder	No start date identified	Stakeholder document: CRI	19,000 Austrians bought food from these stores in 2007.
Buon Fine (To a fair end)	Co-op shops collect every day products which can no longer be sold, due to damaged packaging or an expiration date 2 days later. They give these products, on a daily basis, to not-for-profit organisations working with homeless, poor and disenfranchised youth populations.	Co-op	Retailer	Italy	National	Food Redistribution Programme	NGOs	2003	Marisa Parmigiani Social Policy Director Coop-ANCC Marisa.parmigiani@ancc.coop.it	There are 2376 shops involved in the programme. These shops donated 3.065 tons of food in 2009, worth a monetary value of 15 mi. These products were given to 1210 not-for-profit organisations (NGOs, social cooperatives, church organisations), making food accessible to 77.548 citizens.
FareShare	Promoting the message that "no good food should be wasted", this UK charity diverts edible food and drink products from industry to disadvantaged people, as well as providing warehouse training for the unemployed and helping food industry businesses reduce their greenhouse gas emissions.	FareShare	NGO	United Kingdom	National	Food Redistribution Programme	Multi-stakeholder	2004	http://www.fareshare.org.uk	The organisation redistributed food contributing to 7.4 million meals in 2008/9, and helped businesses reduce their CO2 emissions by 13,950 tonnes during the same period. FareShare's future goal is to redistribute 20,000 tonnes of food annually and to support 100,000 vulnerable people everyday.
ScrapShop	A free online waste exchange allowing organisations to list and purchase redundant stock and surplus materials. It includes a foodstuffs category along with other waste streams.	ScrapShop	Business	United Kingdom	National	Food Redistribution Programme	Businesses	2009	http://www.scrapshop.co.uk	No results yet avaliable.

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Carrefour actions to reduce waste	Usable but not marketable products are given to local associations. As part of the same initiative, local eco-associations are invited to set up in the store and explain to clients how to reduce waste.	Carrefour	Retailer	France	National	Food Redistribution Programme	NGOs	?	Stakeholder document: Carrefour	In 2008, 15490 tons of food were donated to associations.

Industrial uses

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Fish Chips	Use of otherwise inedible fish waste to create an Omega 3 rich fish chip product.	Hospitality People	Business	Denmark	National	Industrial uses	Manufacturers	2009	http://www.food-supply.dk/portal-b2b/article/view.html?id=42844	Given that over 50% of fish is discarded as inedible waste in Denmark (according to the 2010 CRI study), this is an excellent use for a product that would otherwise be waste.

Information tools

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Initiative Name	**Initiative Description**	**Actor responsible for the**	**Type of actor responsible for the initiative**	**Country**	**Geographic level of implementati**	**Type of Initiative**	**Main type of stakeholder targeted**	**Year of Implementati on**	**Source**	**Summary of results**
Managing Environmental Sustainability in the European Food and Drink Industries	A report by CIAA that provides goals and guidelines for avoiding food waste (chapter 2) : use of by-products (e.g. in animal feed, fertilisers, bio-energy, pharmaceuticals, etc.), avoiding food waste in transport and households through optimised packaging solutions, packaging waste prevention through packaging weight reduction, matching of products to user needs (e.g. product and packaging design, portion size).	CIAA (confederation of the food and drink industry in the EU)	Association	EU	EU	Informational tool	Multi-stakeholder	2008	http://envi.ciaa.eu/asp/key_themes_1.asp?doc_cat_2=Resources%20and%20Waste	Case studies on related website are continually updated to reflect adoption of goals and methods outlined in document and provide examples for other organisations to make progress.
Programme local de prévention des déchets - Guide à l'usage des collectivités locales (local waste prevention programme - guide for local	Guide for local governments on waste prevention programmes.	Département de Seine Maritime + ADEME Haute Normandie	Local authority	France	Local	Informational tool	Local governments	No start date identified	http://www.seinemaritime.net/fr/medias/File/actions/environnement/guide-du-programme-local-de-prevention-dechets.pdf	None avaliable.
Le gaspillage alimentaire-un coup dur pour votre budget (food wastage, a hard blow for your budget)	Guide on waste prevention taking an economic perspective, including practical tips and sources for additional information, prepared by Copidec (Conférence Permanente des Intercommunales de Gestion des Déchets wallonnes).	Copidec	Local authority	Belgium	Local	Informational tool	Households	No start date identified	http://www.copidec.be/Gaspillage-Alimentaire.pdf	None avaliable.
Guide "lutter contre le gaspillage alimentaire" (fight against food wastage)	Guide of good practice for restaurants and caterers, edited by UCM environment.	UCM environment	Association	Belgium	National	Informational tool	Food service	2009	http://www.ucm.be/C1256C0D003C8BF5/0/4C57DF1CD3358AE2C125756E0053123C/$file/UCMBrochureGaspillagealimentaire.pdf	None avaliable.
Book "Déchets en restauration" (waste in the	Book that aims at informing and raising awareness of caterers on waste, including reduction tactics.	CPRC	Business	France	National	Informational tool	Business	2001	http://www.editions-bpi.fr/Produits/E1144.asp	None avaliable.
Eviter le gaspillage alimentaire, cela commence au magasin (avoiding food wastage starts while shopping)	Brochure on food wastage by OBCD.	L'Observatoire bruxellois de la Consommation durable	Research centre	Belgium	National	Informational tool	Households	No start date identified	http://www.oivo-crioc.org/files/fr/4538fra.pdf	None avaliable.
"Calling Time on Waste"	A guide on resource efficiency in the bar trade "Calling Time on Waste" includes advice on food waste prevention and has been widely disseminated to the sector.	National Waste Prevention Programme by EPA	National authority	Ireland	National	Informational tool	Business	Published 2009	http://www.monaghan.ie/websitev2/download/pdf/environment/2009/VitnersCallingTimeOnWasteBooklet.pdf http://www.epa.ie/news/pr/2009/name,26091,en.html	Widely disseminated.
Guide on food waste prevention in the commercial catering sector	A guide is being finalised for launch shortly in advance of the institution of a legal requirement to separately collect food waste for treatment. This work is being extended to major hospitals, where there is a large potential for food waste prevention.	National Waste Prevention Programme by EPA	National authority	Ireland	National	Informational tool	Hospitals	2010	www.greenhealthcare.ie www.ctc-cork.ie/lapd	In one hospital, 72 tonnes of waste per year have been prevented, a large proportion of which is food waste.
"Handbook of waste management and co-product recovery in food processing"	The handbook provides information about the major issues and technologies involved in waste co-product valorisation, methods to reduce water and energy consumption, waste reduction in particular food industry sectors and end waste management.	K W Waldron	Research centre	United Kingdom	National	Informational tool	Business	October 2009	http://www.cplbookshop.com/contents/C3664.htm	None avaliable.

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"Helping Consumers Reduce Fruit and Vegetable Waste"	WRAP report examining attitudes and behaviour related to fresh fruit and vegetable storage in the home. Provides recommendations on the proper method and location (fridge, press, etc.) for the storage of fruit and vegetables.	WRAP	NGO	United Kingdom	National	Informational tool	Households	2008	Irish FW Prevention and Home composting draft Final Report	None avaliable.
"Les biodéchets du commerce et de la distribution" (organic waste from stores and distribution) and "Les biodéchets de la restauration" (organic waste from catering)	Document by ADEME on the characteristics of organic supermarket waste and practices for reducing and recycling organic waste from supermarkets ; Document by ADEME on organic waste from the catering and restuaration sector, including treatment and prevention tactics.	ADEME (Environment Agency)	National authority	France	National	Informational tool	Multi-stakeholder	2005	Stakeholder document : ADEME	None avaliable.

