Protocol for evaluating business food waste

Guidance for quantifying food waste in REFRESH and setting the baselines for measurement

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List of abbreviations

CA	Consortium Agreement
FA	Framework for Action
FLW	Food loss and waste
FW	Food waste
FUSIONS	Food Use for Social Innovation by Optimising Waste Prevention Strategies (an EU funded project)
SDG	Sustainable Development Goals
WP	Work Package

1 Summary

This document is to help lead organisations responsible for Frameworks for Action (food industry voluntary agreements established under the REFRESH project) to set baselines and work with business participants to measure and report their food waste data.

Food waste should be defined using the FUSIONS definitional framework and its language. It is important that the main concepts are clearly agreed and understood by all stakeholders.

Food waste quantification is challenging, but the two recently published sets of guidelines can greatly help entities (governments, businesses, research organisations) that are seeking to measure food waste:

- The WRI Food Loss and Waste *Standard* (FLW *Standard* in short)
- FUSIONS Food Waste Quantification Manual (FUSIONS Manual in short)

There is an overlap between the two guidelines, but each also covers some specific elements the other does not cover. It is recommended to first read the introductory chapters and the relevant supply chain stage chapters of the FUSIONS Manual, and follow up with more detailed description of the methods and associated procedures (using records, sampling, analysis) in the FLW *Standard*.

In the REFRESH Frameworks for Action we will measure business' own operational waste, and depending on the projects, before and after wastage rates or awareness levels of targeted food products and targeted audiences.

The first year measurement will present the baseline.

The process of defining the subject and method of measurement should not be rushed as any later changes would add to confusion and reduce the conclusions you can make. It is therefore particularly important for the measurement procedures to be well thought through in the base year already, and that the scope is clearly defined.

Businesses should be involved early in the process with the right people within the business brought on board. Those responsible for operations will usually be able to gather the best data.

Finding the right balance between being practical and making it easy for the businesses (to ensure better quality data) and being ambitious (to collect the right kind of data and enough of it) is the most important challenge.

2 Introduction

REFRESH is an EU research project taking action against food waste. 26 partners from 12 European countries and China work towards the project's goal to contribute towards Sustainable Development Goal 12.3 of halving per capita food waste at the retail and consumer level and reducing food losses along production and supply chains, reducing waste management costs, and maximizing the use of un-avoidable food waste and packaging materials as valuable fuel, materials or soil enhancers.

As part of the REFRESH project, four Frameworks for Action (FAs) addressing food loss along the entire supply chain are being piloted in four European countries and in China. The FAs set up through REFRESH can, therefore, be seen as one step towards delivering the Sustainable Development Goal 12.3 (SDG 12.3) in these countries. For more information on the set up of the four FAs, see REFRESH report D2.3 "FA selection process".

In order to achieve the SDG 12.3, we collectively need to get better at measuring food waste: to track changes over time and to understand where to focus efforts. For retail and household levels, the SDG 12.3 target is quantified and anticipated to be relative to the 2016 baseline, which needs to be established.

Measuring food waste presents many challenges, but in many ways it has never been easier to undertake it; the publication of two food waste measurement guidelines - the WRI Food Loss and Waste Protocol, and the FUSIONS Food Waste Quantification Manual – plus technological advances and existing experience, offer useful assistance to any entity measuring food waste.

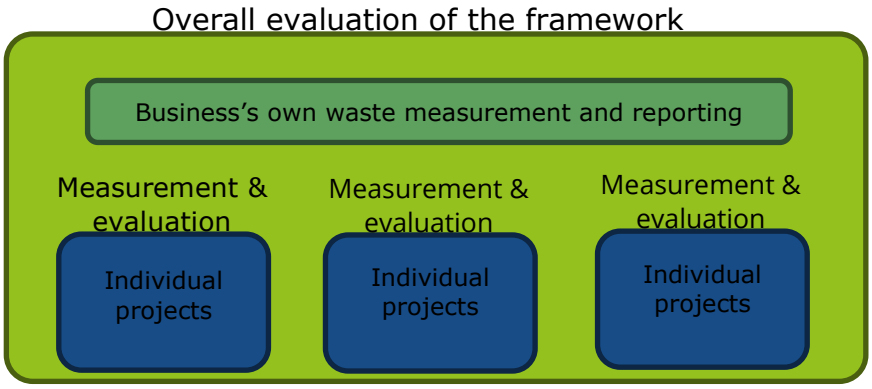
Furthermore, the initial review of Frameworks for Action (FAs) has found that those food businesses that more proactively measure food waste were more successful in planning and implementing actions to reduce it. In WRAP's own experience the measurement of businesses' own waste has been fundamental to the success of the three voluntary agreements with the food and drink industry in the UK (WRAP, 2016). Measurement is required to track progress towards any potential overall targets relating to the Frameworks for Action and to facilitate the evaluation of specific projects within them. Any targets set should be both achievable and measurable.

A two staged model of measurement is therefore proposed for each of the four FAs:

- Each business involved in the Framework should measure and report their own operational waste (regardless of whether the framework sets a target related to the business waste).
- Each pilot project within the Frameworks (some of which might be targeting food waste outside the direct operation of the business signatory, i.e. household or supply chain) should, by design, include monitoring and evaluation.

The Frameworks will be evaluated based on, as much as possible, the success of the measurement of the businesses' own operational waste, and the measured success of the individual projects, complemented by more qualitative indicators.

Figure 1: Overview of measurements and evaluation of each FA



This document is to help lead organisations responsible for Frameworks for Action to set baselines and work with business participants to measure and report their food waste data. It focuses on giving guidance for the measuring and reporting of business's own operational food waste. This is a first step in establishing a baseline and is also applicable to subsequent years. In fact, the design and undertaking of the baseline measurement should allow close repetition for valid comparison.

This document also outlines options for the measurements that will accompany individual projects, although more detailed guidance will be possible once the scope of the projects is clarified. While developing projects, partners should consider and describe how these projects could be measured and evaluated.

