FOOD WASTE AND FOOD LOSSES: PREVENTION AND VALORISATION

Monitoring Flanders 2015

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SUMMARY

The agri-food chain is the concatenated set of economic actors that produce, process, distribute and prepare our food. The consumer completes the chain. In addition to food supply, the agri-food chain also makes an important contribution to the Flemish economy. In terms of resource efficiency, the Flemish agri-food chain is one of the best in Europe. The chain invests heavily in limiting losses and avoiding waste. Where prevention is not possible, the approach is based on valorisation in accordance with the food waste cascade. The agri-food chain, traditionally closing natural cycles, is an example of circular economy *avant la lettre*.

Despite the care with which professionals from the chain as well as consumers deal with food, food losses may still occur. This involves food that, in the present circumstances, has not reached the intended sales channel for human food. These 'human food losses' can still be valorised into animal feed, material and/or energy applications. From a shared vision, the Flemish chain and government want to valorise food commodities as much as possible. This offers significant opportunities on an economic, innovative, environmental and social level. The Ketenroadmap Voedselverlies (Food Supply Chain Roadmap on Food Loss) is a Flemish public-private partnership that aims to reduce food losses by 15% by 2020 relative to the present baseline measurement. The food waste cascade is the guide. The cascade ensures that material flows are used effectively and the environmental impact remains limited. Preventing food loss at the source is paramount, followed by the social re-purposing of food surpluses. After prevention comes valorisation of food waste: as animal feed, material and/or energy.

This monitoring is the result of a transparent public-private partnership and offers an insight into the efficiency with which the agri-food chain deals with food commodities in 2015. The measurement method is aligned with the European state of the art in relation to monitoring. A specific theoretical framework has been developed for monitoring. If a commodity or a product is designated for human food consumption, we refer to this as a food commodity or food product (e.g. banana, cow, sugar beet). A food commodity or food product consists of an edible fraction (=food) (e.g. flesh of the banana, meat, sugar) and an inedible fraction (=residues) (e.g. skin, bones, beet pulp). When food is consumed by people (=food consumption), it has achieved its final purpose. If food is not consumed by people, we refer to this as food loss. Food losses and residues together form food waste.

Caution is required when interpreting the results. It is an initial measurement that is open to improvement. Because of the complexity of the subject matter and the limited availability of data, the monitoring contains assumptions and uncertainties. Despite these limitations, these are currently the best available figures on the subject.

The agri-food chain makes priority efforts to prevent food losses (prevention). The many efforts to prevent food loss at the source and reprocess surpluses into new food products are not covered by this report.

Dealing socially with food surpluses is equally a fully-fledged strategy for preventing food loss because the food is used for human consumption. In 2015, a total of around 16,400 tonnes of surplus food was given a social purpose in Flanders. This involves the total of identified food surpluses given a social purpose in the sectors of auctions (1,477 tonnes), food industry (12,599 tonnes) and retail (2,356 tonnes). This is an under-estimate. Furthermore, no figures are available for primary production (agriculture and fisheries) and food services (hospitality sector and catering).

In the Flemish agri-food chain, from harvest to consumption, an estimated 3,485,000 tonnes of food waste were released in 2015. This is the total of the (edible) food losses and the (inedible, unavoidable) residues.

92% of all food waste is valorised. The largest proportion is valorised as animal feed (43% of all food waste), automatically the highest possible valorisation on the food waste cascade. Anaerobic digestion as a destination accounts for 21% of the food waste. The destination of soil accounts for 17% of the food waste. The cascade index weighs the food waste according to its position on the food waste cascade and is expressed as a figure between 10 (maximum valorisation) and 0 (no valorisation). The cascade index of the Flemish agri-food chain in total is 8.2. This shows that the Flemish agri-food chain is strong when it comes to the valorisation of food waste.