Logistical improvements

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Shopping List Notebook	Circulated during EWWR, the notebook encourages planning before shopping, as this has been identified as an important practical method of reducing household food waste.	European Week for Waste Reduction	NGO	EU	EU	Logistical improvements	Households	2009	http://www.ewwr.eu/outils	None avaliable.
Office cafeteria campaign	Practices implemented include: enrollment/reservations for lunches, just-in-time cooking, plates paid for by weight, consumer surveys on awareness of food waste & satisfaction.	Bruxelles Environnement	Local authority	Belgium	Local	Logistical improvements	Households	No start date identified	http://www.arc-cat.org/cat/publicacions/pdf/cor/setmanaprevencio09/ponencies/13%20Pwp%20Joelle%20Van%20Bamb.pdf	Preliminary study indicated that 0.3 kg of waste/meal are generated in office cafeterias; a 40% reduction in waste was achieved during the pilot project.
"A la carte" menu	Hvidovre Hospital changed how the catering services are operated to reduce food waste. Patients can now order "a la carte", at the time they want.	Hvidovre Hospital	Hospital	Denmark	Local	Logistical improvements	Hospitals	2008	http://www.dagensmedicin.dk/nyheder/2008/09/12/ung-hospitalskok-belnnes-m/index.xml	The programme has helped the hospital avoid 40 tonnes of food waste per year, and the à la carte style encourages portion management; money saved through the initiative has been
Waste-Free Restaurant	Support of the initiative for a waste-free restaurant	Entrepreneur and Ministry of Agriculture, Nature and Food Quality	Multi-stakeholder	NL	local	Logistical improvements	Business	2009-2010		
Experiments for sustainable catering ('LNV als Duurzame Proeftuin')	Pilots to explore possibilities for sustainable catering (e.g. to reduce food waste) at the Ministry of Agriculture, Nature and Food Quality	Ministry of Agriculture, Nature and Food Quality	National authority	NL	Local	Logistical improvements	Business/ Hospitality	Started in 2009		
Experiment 'Last quarter of hour'	Experiment to avoid food waste by not stocking all the food till the last minute (Part of 'LNV als Duurzame Proeftuin')	Ministry of Agriculture, Nature and Food Quality	National authority	NL	Local	Logistical improvements	Business / Hospitality	2010		

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Tesco 'Buy One Get One Free Later'	UK grocery retailer Tesco launched a new initiative to allow customers buying perishable goods to collect their free item the following week.	Tesco	Retailer	United Kingdom	National	Logistical improvements	Households	2010	http://www.environmental-expert.com/resultEachPressRelease.aspx?cid=8847&codi=79507&lr=1	None available.
Cora sustainable development report	Cora supermakets explain, in their sustainable development report, what they do to avoid food waste: each store gives food products with damaged packaging to NGOs, they sell nearly out of date products at a lower price or give them to NGOs and they destroy out of date products.	Cora	Retailer	France	National	Logistical improvements	Consumers/NGOs	No start date identified	http://www.cora.fr/le-groupe/developpement-durable.html#	None available.
Bel company reduces waste	As part of a larger drive to Bel (cheese producer) has worked with waste management companies to reduce and recover more than 50% of their waste sludge.	Bel	Food manufacturer	France	National	Logistical improvements	Multi-stakeholder	No start date identified	http://www.groupe-bel.com/bebel/en/le-groupe/developpement-durable-entreprise-responsable/respecting-the-environment.html	None available.
Smart shelves	"Smart shelves" point out when a product is to be sold out and therefore be purchased.		Retailer	Sweden	National	Logistical improvements	Retailers		http://www.naturvardsverket.se/Documents/publikationer/978-91-620-5885-2.pdf	
Project 'Bread'/'Fast return'	Activity arising from the pilot 'Useful applications for organic residue flows'. Project to avoid or make better use of bread returns within the industrial bread chain.	Stichting Bakkerij Imago (SBI) and the Ministry of Agriculture, Nature and Food Quality	Multi-stakeholder	NL	National	Logistical improvements	Multi-stakeholder	2009		
LNV-innovation impulse	4 Experiments to generate concrete solutions to food waste in specific sectors.	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Logistical improvements	Multi-stakeholder	2010		

Regulatory Instruments

Inventory of Food Waste Prevention Initiatives										
Initiative Name	Initiative Description	Actor responsible for the initiative	Type of actor responsible for the initiative	Country	Geographic level of implementatio	Type of Initiative	Main type of stakeholder targeted	Year of implementation	Source	Summary of results
Phasing out of EU "Cucumber Regulation" EEC No 1677/88	European policy allowing less aesthetically perfect vegetables to be sold, preventing the unnecessary discard of various types of produce.	European Parliament	Public authority	Europe	EU	Regulatory instrument	Businesses	2009	http://www.europarl.europa.eu/sides/getDoc.do?language=SK&type=IM-PRESS&reference=20090706STO57744	
Incentive bin tax	The town of Besançon is setting up a new system that will make people pay for the waste collection tax according to the weight of their bins. It gives financial incentive for waste reduction	Ville de Besançon	Local authority	France	Local	Regulatory instrument	Households	2012	http://www.goodplanet.info/goodplanet/index.php/Contenu/Depeche/Reduire-ses-ordures-pour-reduire-la-facture-la-pesee-des-poubelles-lancee-a-Besancon	
New Irish legislation on separate food waste collection (SI 508 of 2009)	This regulation sets up the source separation of food waste from major commercial premises. This regulation is designed to promote the segregation and recovery of food waste arising in the commercial sector. It will facilitate in particular the achievement of the targets set out in Directive 99/31/EC on the landfill of waste, for the diversion of biodegradable municipal waste (BMW) from landfill sites to composting and anaerobic digestion plants and to other forms of biological treatment.	Ministry of the Environment	Public authority	Ireland	National	Regulatory instrument	Business	2009	http://www.irishstatutebook.ie/2009/en/si/0508.html	
Pilot 'Agrochain approach to food residues'	Pilot to reduce food residues by the Ministry of Housing, Spatial Planning and the Environment to redesign the Dutch waste management policy (the National Waste Management Plan). The purpose was to examine new ways to generate concrete ideas together with agrochain parties on reducing the environmental impact from waste through collaboration in the agrochain.	Ministry of Housing, Spatial Planning and the Environment with participation by the Ministry of Agriculture, Nature and Food Quality.	National authority	NL	National	Regulatory instrument	Multi-stakeholder	2008/2009	www.minvrom.nl	
Pilot 'Meat quality assessment'	Aimed at application (and possible later rolling-out) of a new quality assessment method to determine the quality of meat in slaughterhouses. (One of the spin-offs from the Pilot 'Agrochain approach to food residues'.)	VanDrie Group, Ministry of Housing, Spatial Planning and the Environment and Ministry of Agriculture, Nature and Food Quality.	Multi-stakeholder	NL	National	Regulatory instrument	Multi-stakeholder	Started in 2008	www.minvrom.nl	The estimated reduction of losses in the meat sector is up to 30%.