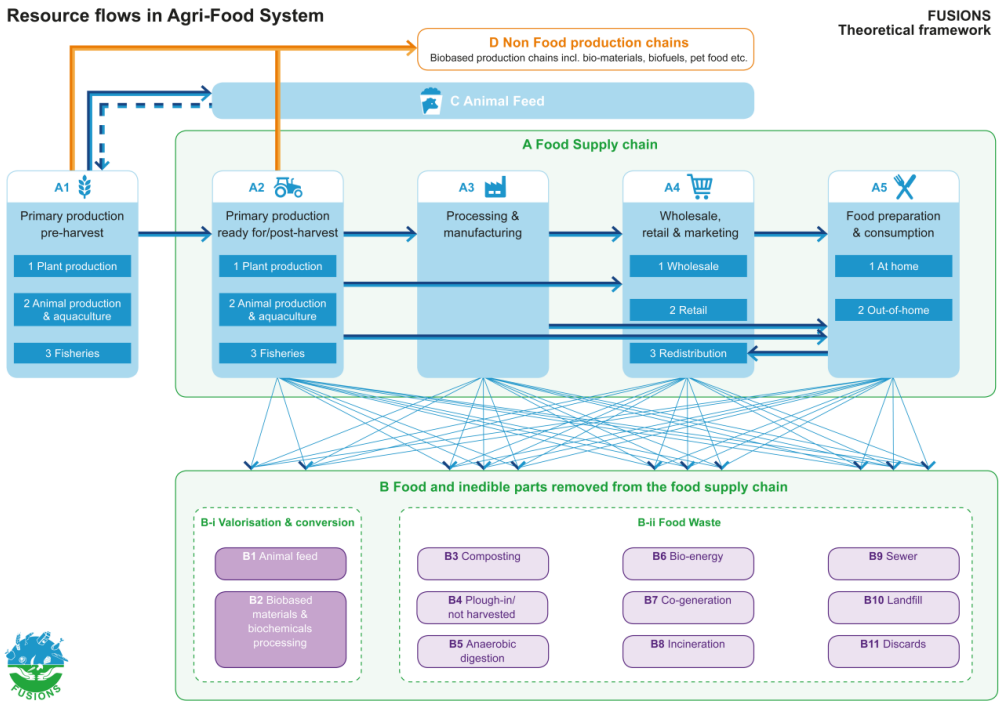
3 Food waste definition

In REFRESH Frameworks for Action we will be following the EU Circular economy package (Proposal for a Directive, COM/2014/0397 final, 2014) / FUSIONS definitional framework definition (FUSIONS, 2015):

> *"food waste means food (including inedible parts) lost from the food supply chain, not including food diverted to material uses such as bio-based products, animal feed, or sent for redistribution".*
>
> *"Food waste is any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composed, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea)".*

FUSIONS have produced a graphic which helps clarifying on what counts (and what does not) towards food waste.

Figure 2: FUSIONS food waste definitional framework illustration



Source: FUSIONS Definitional Framework for Food Waste (2014)

In WRAP's own experience it has been useful to quantify, in addition to food waste arisings, **surplus food** (that being donated to charities for redistribution or diverted to animal feed), **by-products** and **by-product waste**, particularly at the manufacturing stage. This refers to food-related products that might have a value on the market (for example, animal skins, spent grains, brewer's yeast). This potential value may or may not be fully realised.

The definition of 'food waste' is not commonly understood, and not uniquely agreed even amongst experts, and can mean a whole range of things to businesses or householders. The importance of this, and the difficulty of conveying these important concepts, should not be underestimated. It will likely be exacerbated when working across different languages. Confusions arise if material intended to be eaten is instead used for other purposes (such as animal feed, pet food, composting), and whether inedible parts associated with food also count towards food waste.

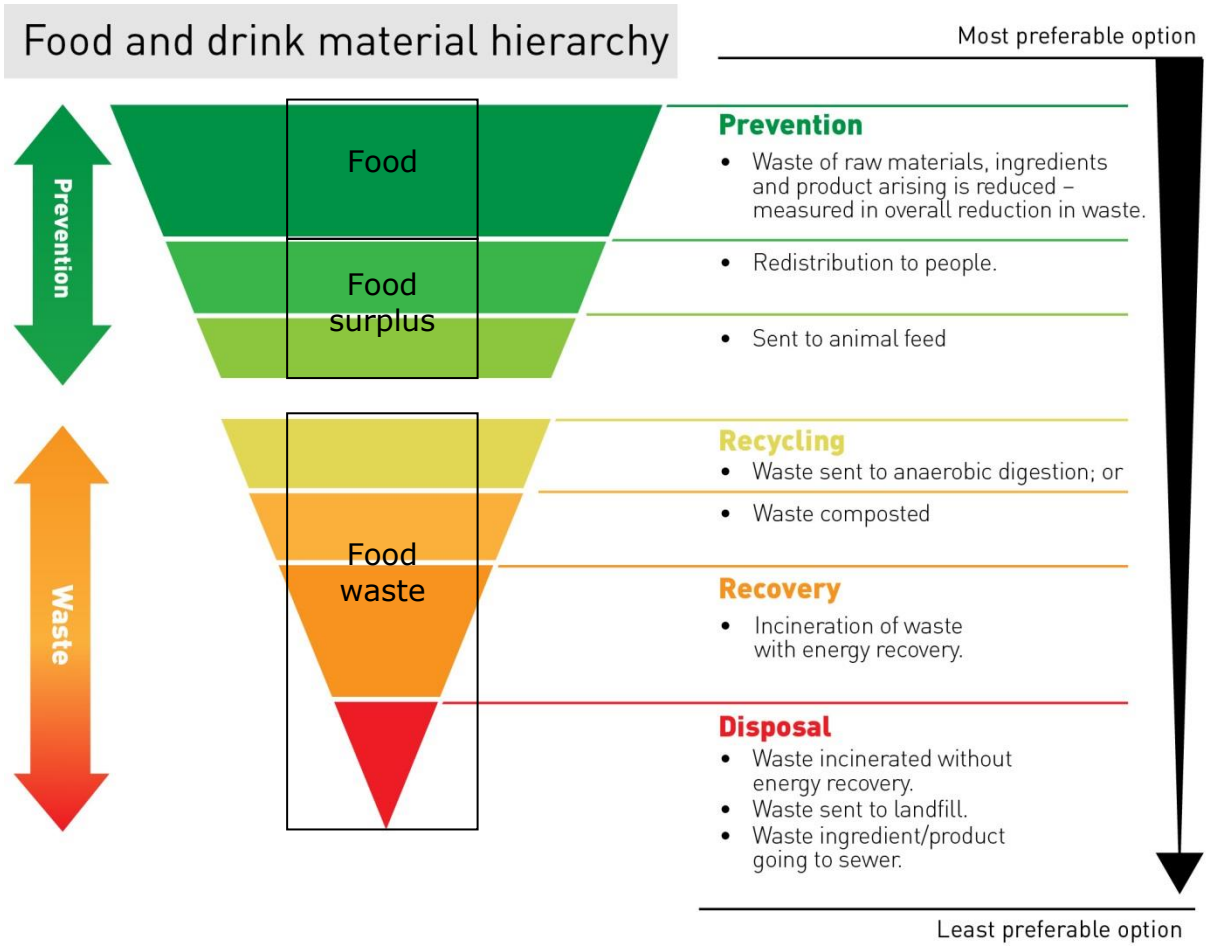
It is important that the definition of food waste as in the FUSIONS definitional framework is clear, and that the working definition of food waste is agreed and understood by all stakeholders. In the business sector there are many different working definitions of 'food waste', including waste that relates to lost income from down-graded product (not a physical waste). Businesses can record food waste in their local context, but in such a way that they are able to map it back onto the FUSIONS definition. For example, they can count all down-graded product as waste in their own books, but also log how much of that down-graded product was used for redistribution, how much for animal feed, and how much was sent for waste management (e.g. anaerobic digestion, composting or landfill).