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Pilot 'Useful applications for organic residue flows'	The purpose of this project is to reduce food losses in the agrochain (prevention) and high-value utilisation where losses occur. With special focus on: (a) implementation of pilots by the sector to initiate concrete preventative action and useful application of food losses in selected food chains and (b) development of a tool to collect information that gains insight into food losses, and possible solutions, in a coherent manner. (One of the spin-offs of the Pilot 'Agrochain approach to food residues'.)	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Regulatory instrument	Multi-stakeholder	2008/2009		Project Bread was a result of this (see below). Other projects may follow.
Impulse programme on sustainable agrochains (2009—2010)	Impulse programme by the Ministry of Agriculture, Nature and Food Quality to implement politically sensitive sections of the Minister's policy programme within this government period. One of the sections is 'Reducing food losses in high-value agrochains'.	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Regulatory instrument	Multi-stakeholder	2009-2010		
Incentive for business initiatives 'Small business innovation research'	One-off support for new business initiatives to prevent or reduce food losses. Support may be used to raise awareness, feasibility studies, reimbursement of organisational or collaboration costs, pilots, etc. (Part of Impulse programme for sustainable agro-chains.)	Ministry of Agriculture, Nature And Food Quality	National authority	NL	National	Regulatory instrument	Business	2010		
Incentive for business initiatives 'Gerichte impulsen LNV'	Support for new initiatives to reduce or prevent waste that are important to the Ministry of Agriculture, Nature And Food Quality. Support may be used for a research or training project, feasibility study, reimbursement of organisational or collaboration costs, pilot projects, etc.	Ministry of Agriculture, Nature And Food Quality	National authority	NL	National	Regulatory instrument	Business	2010		
Public Innovation Agenda: sustainable agro and fisheries chains	Innovation agenda aimed at fundamental long-term innovation in agricultural and fisheries chains and at new bio-based processes and products. Food waste is an action point in this agenda	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Regulatory instrument	Multi-stakeholder			
Policy Document on Sustainable Food	Governmental vision on sustainable consumption and production of food. The Ministry of Agriculture, Nature and Food Quality is aiming to achieve a 20% reduction in food waste by 2015, targeting the consumer and the agrochain.	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Regulatory instrument	Households/ Business	2009-2025		

Research Programmes

Inventory of Food Waste Prevention Initiatives										
Initiative Name	**Initiative Description**	**Actor responsible for the**	**Type of actor responsible for the initiative**	**Country**	**Geographic level of implementati**	**Type of Initiative**	**Main type of stakeholder targeted**	**Year of Implementati on**	**Source**	**Summary of results**
Freshlabel	Integrated approach to enhancing the traceability of fresh and frozen meat and fish products through the cooling chain, using Time Temperature Indicators.	EU	Multi-stakeholder	EU	EU	Research Programme	Business	2005	http://cordis.europa.eu/fetch?CALLER=FP6_PROJ&ACTION=D&DOC=2900&CAT=PROJ&QUERY=1170700790497&RCN=74777&DOC=1&QUERY=012686305b05:3625:021800bc	
Experiment 'Lunchcatering'	Experiments to avoid food waste by catering lunches differently. (Part of 'LNV als Duurzame Proeftuin')	Ministry of Agriculture, Nature and Food Quality	National authority	NL	Local	Research programme	Business / Hospitality	2010		
Project 'Meals on Wheels'	Validation of the experiment to cater differently in hospitals	Ministry of Agriculture, Nature and Food Quality	Multi-stakeholder	NL	Local	Research programme	Hospitality	2010		The result was a a strong decrease of food waste and an improvement of patients' health
Packaging Laboratory: Keep it Fresh	Packaging research to identify what sort of packaging can extend the life of specific fruit and vegetables.	Morrisons Supermarkets	Retailer	United Kingdom	National	Research programme	Households	2009	http://www.morrisons.co.uk/Corporate/Press-office/Corporate-releases/Morrisons-launch-Great-Taste-Less-Waste-campaign-to-save-families-up-to-600-per-year-/	
Food Standards Agency guidance on the application of date marks to food	FDF is currently involved in work with WRAP and the Food Standards Agency to develop date marking guidance to aid greater consumer understanding of best before versus use by.	Food and Drink Federation, WRAP	Association, NGO	United Kingdom	National	Research Programme	Households	2010	http://www.food.gov.uk/consultations/consulteng/2010/fsaguidanceappdatemarksfoodeng	
Study 'Food waste, Value of Food in the Agrochain'	Study by LEI Wageningen UR. Gives a comprehensive picture of the many aspects of food waste in the Netherlands (including a research agenda to support the education agenda).	Green Knowledge Cooperative (*Groene Kennis Coöperatie*) and Ministry of Agriculture, Nature and Food Quality.	National authority	NL	National	Research programme	Multi-stakeholder	2009	www.gkc.nl	
Knowledge and research agenda Food waste	Drafting of a research agenda on food waste.	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Research programme	Multi-stakeholder	2009		
Project 'Bread'-Anaerobic digestion of day-old bread'	Project to study whether it is possible to recover leavening agent from day-old bread to make new bread. (Activity arising from the Pilot 'Useful applications for organic residue flows'.)	European Bakery Innovation Centre (EBIC) and Ministry of Agriculture, Nature and Food Quality	Multi-stakeholder	NL	National	Research programme	Multi-stakeholder	2009		
Target group study	Study on possible different approaches to differences in age group and lifestyle for a media campaign on food waste.	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Research programme	Households	2010		

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Food waste monitor	Development of a food waste monitor using a set of indicators. To monitor the effects of the policy on food waste.	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Research programme	Multi-stakeholder	Started in 2010		
Project 'Salvation Army'	Study of possibilities to better support business operation in the kitchen, using by-products from the food chain.	INHolland catering college, the Knowledge centre for society and religion, Salvation Army, Wageningen UR and others	Multi-stakeholder	NL	National	Research programme	Food service	2010		
Study on negative external effects (i.e. food waste)	Study on (economic) stimuli in the agrochain which trigger negative external effects (i.e. food waste)	Several enterpreneurs and Ministry of Housing, Spatial Planning and the Environment and Ministry of Agriculture, Nature and Food Quality.	Multi-stakeholder	NL	National	Research programme	Business/Retailers	2010		
Study 'Foodsafety vs. Food waste'	Study on the interaction between foodsafety-regulations and food waste.	Ministry of Agriculture, Nature and Food Quality	National authority	NL	National	Research programme	Business/Retailers	2010		
Green Cook'-programme	Where possible support the programme 'Green Cook' (part of Interreg IV)	Ministry of Agriculture, Nature and Food Quality	Multi-stakeholder	NL	National	Research programme	Multi-stakeholder	Started in 2010		
Food Waste Collection Guidance	Guide, based on research and seperate food waste collection trials conducted by WRAP, to provide local authorities with guidance on the collection of food waste as a means of diverting household biowaste from landfills, including options and systems for collecting food waste at the source, possible issues, and advice on how to increase participation through promotion and communication activities.	WRAP	NGO	United Kingdom	National	Research Programme	Local authorities / households	Study 2007-2009; guide published 2009	http://www.wrap.org.uk/downloads/Food_waste_collection_guidance_-_amended_Mar_2010.ce242745.7749.pdf http://www.wrap.org.uk/downloads/Evaluation_of_the_WRAP_FW_Collection_Trials_Update_June_2009.b50ca236.72	None avaliable.

Inventory of Food Waste Prevention Initiatives										
Initiative Name	**Initiative Description**	**Actor responsible for the**	**Type of actor responsible for the initiative**	**Country**	**Geographic level of implementati**	**Type of Initiative**	**Main type of stakeholder targeted**	**Year of Implementation**	**Source**	**Summary of results**
Down the Drain: Quantification and exploration of food and drink waste disposed of to the sewer by households in the UK	Study examining the quantity of food and drink disposed by households via household drains through a weeklong diarykeeping excercise, asking housholders to record quantities of food and drink disposed and an assessment of the reasons for disposal on each occasion.	WRAP	NGO	United Kingdom	National	Research Programme	Households	Research: March 2008, Study: November 2009	http://www.wrap.org.uk/downloads/Down_the_drain_-_report.8aec3b97.8049.pdf	The total quantity of food and drink disposed to the sewer by UK households each year is estimated in this report to be 1.8 million tonnes. This excludes a further 1.7 million tonnes of added water. 1.5 million tonnes of the food and drink disposed could have been avoided had it been better stored in the home or with better planning or preparation. The cost to the consumer, based on the retail purchase price of this food and drink, is estimated at £2.7 billion. Approximately 4.6 million tonnes of CO2 equivalent greenhouse gas emissions are released as a result of the avoidable (i.e. edible) food and drink disposed via the sewer by UK households.
Household Food and Drink Waste in the UK	A report containing quantification of the amount and types of household food and drink waste in the UK collated from recent studies to help policy development; includes advice and tools for reducing unnecessary food waste.	WRAP	NGO	United Kingdom	National	Research Programme	Multi-stakeholder	Research: June-November 2009, Study: November 2009	http://www.wrap.org.uk/downloads/Household_food_and_drink_waste_in_the_UK_-_report.a1ddded0.8048.pdf	For the average household, the retail price of the avoidable food and drink waste is £40 per month, or more than £1 per day. This compares to an average monthly food and drink expenditure of £260 per household. Therefore avoidable food and drink waste accounts for approximately 15% of the shopping budget.
Dealing with Food Waste in the UK	This report seeks to inform and to provide guidance on what is 'the most cost effective and environmentally sustainable ways of diverting household food waste from landfill that leads to the production of a saleable product'. It builds on earlier work by assessing the financial and environmental costs and benefits of different approaches to biowaste management.	WRAP + Eunomia	NGO	United Kingdom	National	Research Programme	National/local authorities	March 2007	http://www.wrap.org.uk/downloads/Dealing_with_Food_Waste_-_Final_-_2_March_07.7bb9c744.3603.pdf	In terms of financial costs, separate collection systems which target food wastes are likely to be the most cost-effective; In terms of environmental performance, the systems which perform best are those which route a higher proportion of the collected biowaste into digestion processes.
Waste arisings in the supply of food and drink to households in the UK	This study focuses on the production of food waste throughout the food and drink supply chain, considering the following stages: manufacture, distribution, retail.	WRAP	NGO	United Kingdom	National	Research Programme	National/local authorities	Research: January to December 2009, Study: March 2010	http://www.wrap.org.uk/downloads/RSC002-005_March_25_2010_FINAL.fb13f2a6.8904.pdf	It is estimated that 18.4 million tonnes of waste was generated by the UK retail food and drink supply chain, and households, in 2008 (see Table 31). Household waste accounted for 65% (food and drink waste 45%, and packaging waste 20%) and manufacturing 27% (see Figure 49). In addition to this there is 2.2 million tonnes of by product from manufacture going to animal feed.
Understanding Food Waste	Summary study on food waste research focused on consumer behavior and public awareness.	WRAP	NGO	United Kingdom	National	Research Programme	National/local authorities	March 2007	http://www.wrap.org.uk/downloads/FoodWasteResearchSummaryFINALADP29_3__07.94bc1c51.3659.pdf	No quantitative conclusions, but reiterates the importance of consumer behavior change in food waste reduction.

Inventory of Food Waste Prevention Initiatives										
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Performance analysis of mixed food and garden waste collection schemes	A project to explore the effectiveness of mixed food and garden waste kerbside collection schemes in diverting food waste for recycling.	WRAP	NGO	United Kingdom	National	Research Programme	National/local authorities	Research: September 2008 to March 2009, Study: February 2010	http://www.wrap.org.uk/downloads/Food_Garden_Waste_Report_Final.1517a616.8564.pdf	Capture rates for food waste for mixed schemes show a wider range of results than separate food only collection schemes. The average capture rate for food only schemes is twice that for mixed schemes.
Microbiological Guide for biogas plants	This technical manual explores the process of biogas production, cites possible production problems and provides solutions and monitoring recommendations for potential issues.	Swedish Waste Management (Avfall Sverige)	Association	Sweden	National	Research Programme	Multi-stakeholder	2009	http://www.avfallsverige.se/m4n?oid=U2009:03	
Processing Raw materials into Excellent and Sustainable End products while Remaining Fresh	Focuses on three partially interrelated innovative techniques for food conservation to better maintain product quality and freshness and the potential for improved sustainability via a reduction in raw material losses, lower energy costs and reductions in the use of chemicals. Study involves assessment of environmental benefits and development of a demonstration unit, notably geared towards usage by SME.	EU/Cordis (Funded under 7th Framework Programme)	Government	EU-wide	EU	Research Programme	Business	2010	http://cordis.europa.eu/fetch?CALLER=FP7_PROJ_FR&ACTION=D&DOC=6&CAT=PROJ&QUERY=0127e7abb917:189a:75e8d3c9&RCN=94253	None yet, project started in spring 2010 will be completed in 2014.
New Advances in the integrated Management of food processing Waste in India and Europe: use of Sustainable Technologies for the Exploitation of byproducts into new foods and feeds	Aims to find valorization routes and markets for fruit and cereal processing by-products and wastes, notably focusing on citrus, mango, pomegranate, and wheat and rice bran-related food waste. The project seeks to turn the wastes into ingredients, foods or feeds and will involve a strong collaboration with industry partners.	EU/Cordis (Funded under 7th Framework Programme)	Government	EU-wide	EU	Research Programme	Business	2010	http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_LANG=ES&PJ_RCN=11225467&type=pro	No results yet avaliable, started 2010, finished 2013.
"Food Waste From Hotels and Restaurants in the U.K."	An investigation into food waste in the hotel sector of the catering industry.	Department of Catering and Hotel Administration, Dorset Institute of Higher Education	Schools/universities	United Kingdom	National	Research programme	Hospitality	1983	http://wmr.sagepub.com/cgi/content/abstract/1/1/295	Waste values represented 31 and 33% of food input on an energy basis in the hotels and 3% of food input on an energy basis in the restaurant complex.
Pilot project 'Meat quality assessment'	A new method for evaluating the quality of meat was used in slaughterhouses	Minsitry of Agriculture, Nature and Food quality	National authority	Netherlands	National	Research programme	Manufacturers	2009	http://www.se2009.eu/polopoly_fs/1.24471!menu/standard/file/Roland%20Th%C3%B6nissen.pdf	Wastage could be reduced by up to 30% in the sector .

Inventory of Food Waste Prevention Initiatives										
Initiative Name	**Initiative Description**	**Actor responsible for the**	**Type of actor responsible for the initiative**	**Country**	**Geographic level of implementati**	**Type of Initiative**	**Main type of stakeholder targeted**	**Year of Implementation**	**Source**	**Summary of results**
Groene Kennis Coöperatie (Green Knowledge Cooperative)	This collaboration is developing ways to increase awareness of food waste in vocational and higher education and how the associated competencies can be better taught. A two-year programme has been developed.	Ministry of Agriculture, Nature and Food Quality	National authority	Netherlands	National	Research programmme	Students	No start date identified	Stakeholder document : CIAA	

Target

Inventory of Food Waste Prevention Initiatives										
Initiative Name	**Initiative Description**	**Actor responsible for the**	**Type of actor responsible for the initiative**	**Country**	**Geographic level of implementati**	**Type of Initiative**	**Main type of stakeholder targeted**	**Year of Implementation**	**Source**	**Summary of results**
Five Fold Environmental Ambition	The FDF aims to achieve zero food and packaging waste to landfill from 2015.	Food and Drink Federation	Association	United Kingdom	National	Target	Manufacturers	2009	http://www.fdf.org.uk/environment/waste.aspx	

Training programme

Inventory of Food Waste Prevention Initiatives										
Initiative Name	**Initiative Description**	**Actor responsible for the**	**Type of actor responsible for the initiative**	**Country**	**Geographic level of implementati**	**Type of Initiative**	**Main type of stakeholder targeted**	**Year of Implementation**	**Source**	**Summary of results**
Anti-waste workshops' - Cooking Classes	Cooking workshops for the local community that highlight techniques and benefits of food waste reduction.	Bruxelles Environnement	Local authority	Belgium	Local	Training programme	Households	2009	http://www.arc-cat.org/cat/publicacions/pdf/ccr/setmanaprevencio09/ponencies/13%20Pwp%20Joelle%20Van%20Bamb.pdf	1000 people trained in 2009.