4 Basic steps in measuring food waste

We advise using the same measurement framework as proposed in the WRI FLW Standard (Figure 4).

The first step is to **define the goal**. The principal goal of REFRESH is to reduce food waste, but there could be other goals, for example to reduce financial losses or increase awareness. In addition to reducing food waste, the additional goals are to reduce surplus food (down-graded food sent to animal feed and redistribution). Overall the idea is to move the material up the food waste hierarchy (Figure 3) as much as possible.

Figure 3: WRAP Food and Drink Material Hierarchy



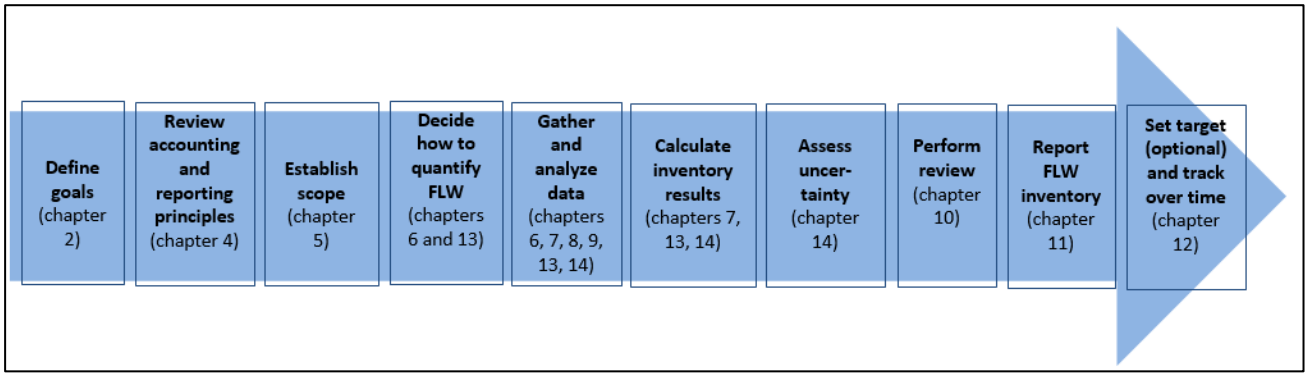
Source: WRI FLW Standard (2016)

Measuring helps demonstrate how SDG 12.3 might be achieved if innovative pilot activities were scaled-up. The measurements undertaken in the pilots can potentially also contribute to national food waste studies. Lead organisations should discuss these goals with their steering boards, and define goals related to each project.

The next step is to **review** accounting and reporting principles (WRI *Standard* promotes five accounting principles: relevance, completeness, consistency, transparency and accuracy).

The next two large steps are to decide **what** to measure (scope), and **how** to measure (methodology). The remainder on the chapter focuses on those two steps.

Figure 4: Overview of steps in FW accounting and reporting



Source: WRI FLW Standard (2016)

4.1 What to measure?

Food waste is defined as edible and inedible material associated with food exiting the food supply chain. As a minimum, the combined amount of wasted edible food and associated inedible parts[1] should be measured. It is recommended that furthermore, edible and inedible parts are measured separately, or estimated within the total arisings. All food and drink categories and geographies that the business handles should be included, or exceptions noted. If sampling procedures are employed, it is important to note what they are. Random sampling is recommended.

Another important aspect is not to include material surrounding food waste (e.g. packaging, water that is used to dilute food waste) in the food waste figures.

A good way to ensure that the scope for the FAs measurement (**what** to measure) is fully considered and clearly documented, is to follow the FLW *Standard* reporting requirements, namely:

1 Timeframe (inventory time period)

[1] WRI FLW *Standard* talks about "food removed from the food supply chain" as well as "associated inedible parts" removed (e.g. banana peel), but under the EU FUSIONS (FUSIONS, 2016) food definition, both of those streams are defined as simply food waste.

2 Material type (does it refer to all food waste; does it include solid or also liquid waste[2])

3 Destinations (where it's gone: landfill, animal feed, anaerobic digestion (AD), etc.) – see below;

4 Boundaries:

a. Food category - specific food(s) being measured e.g. bread (applying Codex GSFA)
b. Life-cycle stage - how many and which industry (ISIC code) and/or life-cycle stage
c. Geography - geographic borders
d. Organization - unit(s) about which information is being reported

We recommend that if at all practical, the lead partners collect information on the destination of food waste and also surplus food (e.g. re-distributed surplus food or surplus food designated for animal feed.) See the Table 1 below for the possible destinations, and how they map onto destinations as defined in FLW *Standard* and FUSIONS Manual; but destinations can also be recorded in simpler, combined categories. This is important as the objective of REFRESH is to move as much material as possible up the waste hierarchy – for example, surplus food destined as animal feed may not be classified as food waste, but it would still be preferable if it was used for its original purpose – to feed people.