Waste measurement programmes

Inventory of Food Waste Prevention Initiatives										
Initiative Name	**Initiative Description**	**Actor responsible for the**	**Type of actor responsible for the initiative**	**Country**	**Geographic level of implementati**	**Type of Initiative**	**Main type of stakeholder targeted**	**Year of Implementati on**	**Source**	**Summary of results**
Canteen Pilot Project	2 company canteens and 2 school canteens designed and implemented a set of good practices and measure the quantity of waste before and after the action.	Bruxelles Environnement	Local authority	Belgium	Local	Waste measurement programme	Business / Schools	2008	http://documentation.bruxellesenvironnement.be/documents/InfoFiche_GaspiProfessionnels.PDF?langtype=2060	Waste for each plate was reduced by 41% in the business canteens. In schools, it was found that the kind of food served to children has an influence on the amount of food waste. The fact that schools cannot always change the quantities of food ordered is also a problem. For companies, the issue is about reconciling supply and demand. Consumers act differently when they are at home or at work.
Opération "Foyers-témoins" (test-households)	18 model families for waste sorting in Guadeloupe. For 3 months, selected families will weight and sort perfectly their waste, and they will use a compost bin for organic waste.	Ville de Baie-Mahault + ADEME	Local authority	France	Local	Waste measurement programme	Households	2010	http://www.guadeloupe.franceantilles.fr/actualite/education-sante-environnement/dechets-18-familles-montrent-l-exemple-02-02-2010-65735.php	
Opération "Familles-Témoins" (test-families)	24 families tried to reduce their waste production by following specific rules for 14 weeks. The rules included : composting, choose the right packaging, avoir disposable produots, repair as much as possible + weight their waste.	Symevad (SYndicat Mixte d'Elimination et de VAlorisation des Déchets) des Communautés d'Agglomération du Douaisis, d'Hénin-Carvin et la Communauté de Communes OSARTIS	Local authority	France	Local	Waste measurement programme	Households	2008	http://www.symevad.org/Familles-temoins.html?var_recherche=familles%20t%C3%A9moins	Waste decreased by 7kg per household per month, overall reduction 31%.
Study on food spillage	Residual household waste of 2000 families will be sorted with special attention on kitchen waste. This fraction will be further sorted, classified in several categories as avoidable or not (depending on storage life), compostable or not, package open or closed, fruit, vegetable, meat... The conclusion can be that an awareness-raising campaign is needed for some categories.	OVAM (Public Waste Agency of Flanders)	Regional authority	Belgium	Local	Waste measurement programme	Households	2010	An internal study (based on literature) was conducted and will be published on www.ovam.be ; kathleen.schelfhout@ovam.be	Results are expected half 2011.
Eurest restaurant food waste campaign	150 units participating in efforts to quantify food waste, publicise results to staff and customers, explain the impacts of food waste and what can be done about it.	Eurest	Food service	Sweden	National	Waste measurement programme	Business	No start date identified	http://docs.google.com/viewer?a=v&q=cache:SghQKoE5dfUJ:www.silma.ee/orb.awf/class%3Dfile/action%3Dpreview/id%3D1104722/DP_EWWR_GB.pdf+EUREST+sweden+food+waste&hl=en&pid=bl&srcid=ADGEESif8AI8SDlQ6s3hro4KqTqwZiMBsRrKXRMbal3FqSltSWPlZwkdl0rJfV8lNmgfgC6sotsow4d0em4T5CkBdZ07aiOAWE7Kyd6c77jcR7f5yRuiujQpb67TEzFRcHGs771x5ll1&sig=AHIEtbTQcSvKjOz95Z9hHsf4q_KmPZCUgA	
Green Business programme	Offers businesses Resource Efficiency Assessments including food waste, energy and water.	National Waste Prevention Programme by EPA	National authority	Ireland	National	Waste measurement programme	Business	2010	www.greenbusiness.ie	

Inventory of Food Waste Prevention Initiatives										
Initiative Name	**Initiative Description**	**Actor responsible for the**	**Type of actor responsible for the initiative**	**Country**	**Geographic level of implementati**	**Type of Initiative**	**Main type of stakeholder targeted**	**Year of Implementation**	**Source**	**Summary of results**
Green Hospitality Award Scheme	Scheme for the hotel and catering sector, involving the measurement and reduction of waste, with a specific focus on food waste, with an award for top-performers.	National Waste Prevention Programme by EPA	National authority	Ireland	National	Waste measurement programme	Hospitality	2008	www.ghaward.ie	GHA now has a membership of 150 hotels and 10 major catering businesses all working to reduce waste/energy/water use including food waste. 100 of these will achieve award status in 2010. 120 properties were surveyed in 2009 and showed a 6,000 tonne reduction in waste (no breakdown in relation to food waste but this is a large component of waste from this sector).
European Week for Waste reduction in Eurest restaurants	25 restaurants and 2 coffee shops in 15 different places in Sweden weighed and measured the waste from their preparations and from the guests during one day. Most of their other restaurants informed the guests what Eurest does to prevent food waste, using the 10-measure list to prevent and reduce waste. They use an Excel sheet to measure waste, with a graph entitled "so much waste we produce every single day", available to guests and staff.	Eurest	Business	Sweden	National	Waste measurement programme	Households/ Business	Started in November 2009	Christina Odén – environmental coordinator christina.oden@eurest.se www.avfallsverige.se	22,055 guests reached in the restaurants which measured waste, once a month. Food waste from the guests 45g/meal Food waste from preparations 85g/meal Average =130g food waste/meal Some restaurants had under 50g/food waste/meal (from guests and preparations) They continue measuring the food waste. More recently they had under 100g/meal, more than 20 restaurants have under 50g food waste/meal. Food waste quantity was reduced by 23% per meal between November and February.
Food and Drink Federation's Five-fold Environmental Ambition	The waste part of our Ambition is to send zero food and packaging waste to landfill from 2015. Projects : - 2008, first FDF survey of members' food and packaging waste arisings in 2006. This survey established the baseline for our 2015 target. - joint project with WRAP to carry out waste prevention reviews at 13 of our member company sites across the UK. - working closely with FareShare, the national food charity which supports local community projects to relieve food poverty through the redistribution of surplus food that might otherwise end up in the waste stream. - encouraged our members to sign up to the original Courtauld Commitment (2005-10) and which includes a target to reduce domestic food waste by 155,000 tonnes by 2010 compared to 2008.	Food and Drink Federation, WRAP	Association	United Kingdom	National	Waste measurement programme	Business	2007	FDF's Zero Waste to Landfill Ambition: http://www.fdf.org.uk/environment/waste.aspx FDF's Five-fold Environmental Ambition: http://www.fdf.org.uk/environment_progress_report.aspx FDF's Five-fold Environmental Ambition Progress Report 2009: http://www.fdf.org.uk/corporate_pubs/Environmental_Ambition_2009.pdf	Members prevented more than half a million tonnes of food waste being created in 2006.FDF will also repeat this waste survey in 2010 to collect 2008 and 2009 data to track progress towards our 2015 Ambition. Waste prevention at specific sites for companies: Most sites were found to be performing well in areas such as waste management, process control and monitoring and variance reporting. More FareShare partnerships with member companies were forged through the promotion of its 10,000 pallet challenge, which aims to distribute a minimum of 5,750 tonnes of food a year; double the number of people receiving food from FareShare to 60,000 a day; and to increase the meals provided each year to 14 million.