Table 1: Possible food waste and food surplus destinations

DESTINATION	FLW Standard category	FUSIONS Manual category	DEFINITION
Re-distribution or re-use for human consumption	Not in scope	Not in scope	Redistributed to food banks or other charitable organisations, or, for example to make soup of rejected tomatoes.
Animal feed	Animal feed	B1	Used directly by farmers or processed to feed domestic animals.
High-value materials and chemicals	Bio-based materials and biochemical processing	B2	Conversion to industrial products. Examples include creating fibres for packaging material, bioplastics including PLA, or rendering fat, oil and grease into a raw material to make soaps, or cosmetics.
Ethanol fermentation	Ethanol fermentation	B6	A biological process in which carbohydrates (such as glucose, fructose, and sucrose) are converted into cellular energy and thereby produce ethanol and metabolic waste products.
Anaerobic digestion	Codigestion / anaerobic	B5	A process where bacteria break down biodegradable matter in the absence of

[2] *In our experience, reporting of liquid waste can be troublesome for businesses, and is only really significant in the sectors such as dairy and drinks manufacturing.*

	digestion		oxygen. This generates biogas and nutrient-rich matter. Co-digestion refers to the simultaneous anaerobic digestion of multiple organic wastes in one digester.
Production of other bio-energy fuels	Bio-based materials and biochemical processing	B6	Production of energy using resources other than biogas/methane or bioethanol, including biodiesel as well as gasification / pyrolysis processes.
Composting	Composting / Aerobic digestion	B3	The natural biological degradation and purification process in which bacteria that thrive in oxygen-rich environments break down and digest biodegradable material. Composting refers to the production of organic material that can be used as soil amendment.
Not harvested / Plough-in	Not harvested / Plough-in	B4	Unharvested crops left in field or tilled under
Land application	Land application	B4	The spreading, spraying, injection, or incorporation of biosolids (e.g., treated sludge from manufacturing sites) including derived materials, onto or below the surface of the land to take advantage of the soil enhancing qualities of the bio-solids.
Incineration and Cogeneration	Incineration	B7 and B8	The combustion of solid and liquid waste in controlled incineration facilities. This would include for example, fuel for a boiler that produces process steam, i.e., steam used for heat and moisture rather than for power.
Sewer	Sewer / wastewater treatment plant	B9	Down the sewer, with or without processing or treatment first. Sewer may go to an advanced wastewater treatment plant or be discharged without processing.
Landfill	Landfill	B10	An area of land or an excavated site that is specifically designed and built to receive wastes.
Open burn	Open burn	B11	Burning in the open without a chimney or a stack
Refuse / discarded or dumped to land or sea	Refuse / discarded or dumped to land or sea	B11	Refers to abandonment on land or sea. This includes open dumps (e.g., uncovered or unlined) as well as fish discards, which are the portion of total catch which is thrown away.

Source: adapted from WRI FLW Standard (2016)

Table 2 summaries the scope of measurement and reporting for business operational food waste for REFRESH FAs. The scope of measurement for individual pilots will depend on the pilots themselves, and agreed after they have been selected.

Table 2: Scope of business own food waste measurement

REQUIRED	RECOMENDED	NICE TO HAVE
• Food waste measured separately from other waste (in tonnes, measured over a course of a year) • Quantification of surplus food going to redistribution and animal feed (separately)	• Disaggregation by food waste destinations • Edible (avoidable, what could have been eaten) vs. inedible (e.g. peels) food waste • Quantification of by-product waste	• Disaggregation by product category • Disaggregation by reason • Disaggregation in time and space

4.2 How to measure – an overview of quantification methods

The FLW *Standard* also provides useful points to consider for defining **how** to measure food waste:

1. Quantification methods used
2. Sampling used
3. Representativeness of sample to population (if applicable)
4. Scaling used (if applicable)
5. Conversion factors (if applicable)
6. Normalization factors (optional)
7. Uncertainty estimate for results, including sampling uncertainty (if known)
8. Review process or quality assurance

4.2.1 Quantification methods

Food waste quantification is a very practically based problem where local circumstances and adaptation of current measurement practices need to be taken into account.

As guidance, Table 3 shows an overview of quantification methods drawing from both the WRI *FLW Standard* and the FUSIONS Manual. It signposts both documents for more detailed descriptions. Before deciding on a method, it is worthwhile to get acquainted with all of them. We present an overview below, but it is recommended to read relevant sector chapters in the FUSIONS Manual or in the Guidance on FLW Quantification Methods (a part of the *FLW Standard*).

Table 3: The main methods for measuring food waste, and signposts to the respective chapters of the Guidance on FLW Quantification Methods (Supplement to the FLW Standard) and FUSIONS Manual

Method		FLW Guidance chapter	FUSIONS chapter
Use of records	Records (such as waste transfer receipts) can be used to quantify the amount of FLW if they are of sufficient quality. The business choosing to report in this way should understand how the records have been created since some methods result in more accurate quantification.	5	
Direct weighing	Involves using a measuring device to determine the weight of food waste. It is the most commonly used method to measure food waste, sometimes in combination with other techniques such as waste composition analysis.	1	7.5.1 8.5.1
Scanning / Counting	Assessing the number of items that make up food waste and using the result to determine the weight. Useful when whole items are discarded. Usually a conversion from fanatical value (eur) or SKU to weight is also required.	2	7.5.2 8.5.2
Volumetric assessment	Assessing the volume that food waste takes up, and combining that information with density factors to determine the weight. Usually used for liquid material, but can also be used for solid and semi-solid material. It may be more practical than using weighing, but can introduce inaccuracies through the use of incorrect density factors.	3	
Waste composition analysis	Physically separating food waste in order to determine the weight. Commonly used to separate food waste from a waste stream that includes other material which is not food waste (e.g. packaging). It may also be used to understand the different components that make up food waste (e.g. edible vs. inedible food waste, food types). It provides an opportunity to collect very detailed and useful information about food waste, but is generally expensive and organisationally difficult. A composition analysis might be done on a sample of waste, and then applied to the total waste stream determined by other methods. Consent might be needed if the producer of food waste (e.g. households) and the entity measuring the waste are not one and the same. This can also influence results, for example high wasters may be less inclined to give consent.	4	7.5.1