3. TABLE SHOWING FOOD WASTE GENERATION IN EU MEMBER STATES AS REPORTED BY DIFFERENT SOURCES IN TONNES/YEAR

(EUROSTAT 2010, BMFLUW 2009, Ademilua 2009, Obersteiner & Schneider 2006, Schneider & Wassermann 2004, CRI 2001, EA 2003, WRAP 2008, 2009, Statistisches Bundesamt 2009, Kohl 2009, SEI 2008, EEIC 2008, Irish EPA 2009, Panagiotis & Christopoulos 2005, ADEME 2004, ARSO 2010, Naturvårdsverket 2010)

		Food Manufacturing and Processing industry			Wholesale and retail (including market waste)			Households			Food service and restaurant waste		
		t	year	Source	t	year	Source	t	year	Source	t	year	Source
Austria	AT	570 544	2 006	Eurostat (2010)	267 000	2 008	BMLFUW (2009)	784 570	2006, 2008	Obersteiner & Schneider (2006), Ademilua (2009)	103 500	2008	BMLFUW (2009)
Belgium	BE	2 311 847	2 006	Eurostat (2010)	347 374	2 006	Eurostat (2010)	157 500		estimated	273 000		estimated
Bulgaria	BG	358 687	2 006	Eurostat (2010)	10 102	2 006	Eurostat (2010)	38 594		estimated	17 389	2006	Eurostat (2010)
Cyprus	CY	186 917	2 006	Eurostat (2010)	7 872	2 006	Eurostat (2010)	3 832		estimated	13 549	2006	Eurostat (2010)
Czech Republic	CZ	361 813	2 006	Eurostat (2010)	41 404	2 006	Eurostat (2010)	108 723	2 006	Eurostat (2010)	71 269	2006	Eurostat (2010)
Denmark	DK	101 646	2 006	Eurostat (2010)	45 676		calc. from CRI Danish food waste report (2001)	494 914		calc. from CRI Danish food waste report (2001)	28 679	2006	Eurostat (2010)
Estonia	EE	237 257	2 006	Eurostat (2010)	13 251	2 006	Eurostat (2010)	82 236	2 008	calc. from (SEI 2008, EEIC 2008)	24 564	2008	calc. from (SEI 2008, EEIC 2008)
Germany	DE	1 848 881	2 006	Eurostat (2010)	72 000	2 007	Statistisches Bundesamt (2009)	7 676 471	2 006	Eurostat (2010)	2 000 000		Kohl (2009)
Greece	GR	73 081	2 006	Eurostat (2010)	882	2 006	Eurostat (2010)	1 461	2 002	Panagiotis & Christopoulos (2005)	1 518	2006	Eurostat (2010)
Finland	FI	590 442	2 006	Eurostat (2010)	76 282	2 006	Eurostat (2010)	90 000	2 009	HSY Study	131 305	2006	Eurostat (2010)
France	FR	626 000	2 006	Eurostat (2010)	782 339	2 006	Eurostat (2010)	6 322 944		calc. from CRI Danish food waste report (2001)	1 080 000	2003	ADEME (2004)
Hungary	HU	1 157 419	2 006	Eurostat (2010)	112 388	2 006	Eurostat (2010)	45 509	2 006	Eurostat (2010)	193 452	2006	Eurostat (2010)
Ireland	IE	465 945	2 006	Eurostat (2010)	107 598	2 006	Eurostat (2010)	292 000	2 008	estimated from Irish EPA (2009)	185 208	2006	Eurostat (2010)
Italy	IT	5 662 838	2 006	Eurostat (2010)	149 756	2 006	Eurostat (2010)	2 706 793	2 006	Eurostat (2010)	257 774	2006	Eurostat (2010)
Latvia	LV	125 635	2 006	Eurostat (2010)	3 870	2 006	Eurostat (2010)	10 466	2 006	Eurostat (2010)	6 661	2006	Eurostat (2010)
Lithuania	LT	222 205	2 006	Eurostat (2010)	91 240	2 006	Eurostat (2010)	17 016		estimated	157 051	2006	Eurostat (2010)
Luxembourg	LU	2 665	2 006	Eurostat (2010)	11 329	2 006	Eurostat (2010)	62 538	2 006	Eurostat (2010)	19 500	2006	Eurostat (2010)
Malta	MT	271	2 006	Eurostat (2010)	1 044	2 006	Eurostat (2010)	1 778	2 006	Eurostat (2010)	1 796	2006	Eurostat (2010)
Netherlands	NL	6 412 330	2 006	Eurostat (2010)	443 192	2 006	Eurostat (2010)	841 212		estimated	762 864	2006	Eurostat (2010)
Poland	PL	6 566 060	2 006	Eurostat (2010)	130 915	2 006	Eurostat (2010)	2 049 844	2 006	Eurostat (2010)	225 344	2006	Eurostat (2010)
Portugal	PT	632 395	2 006	Eurostat (2010)	137 349	2 006	Eurostat (2010)	52 848		estimated	236 418	2006	Eurostat (2010)
Romania	RO	487 751	2 006	Eurostat (2010)	400 348	2 006	Eurostat (2010)	108 051		estimated	689 118	2006	Eurostat (2010)
Slovakia	SK	347 773	2 006	Eurostat (2010)	38 592	2 006	Eurostat (2010)	78 546	2 006	Eurostat (2010)	66 429	2006	Eurostat (2010)
Slovenia	SI	42 072	2 006	Eurostat (2010)	23 971	2 006	Eurostat (2010)	25 215	2 006	Eurostat (2010)	11 405	2007	ARSO (2010)
Spain	ES	2 170 910	2 006	Eurostat (2010)	1 244 846	2 006	Eurostat (2010)	218 791		estimated	2 142 746	2006	Eurostat (2010)
Sweden	SE	601 327	2 006	Eurostat (2010)	110 253	2 006	Naturvårdsverket (2010)	911 000	2 008	calc. from Naturvårdsverket (2010)	298 880	2006	Naturvårdsverket (2010)
United Kingdom	GB	4 100 000		EA (2003)	1 600 000	2 007	WRAP (2008)	6 700 000	2 008	WRAP (2009)	3 000 000	2007	WRAP (2008)

4. GLOSSARY

Avoidable food waste: Food that is thrown away that was, at some point prior to disposal, fit for human consumption (e.g. slices of bread, apples, meat).

Best available data: Data which, in the absence of other more accurate data, represents the best set of data available and reflects the most validated set of assumptions and extrapolations possible at the current time.

Bio-waste: Defined by the European Commission in the green paper on the management of bio-waste as "biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, and comparable waste from food processing plants. It does not include forestry or agricultural residues, manure, sewage sludge, or other biodegradable waste such as natural textiles, paper or processed wood. It also excludes those by-products of food production that never become waste."

Business as usual (BAU): Also known as non-action, this situation assumes the continuation of the current set of legislative policies with no additions or changes to their applications. In the case of bio-waste and food waste, this involves the continued unmodified application of the policies and principles in the Landfill Directive 1999/31/EC, the Waste Framework Directive 2008/98/EC, the Thematic Strategy on the Prevention and Recycling of Waste and the green paper on bio-waste management in the EU.

By-product: Defined in Article 5 of the Revised Waste Framework Directive as "a substance or object, resulting from a production process, the primary aim of which is not the production of that item" meeting the following conditions:

> "(a) further use of the substance or object is certain;
>
> (b) the substance or object can be used directly without any further processing other than normal industrial practice;
>
> (c) the substance or object is produced as an integral part of a production process; and
>
> (d) further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts."

Edible food waste: Food waste which was, at some point prior to disposal, fit for human consumption; includes both avoidable food waste (e.g. slices of bread, apples, meat) and possibly avoidable food waste (e.g. bread crust, potato skins).

EWC 09 NOT 093: Animal and vegetal waste excluding slurry and manure; data set calculated to assess the current quantities of food waste generated in the EU27. Derived from the following waste streams, as measured by EUROSTAT:

- (EWC_09) Animal and vegetal wastes
- (EWC_0911) Animal waste of food preparation and products
- (EWC_093) Animal faeces, urine and manure

The calculation of EWC 09 NOT 093 involves the assumption that EWC_0911 is already included in EWC_09 and the subtraction of EWC_093 from EWC_09 to exclude animal manure, as agricultural waste is not addressed in the current study. The reference year for the data used for this category, in the current study, is 2006.

Food waste: is waste composed of raw or cooked food materials and includes food materials discarded before, during or after food preparation, in the process of manufacturing, distribution, retail or food service activities, and includes materials such as vegetable peelings, meat trimmings, and spoiled or excess ingredients or prepared food. Food waste can be both edible or inedible.

Inedible food waste: Food waste arising from food preparation that was not any point edible (e.g bones, egg shells, pineapple skins); inedible food waste is considered unavoidable food waste.