Mass balance	An organisation measures inputs (e.g. ingredients) and outputs (e.g. products made) and uses a mass-balance method to infer food waste. Account is taken of changes in stocks and due to processing (e.g. evaporation of water during cooking). In theory this can be a cheap and reliable way of determining waste, but in practice, it is often obscured by the developments not entirely clear or known to the inventory-maker, for example, stolen items or evaporation.	8	7.5.3
Models	Mathematical, statistical or computed.	9	
Use of proxy data	We can employ calculations via proxy, when direct measurement of food waste, or specific attribute of interests, are not possible, but we have information about those from a similar entity or another waste stream.	10	
Diaries	An individual or a group keeping a record of information on a regular basis. Often used when the entity gathering data is not in control of the waste stream (e.g. waste generated by other actors in the chain). Also useful to understand the behaviours linked to amounts and types of food. A large disadvantage is the issue of under-reporting. They are most commonly used to measure food waste in households and commercial kitchens. Recording in the diary is only a form of data capture. However, it also needs a form of measuring (such as weighing). The most successful applications encourage the food waste to be recorded in 'real time', to avoid the issues of faulty recall. The use of diaries tends to be expensive due to large required sample size and drop-outs.	6	8.5.3
Surveys	Gathering information from a large number of individuals or entities on attitudes, beliefs, and self-reported behaviours through a set of structured questions. Also used when the entity gathering data is not in control of the waste stream. Relying on recall is prone to error and as such, the uncertainty associated with this data should be clearly explained. Generally surveys are not reliable enough to produce quantification of waste, but can be used to gather insights about the attitudes, values and behaviours associated with specific amounts and types of food waste.	7	

Quantification methods best suited for quantification in manufacturing

Most large manufacturers and retailers should first look at their waste collection arrangements. Some might already have an arrangement in place that charges them according to actual weight of waste collected. If food waste is also collected

separately and the amount of food waste in mixed waste is negligible, then businesses could base their reporting on waste collection receipts without much extra work.

More often however, businesses might be charged a flat seasonal rate, or be charged based on the number of collections or the number of bins collected. The weight could be approximated from the latter, but it is recommended that businesses negotiate with their waste collection company to be charged by actual weight at next opportunity.

Another possibility is that waste collections are weighed or otherwise measured, but food waste is not collected separately and is instead a part of the mixed waste. In this case a solution might be to undertake a waste compositional analysis on a small, but representative sample of waste to determine the share of food waste in the mixed waste stream. In either of these cases, waste collection arrangements are a good place to start.

Note that the cost of food waste is larger than just the cost of its disposal, as it also embodies forgone income, or unrecovered materials, labour and energy. Businesses may be interested in measuring and then reducing this 'true cost' of food waste.

For the latest quantification of food surplus, waste and related materials in the supply chain (WRAP, 2016), WRAP used a combination of waste registry collected by the UK environment agency, and site visits to arrive at a food waste estimate for Manufacturing

Quantification methods best suited for quantification in retail

For the retail sector, the recommended approach is based on food waste collection at store level, derived from stock-keeping/book keeping reporting systems linked to on-site product scanning systems. Food waste estimates are derived from standard product weights held for each stock-keeping unit. The other benefit is that these stock-keeping systems allow for a direct estimate of the true financial cost of food waste.

Tesco (a UK supermarket chain) offer an insight in how they quantified food waste in their operations on their website.

Quantification methods best suited for quantification in retail

For the hospitality sector weighing is recommended as the best method if the collection company does not weigh the waste they collect (for example, bins can be weighed before they are put out for collection). In some circumstances scanning or diary based methods are also possible. Smart bins have previously been successfully deployed in the food service sector as a device to record the amounts and types of food waste.

For smaller shops and restaurants, we recommend the registration of all waste from the waste management company and conducting a waste compositional analysis to determine waste composition.

4.2.2 Data analysis

In addition to using a quantification method, FAs should also consider other data analysis steps:

1 Mapping

The data collected through the FAs has a great potential to be used as inputs to national food waste quantification studies (e.g. to provide new food waste statistics for retail in Germany). If we are to use the REFRESH data for this purposes it is recommended that a **mapping** exercise of the sector is conducted before the quantification. In this mapping exercise the overall structure of the sector is analysed. This includes a degree of market concentration (for example, in Germany, the Top-5 retailers jointly exceed 60% of market share), the type of stores, types of retail (online vs traditional) and so on. A good understanding of the food and drink sector in the country is important for sampling and scaling.

2 Scaling

For example, it may be necessary to scale up information on the food waste to the country level from data that only covers a certain percentage of the market. This can be done by using market shares or sales as assumed scale factor. This assumption can be tested by analysing the data collected.

3 Normalisation

It may be useful to report food waste data compared to a relevant denominator, for example *per person*, or *per meal served* in a restaurant, etc. The best normalization factors (denominators) are meaningful for the intended audience, strongly correlated with the level of food waste, and have themselves good data reliability.

4 Identifying the degree of **uncertainty**

While impossible to completely remove uncertainty within the waste measurement, it is important that the uncertainty is identified, minimised as much as possible, and appropriately communicated.

More information on scaling, normalisation and treatment of uncertainty can be found in Part III of the FLW *Standard.* The FUSIONS Manual provides more information on conducting mapping processes in the corresponding sector chapters.

4.3 Establishing a baseline

Once the data on food waste from individual businesses is collected by the partner leading the Frameworks for Action for the first year (=base year), these can be added together to set a baseline for the Framework, or, if covering enough of the market share, for the whole sector.

The baselines for individual pilots will be comprised of the measurements before the implementation of the pilot intervention (these will typically take less than a

year – depending on the variability of the process line and sample size of households).

By setting targets in the pilot activity and measuring progress, FAs can predict the overall impact if activities were scaled up – leading to this being a useful tool for measuring progress against UN Sustainable Development Goal 12.3.