Possibly avoidable food waste: Food, fit for human consumption, that some people eat and others do not (e.g. bread crusts, potato skins).

Prevention: The revised Waste Framework Directive defines prevention, as related to waste, as "measures taken before a substance, material or product has become waste, that reduce:

(a) the quantity of waste, including through the re-use of products or the extension of the life span of products;

(b) the adverse impacts of the generated waste on the environment and human health; or

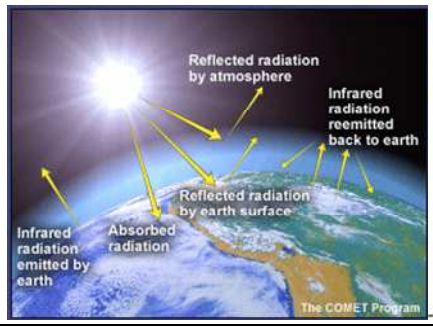
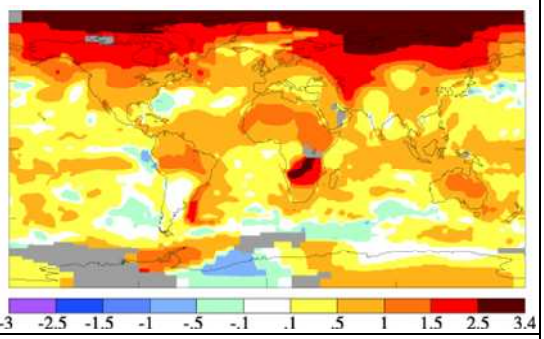
(c) the content of harmful substances in materials and products".

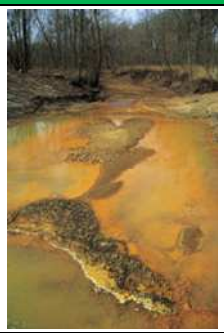
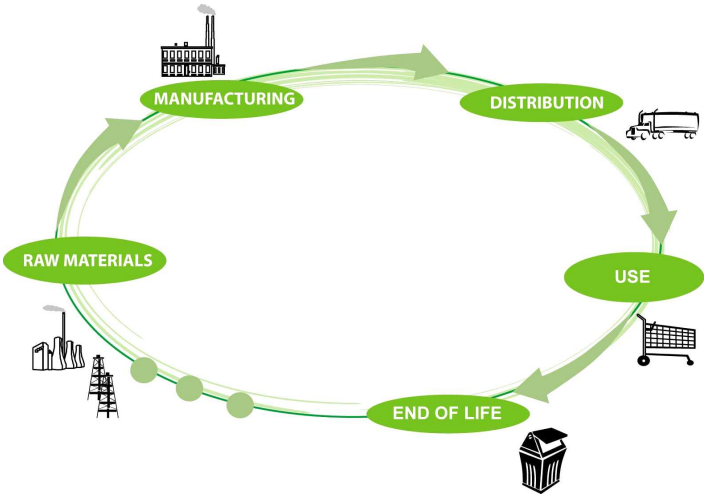
Stakeholder: Parties involved in or affected by a given course of action; in the current study stakeholders representing public authorities, NGOs, associations and private sector organizations were consulted.

Take-back: As defined by DEFRA, a system whereby, "some retailers include clauses in supply contracts that entitle them to return stock to their suppliers once it has reached a specified amount of residual shelf-life remaining e.g. 75%.

Unavoidable food waste: Waste arising from food preparation that is not, and has not, been fit for human consumption under normal circumstances (e.g. bones, egg shells, pineapple skins).

5. TECHNICAL GLOSSARY FOR SECTION 0

Term	Definition
Abiotic resource depletion potential	Resource depletion can be defined as the decreasing availability of natural resources. The resources considered in this impact are fossil and mineral resources, excluding biotic resources, and associated impacts such as species extinction and loss of biodiversity. 
Acidification potential	Air acidification consists of the accumulation of acidifying substances (e.g. sulphuric acid, hydrochloric acid) in the water particles in suspension in the atmosphere. Deposited onto the ground by rains, acidifying pollutants have a wide variety of impacts on soil, groundwater, surface waters, biological organisms, ecosystems and materials (buildings).  
Climate change (greenhouse gases emissions)	Climate change refers to anthropological changes in the global climate, namely global warming. Global warming refers to the increase in the average temperature of the Earth's surface, due to an increase in the greenhouse effect, caused by anthropogenic emissions of greenhouse gases (carbon dioxide, methane, nitrous oxide, fluorocarbons (e.g. CFCs and HCFCs), and others).  
Eutrophication potential	Eutrophication is a process whereby water bodies, such as lakes or rivers, receive excess chemical nutrients – typically compounds containing nitrogen or phosphorus – that stimulate excessive plant growth (e.g. algae). Nutrients can come from many sources, such as fertilisers applied to agricultural fields and golf courses, deposition of nitrogen from the atmosphere, erosion of soil containing nutrients, and sewage treatment plant discharges.  

Term	Definition
(Freshwater aquatic) ecotoxicity potential	The European Union System for the Evaluation of Substances (EUSES) quantitatively assesses the risks posed by chemicals to human health and the environment. Using toxicological benchmarks for both human and ecological effects, EUSES produces "risk characterisation ratios" that indicate when chemical releases are likely to result in toxic doses that exceed acceptable levels. Freshwater Aquatic Ecotoxicity Potential characterises health risks to a specific ecological system: fresh surface waters. 
Human toxicity potential	The European Union System for the Evaluation of Substances (EUSES) quantitatively assesses the risks posed by chemicals to human health and the environment. Using toxicological benchmarks for both human and ecological effects, EUSES produces "risk characterisation ratios" that indicate when chemical releases are likely to result in toxic doses that exceed acceptable levels. Human Toxicity Potential characterises health risks to humans.
Life cycle	Succession of steps. The life cycle of a product comprises any steps in a "cradle to grave" approach: the extraction of the necessary raw materials, the manufacturing of the product (comprising material manufacturing and assembly), its distribution to the user, its use and its end-of-life (including collection and treatment: reuse, recycling, incineration with or without recovery, landfilling and so on). 
Life Cycle Assessment (LCA)	Methodology aiming to assume the quantifiable environmental impacts of a service or product from the extraction of the materials contained within the components involved, to the treatment of these materials at end-of-life. This "cradle-to-grave" methodology has been standardised at the international level through ISO 14044.
Normalisation	Expression of impacts per inhabitant-equivalent. To make easier the comprehension of the damages or benefits computed by a LCA, the environmental impacts are translated into inhabitant-equivalents. One inhabitant-equivalent is the contribution of an “average” inhabitant – in a given geographic area – into the environment over one year for a given indicator of impact. This value is obtained by dividing the total quantity, for a given indicator, generated over the area considered during 1 year by the number of inhabitants within the area.

Term	Definition	
Photochemical oxidation potential	This pollution results mainly from chemical reactions induced by solar light between nitrogen oxides and volatile organic compounds (VOC), commonly emitted in the combustion of fossil fuels. It provokes high levels of ozone and other chemicals toxic for humans and flora.	

6. STAKEHOLDER CONSULTATION

Stakeholder Consultation

A stakeholder consultation was completed in parallel with the steps of analysis outlined above.

The concept of waste prevention as presented in the Waste Framework Directive (2008/98/EC) is relatively new and has in many cases not yet been transposed into national law by Member States.[132] The consultation has demonstrated that food waste prevention in particular is an increasingly important issue for a wide range of stakeholders. The numbers of studies currently underway or published in the last year testify to this, as well as the number of initiatives that are still in the pilot phase.

The stakeholder consultation has thus greatly enriched the evidence found in the literature review, offering access to research that in many cases was still under development, and to expert opinions on areas that have not yet been fully documented.

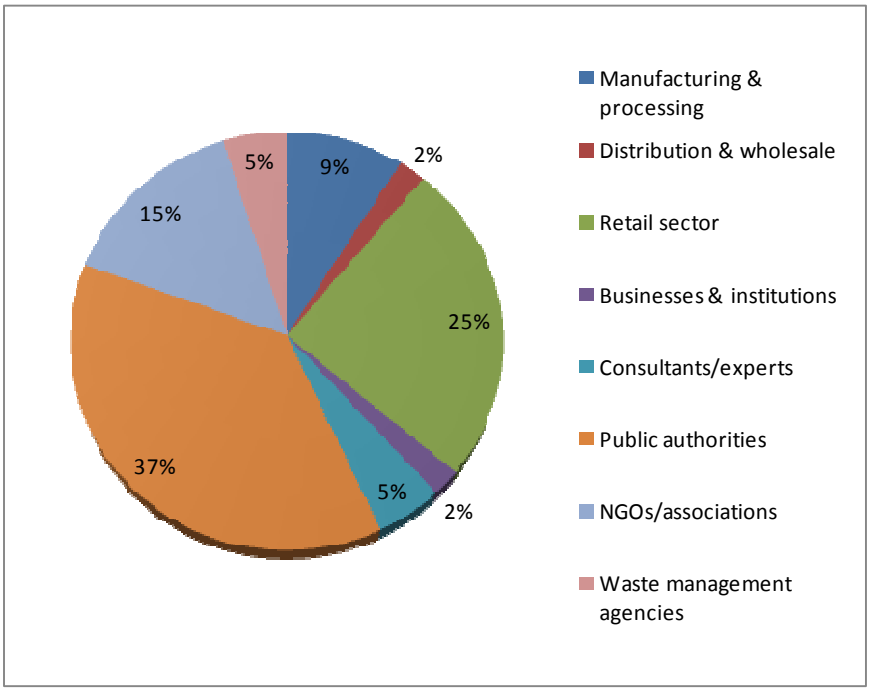
The identification and interaction with stakeholders is summarised below, providing a record of significant issues raised.

- **Identification of stakeholders**

  The stakeholder list was provided to the European Commission with the Inception Report on December 16th 2009. Additions were provided by Patrice Gruszkowski at DG Environment and the list was developed by BIO. The final list contained 145 stakeholders. The following diagram shows the breakdown of relevant stakeholders identified. Four key sectors are covered, and households are represented by public authorities, NGOs and associations.

[132] Examples of grassroots waste prevention activity can be found at: ec.europa.eu/environment/waste/prevention/practices.htm

Figure 30: Types of stakeholders (represented as %) targeted via the consultation



Contact persons at several organisations had changed and new details were sought and updated; the process has enabled an increasingly complete and accurate list of food waste stakeholders to be gathered.

➢ **Expert interviews**

Experts were contacted seeking more detailed input on the causes and quantities of food waste and regarding good practices in food waste prevention. Four experts discussed different dimensions of the study in relation to their experiences in the hospitality industry, the retail sector, the supply chain, and in schools and offices.

WRAP's Retail Supply Chain Programme Manager, Charlotte Henderson, talked to BIO about WRAP's pioneering resource mapping study, and the specificities of particular food products that commonly lead to their discard.

WRAP's Phil Williams, currently working on the hospitality industry food waste arisings study, discussed anecdotal evidence that where food-service businesses were required to measure and assess the food waste they generate, this had a strong impact on their behaviour and wastefulness.

Anja Van Campenhout of Bruxelles Environnement talked to BIO about original initiatives in the Brussels area addressing food waste in a range of contexts. The Sustainable Canteens programme for example addresses both schools and office cafeterias, and further workshops and training programmes on food waste prevention are organised targeting households. Research has been conducting showing that 15kg/person/year of food waste is generated in households, 18kg/employee/year is generated in office cafeterias, and 6kg/pupil/year in schools in the Brussels region.

Tristram Stuart, author of a 2009 book on food waste[133], underlined the unreliability of self-reported data on food waste generation, particularly in the relation to the Retail sector. Requiring retailers to measure food waste however is an important first step, as Phil Williams stated above, in building awareness. The publication and verification of food waste data, however, would have a much greater impact, by stimulating competition among businesses as well as enabling them to share good practices on food waste prevention.

- **Stakeholder enquiry**

  - **Methodology**

    A two phase approach was used to solicit stakeholder input on both quantities of food waste and good practices in the prevention of food waste. This approach was selected in order to keep different study areas separate, simplifying the reply process for the stakeholder and aiming to maximise response.

    A short, clear email was conceived, defining the four sectors of food waste producers used by the study and seeking data on food waste generation by sector and by MS, as far as available. Replies were encouraged including the original source of the data.

    A questionnaire was developed by BIO and with the input of the EC was expanded to include a wide number of examples of food waste prevention practices, helping stakeholders understand the kinds of possible approaches that can be effective at minimising food waste in different sectors (see Appendix I).

    Both enquiries were sent on February 24th 2010. As and when new stakeholders were identified, the enquiries were personalised and sent to the new contacts.

  - **Results**

    Stakeholders contributed 28 documents featuring relevant but highly heterogeneous data. Many stakeholders replied stating that they did not know of any data but would transfer the request. The Environment Ministries of Bulgaria, Latvia and Lithuania confirmed that there was no data available on food waste generation in their MS.

    Among the documents received, several had been published in recent months (WRAP's household food and drink waste study, November 2009, for example), in addition to as yet unpublished research, including a Danish Food Waste Study and the EC Bio-waste Report.

    While only seven completed questionnaires were received, many of these described several practices, and the deadline for submissions was extended for a number of parties upon request.

    Several stakeholders expressed an interest in the exclusion of home-composting from the study and asked whether this had become the

[133] Stuart, T. (2009) *Waste : Uncovering the Global Food Scandal* Penguin: London

official EU position. It was explained that the focus of the Waste Framework Directive on 'measures taken before the substance becomes waste' had guided this decision and was proposed by the EC relating to this study only.

The Environment Ministry of the Slovak Republic concluded that based on this definition, there are no food waste prevention initiatives in its territory at this time, but asked for information about initiatives in other MS that it might be able to implement.

ACR+ noted, furthermore, that there are opportunities for the prevention of green waste (non-food bio-waste) that also deserve the attention of public policy.

- **Stakeholder feedback on food waste quantities**

  - **Methodology**

Following the completion of the food waste quantity calculations, 45 targeted stakeholders were selected, notably national environmental ministries and industry authorities who would be in a position to comment on proposed national and sectoral tonnages.

The primary channel for stakeholder feedback on quantities was email. A short, clear email was conceived, showing in graphical form the results of the food waste analysis for the four sectors considered and the food waste produced per capita in the EU27. The initial email was followed up approximately 10 days later with a reminder email to encourage stakeholders to provide feedback or initial comments on the data presented.

- **Stakeholder feedback on policy options**

Following on finalisation of the five potential policy options in consultation with the European Commission, BIO Intelligence Service sought out stakeholder feedback on policy options from national authorities, research bodies and industry representatives to understand the potential implementation costs, context and impacts of the five proposed policy options. An overview of this consultation is provided below; detailed information on the stakeholder feedback provided is included in section iii of Chapter 4.

- **National authorities:** BIO Intelligence Service consulted national authorities in Denmark, Spain and Belgium to understand the MS level implementation costs and impacts for food waste data requirement and potential prevention targets.

- **Research bodies:** BIO consulted EUROSTAT to understand the possible modifications required to the current waste reporting system to include specific food waste quantity reporting. In order to learn more about consumer awareness campaigns, BIO spoke with WRAP about the costs and impacts of the Love Food Hate Waste campaign.

- **Industry representatives:** To understand and incorporate the industry perspective on the proposed policy options as well as their potential implementation costs and impacts, BIO consulted

a range of industry actors including the Food and Drink Federation, Eco-Emballages, the CIAA on food waste data reporting, target setting, date labelling coherence and consumer awareness campaigns.