5 How to use the WRI Food Loss and Waste Standard and the FUSIONS Food Waste Quantification Manual

Two recently published sets of guidelines aim to help entities (governments, businesses, research organisations) that are seeking to measure food waste:

- The WRI Food Loss and Waste *Standard* (FLW Standard in short)
- FUSIONS Food Waste Quantification Manual (FUSIONS Manual in short)

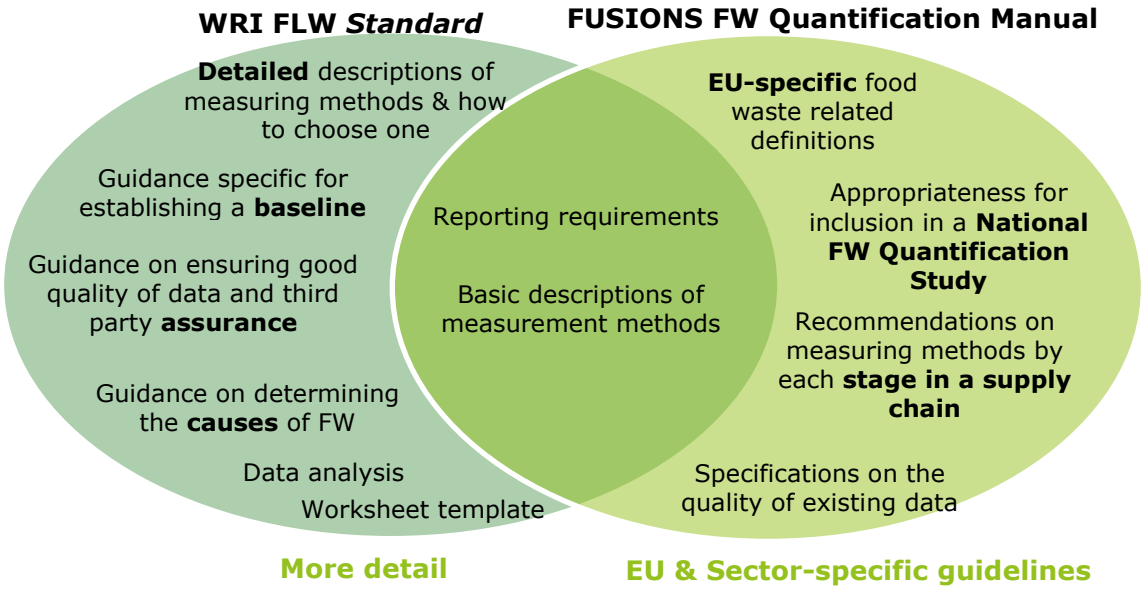
Both of these sets of guideline documents include information on methodologies and establish a framework for common reporting. Each was the result of a multi-year consultation of stakeholders with experience in measuring food waste. The two guidelines are generally harmonised, so adhering to one should automatically satisfy the requirements of the other; however the FUSIONS FW Quantification Manual uses EU-specific definitions of food waste and by-product, whereas the WRI FLW *Standard* is flexible in terms of which definition one uses.

The FUSIONS Food Waste Quantification Manual focuses on providing guidelines on measuring food waste and reporting it at the national level and eventually to the European Commission. It is therefore aimed at national bodies responsible for FW (e.g. Environment Ministries or Agencies), but also anyone who will collect the data at sectoral level to contribute to the National FW Quantification Study.

The WRI Food Loss and Waste Standard (or short FLW standard) aims to be an internationally /globally accepted accounting and reporting standard. It provides a step-by-step framework on how to quantify food loss and waste, and gives very detailed descriptions of methods. It does not specify definitions or measurements to use, but does specify what needs to be reported.

There is an overlap between the two guidelines, but each also covers some specific elements the other does not include (illustrated in the Venn Diagram of Figure 5).

Figure 5: Diagram showing commonalities and differences between FLW Standard and FUSIONS Manual



It is recommended to first read the introductory chapters and the relevant supply chain stage chapters of the FUSIONS Manual, and follow up with more detailed description of the methods and associated procedures (using records, sampling, analysis) in the FLW *Standard*.

The introductory chapters (1-4) of FUSIONS Manual describe core requirements for the data collected. For any businesses seeking to measure FW, section 4.3 (*General approach for sectorial quantifications*) provides a useful step-by-step plan. The manual provides specific recommendations for each stage in a supply chain (e.g. for primary production, manufacturing, etc.). Food processing and manufacturing sector is covered in Chapter 6, retail in covered in Chapter 7, and food service in Chapter 8.

The FLW *Standard* can be used to supplement these guidelines with more detailed descriptions of methods and the whole process of collecting data. The descriptions of measuring methods sit in a separate Guidance document, and guidance on how to select the measuring method in Chapter 7, are particularly useful for measuring the FW within FAs. These tally with those described in the FUSIONS manual, but go into more depth. For each of the methods described in the separate Guidance document of the *FLW Standard*, the following information is provided:

- Overview of the method
- Advantages and disadvantages
- Level of expertise required
- Cost

- Guidance on implementing the method

Other chapters of interest to establish the baseline for REFRESH FAs are:

- Chapter 5: Principles of FLW Accounting and Reporting
- Chapter 6: Establishing Scope
- Chapter 8: Data collection and calculation
- Chapter 12: Review and assurance
- Chapter 14: Setting Targets and Tracking Changes over Time

It should be noted that neither the FLW *Standard* nor the FUSIONS Manual specify which methods need to be used, but they do specify what needs to be disclosed and reported.

6 Measuring pilot results

In addition to the measuring and reporting of food waste by the participating businesses, food waste measurement will accompany each pilot project in the FAs.

In contrast to measuring of all of the food waste, these measurements should be more targeted to enable quantification of the particular change. For example, one pilot project could be about reducing waste from a specific product line. The business trialling this pilot should measure and report their business level at an aggregated level for the purposes of establishing the baseline for the whole FA, and in addition measure waste specifically from the production line where they are implementing a pilot – before and after the implementation of the pilot.

To assess the effectiveness of a pilot on a particular line a different approach to annual whole business food waste will be required. We recommend:

- Measuring food waste daily or weekly from the line in question prior to the intervention (if not already being done);
- Calculating the standard deviation of the amount of food waste arising from the above data and looking for any important patterns (e.g. seasonality, changes in how the line is operated, etc.)
- Determining how much sampling is required pre- and post-intervention to be able to estimate (with a given degree of confidence) the change in food waste (and best to underestimate this change for the purposes of these calculations). This may require the input of someone with statistical expertise.

Pilot projects could also target supply chain waste or household waste – areas outside direct control of the participating businesses. Waste should still be measured, ideally with direct methods, such as waste compositional analysis before and after, or in case the cost is prohibitive via questionnaires and diaries

(One of the tasks in REFRESH WP1 is to determine a cost-effective way to robustly quantify household food waste.).

Again, the scope should mention the intervention scope. If only a subset of households is given an intervention, the wastage of only those targets households needs to be assessed before and after intervention, not the whole population. However to assess this accurately, a control group that has not received the intervention should ideally be used to accurately assess the effect.

If the scope of intervention is, for example, to reduce the amount of bread people throw away by encouraging them to freeze it, the measurement should be specific to bread waste before and after the intervention. However, it should be done on a big enough sample, and over a long-enough period of time, and it should, ideally, include measurements of a control group (a group of households that are not targeted with the intervention, but are otherwise similar in all respects to the intervention group).

Box 1: Case Study on measuring household food waste

WRAP monitored an integrated campaign in West London during 2012/13. The monitoring involved pre- and post-campaign waste compositional analysis and surveys. Each waste compositional analysis measured waste over the course of two weeks, and they were completed 6 months apart.* The same households were targeted in each wave to allow a comparison of the same households. There was a reduction of 15% for total food waste. However, due to the presence of surveys, there is the possibility of a 'research effect' influencing the results – i.e. households being influenced by taking part in a questionnaire (twice). Small but significant changes in claimed behaviour were also seen, as measured through the 'behavioural scorecard' question. Sample size was 450 households for the waste compositional analysis.

*12 months apart would yield more robust evidence due to seasonal effects.

7 Ensuring data confidentiality and security

This chapter outlines the experience of WRAP with handling sensitive commercial data in the UK. It may help entities that are aiming to collect, analyse and report food waste data from businesses. Before sharing such information of voluntary basis, businesses are likely to want to be satisfied that their data will be handled confidentially. Rather than a protocol to follow, this chapter just outlines an example of how this was achieved for the UK food waste business reporting.

WRAP has been collecting data from the business signatories of their Frameworks for Action (such as Courtauld Commitment, and Hospitality and Food Service Agreement). This data is commercially sensitive and gaining the trust of businesses was crucial to ensuring that sufficient, transparent and robust data was reported.

This section outlines the security measures that are followed to ensure that strict confidentiality of company level data is maintained, while allowing data validation and analysis to better support the delivery of targets. This proved to be very important in gaining businesses' trust necessary for smooth reporting of often sensitive information.

With respect to data submitted, the data collector (in the case of Courtauld agreement, WRAP) has the following responsibilities to:

- keep all confidential data secure
- analyse and report the data as accurately and objectively as possible
- only report data that cannot be attributed to individual signatories

In the past, WRAP has used two systems of accepting the data. In the first two phases of the Courtauld Commitment, the data was sent to WRAP in the form of encrypted Excel spreadsheet (the spreadsheet form being pre-prepared by WRAP). In the third phase of the Courtauld Commitment an online portal was developed, which was seen as having improved security and user-friendliness; however, it is a costly solution not without its own problems; Therefore the encrypted spreadsheet is the recommended approach for the reporting in REFRESH Frameworks for Action.

Basic principles:

- Individual company data (for example, of one retailer) is never reported by WRAP, only aggregated data is shared
- Individual company data is password-protected and encrypted. Individual signatory data is shared only with the relevant signatory, a limited number of WRAP employees as necessary, and the contracted external auditor.
- Data is entered and submitted via an online reporting portal or by encrypted spreadsheet sent by email. Email attachments should be deleted as soon as data is securely stored in the secure folder structure.
- Data extracted from the portal or, submitted outside the portal, is stored on a secure section of the hard drive. Access to these folders is managed via IT permissions.

Table 4: Levels of data confidentiality

	What	Who	Basic rules	External access
Open access	Results and aggregate analysis for public consumption.	Public	No special rules.	Publicly available
L1	Reports and analysis of aggregate data (individual not identifiable)	All employees	Do not require passwords, can be shared via attachments, and can be stored on laptops and printed.	Shared at discretion

L2	Company data	Named employees	Require passwords, can only be shared via links, must be kept in secure folder structure and should not be printed.	Feedback to company.
L3	Final database and analysis (all data)	Quality Assurance analyst		External auditor.

For the data of levels L2 and L3, WRAP has adopted the security measures outlined below. These do not need to be followed exactly; other methods that give equivalent levels of reassurance can be used.

- Encrypting all files using freely available **encryption** (e.g. *Sophos Free Encryption*) and protected by passwords
- Keep all sensitive files (L 2 and 3) in a **secure folder structure**. The data must not be removed from the secure folders and must not be stored on a laptop or other mobile device.
- The passwords should be known only to those who require access. A handwritten record of the passwords is kept in a sealed envelope in the company safe. This is the only place the passwords may be written down.
- Files must only be shared via links to preserve the security restrictions of the folder structure.
- When encrypted files are sent via email for submission, the password should be sent via another communication channel e.g. phone. A voice, or text, message is acceptable.
- Data should not be printed.
- Presentations using the data (e.g. to report back to the signatory on progress) should be treated with same confidentiality as raw data that they are drawing from. If possible the signatory should provide their data summary at the meeting to avoid WRAP having to transport their data. If that is not possible, the signatory must agree in writing (email) that they are comfortable with their data being transported via laptop. The presentation should be encrypted, placed on the laptop at the latest practical moment, and securely deleted (using secure-delete function) as soon as possible after the presentation.
- Even when data are reviewed by an external person, it is done so within WRAP offices and via a WRAP computer. There should be no remote access. The password that the external auditor uses must be changed straight after use.

8 Other practical advice

This practical advice results from interviewing WRAP's staff on their experience in working with Courtauld signatories. While some of them re-iterate the advice that can be found in the published manuals, their practice-based, and less formal advice is worth highlighting on its own.

1 Clearly and carefully define what is to be measured and how, and stick to this

Any later changes will add to confusion and reduce the conclusions you can make. Even if measurement procedures in base-year are not ideal, they need to be carried forward unchanged. In other words, the results should not be skewed because companies get better at measuring.

Following form the above, it is particularly important for the measurement procedures to be well though through in the base year already, and that the scope is clearly defined. It is important to get it right in the first place.

2 Involve the businesses as soon as possible

It is best if they are able to highlight any issues they foresee, and explain how the logistics in their operations work.

3 Involve the right people from the businesses

The most appropriate people to report required data tend not to be from corporate and social responsibility departments, but instead from operations departments.

Consider also involving the waste collection companies, and encourage businesses to review their waste collection contracts with an aim to enable measurement by the waste collection companies of appropriate level of granularity.

4 Choose measurements that are relatively easy and implementable

It is better to have fewer data of good quality than an abundance of data of varying or unknown quality. For example, many businesses we worked with in the past had problems with measuring waste to sewage (experiences show best method to assess it is mass balance); but this is a significant disposal route only for a few sectors, for example, dairy and drinks.

5 Avoid using terms that might confuse businesses providing the data or allow ambiguity in respect to which category to use.

For example, avoid using the term 'mixed waste' if you are also asking for separate categories, as it can be ambiguous whether a particular material counts as one or the other.

Visit the company in the first year to check how they measure and what they measure, to ensure that they interpreted the questionnaire the way it was intended (particularly around the delineation between waste, by-products and products).

6 Analyse carefully

Keep in mind that businesses are dynamic, for example during the duration of the FA mergers, selling of a part of a company might have happened. For this purpose it is good to also collect some contextual data, for example total production or total sales. Structural changes, such as mergers, acquisitions, divestments, outsourcing and insourcing may require a recalculation of the baseline.

7 Explain the importance of gathering data

Provision of accurate and up-to-date data will improve reporting of progress to stakeholders in the Framework for Action. It will help us to test and demonstrate the value of the approach to the public and the regulators. It will provide businesses with benchmarking, which will help the sector as a whole in adopting best practices.

8 Provide clear guidelines and information to help business collecting the data

This can include: written guidelines to accompany the questionnaire, clear definitions, a running Q&A, support to the questionnaire in person.

9 Encourage data submission on time and sense-checked internally

Define clear deadlines, and give plenty lead time to signatories.

9 Existing data in the four pilot countries

Some data on household and supply chain food waste already exist in the four pilot countries. The country with the most advanced FW assessments is Germany, where estimates exist by each major step in the supply chain. At the other end of the scale, Hungary has almost no data on food waste. The Table below shows these existing data points. This data can help us identify relative scales of waste occurring in different stages in the supply chains.

Table 5 Data of food waste at different stages in the supply chain, in all four pilot countries.

Country	Supply chain	Retail			Households	References
Germany	14 kg per tonne of produce	9.3 kg/cap	Data quality good	71 kg/cap	Comprehensive study in 2010	Boku (2012)
Netherlands	No data	11 kg/cap	Data quality good	73 kg/cap	Comprehensive studies in 2010 and 2013	Ministry of Economic Affairs (2014)
Spain	No data	9.1 kg/cap in retail, 5.6 kg/cap in hosp.	Catalonia only	62 kg/cap	Less clarity on the scope and quality of the study. Separate data for Catalonia.	ARC - The waste Agency of Catalonia (2012) HISPA COOP (2012)
Hungary	No data					

The Country Reports published as a part of the FUSIONS project (2015) also offer good sources of information on the data and policies in each of the four pilot countries.

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11 Annex: Questionnaire developed for collecting business food waste data in REFRESH

REFRESH business food waste measurement questionnaire

Key:

	required data entry
	Optional (recommended) data entry

All data refers to the total for the calendar year January-December 2016

Name of the business	
Name of person completing this document	
Contact (phone number, email)	
Date of submission	

Part I:Quantitive data

Contextual information	Units	Data 2016
Turnover of the business for the calendar year	€	
Total retail sales volume in tonnes of product	Tonnes	
Total waste of all materials (food waste, packaging waste and other wastes combined)	Tonnes	
Disposal cost of handling all materials waste	€	
Disposal cost of handling food waste	€	

Food Surplus data

Food surplus is any food, and inedible parts of food that are not sold as primarily intended, but are nonetheless used *to feed humans or livestock, or are used in high-value industrial purposes (e.g. bio-plastics).*

Food surplus/reject donated to charity for redistribution or sold on secondary markets	Tonnes	
Food surplus/reject sent to animal feed	Tonnes	
Food surplus/reject sent for input to food or non-food industrial processes	Tonnes	

Food Waste data

Food waste is any food, and inedible parts of food, removed from the food supply chain to be send for disposal *(including anaerobic digestion, composting, bio-energy production, co-generation, incineration, crops ploughed in/not harvested, disposal to sewer, landfill or discarded to sea)*

Please specify the quantity of food waste converted to tonnes	Tonnes	

Food Waste breakdown (optional)

By destination

In reference to FLW Protocol, please outline the split of food waste by different destinations / treatment options:

Anaerobic digestion	Tonnes	
Composting	Tonnes	
Land spreading	Tonnes	
Rendering	Tonnes	
Thermal treatment with energy recovery	Tonnes	
Thermal treatment without energy recovery	Tonnes	
Landfill	Tonnes	
Other waste management technology	Tonnes	
TOTAL	Tonnes	**0**

By avoidability / edibility

In reference to FLW Protocol, please outline the split of food waste between food and associated inedible parts such as peels and bones:

The part that would have been edible	Tonnes	
Associated inedible parts	Tonnes	
TOTAL	Tonnes	**0**

By food category

Please fill according to any break-out you have, and copy lines if more needed

e.g. bakery	Tonnes	
e.g. dairy	Tonnes	
^Add more lines if necessary.	Tonnes	
TOTAL	Tonnes	**0**

Check to confirm the following:

Packaging and any other non-Food waste material have been EXCLUDED from inventory results.	☐
Inventory results reflect the state in which the FLW was generated (i.e., before water is added or before intrinsic water weight of FLW is removed).	☐
Pre-harvest losses have been EXCLUDED from inventory results.	☐

Part II: Important contextual information

Approach to measuring food waste and food surplus

Please, describe how you have measured/estimated your food waste for this submission. E.g. have your done some measurements? Have you estimated it from waste collection cost? etc. Specially indicate if you have encountered any problems or made any assumptions and how you are planning to address this next year (or if you need help addressing those problems).

Approach to reducing food waste and food surplus

Are you currently running any initiatives to reduce food waste from your own operations, supply chains or your customers?

Were you running any initiatives to reduce food waste from your own operations, supply chains or your customers between Jan-Dec 2016?

If yes, please briefly describe them. Have you measured any associated savings?

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