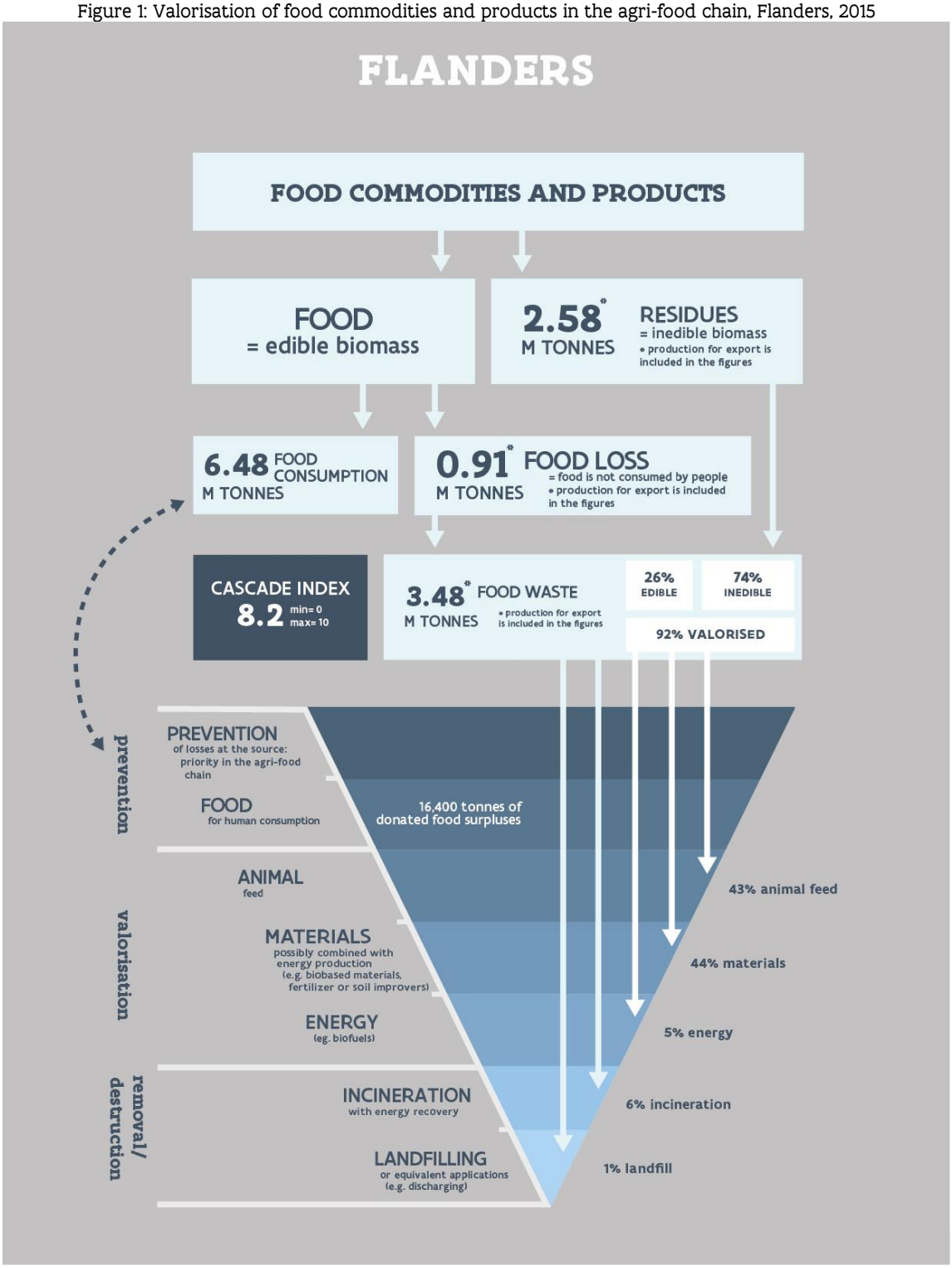
Within the food waste, a distinction can be made between the edible (food losses) and the inedible fraction (residues). Three quarters (74%) of food waste are residues. Just one quarter (26%) of food waste in 2015 is food losses. Expressed in absolute figures, this equates to 2,578,000 tonnes of residues and 907,000 tonnes of food losses across the entire chain.

In the links that involve a lot of processing of raw materials into finished products (mainly industry, but also hospitality sector), the food waste consists largely of inedible food waste (residues), and less of edible food waste (food losses). In the other links of the chain, the fraction of inedible food waste is smaller. This is because there is little to no processing (agriculture) or because the focus lies on distribution (auctions and retail) or because prepared products are mainly used (catering). In fisheries and households, the percentage of inedible food waste is approximately the same as the percentage of edible food waste.

The links of agriculture, food industry and households together account for 84% of food losses. This is closely linked to the high production volume of the food industry and agriculture (significant portion intended for export), as well as the 'natural' production conditions in agriculture. As the only link in the chain, the farmer is directly dependent on 'natural' production conditions (such as e.g. the climate) over which he has no control. These conditions can have a major impact on e.g. harvesting, sorting and storage losses and can also have repercussions for quality further down the chain.

In proportion to total production and consumption, food loss in agriculture, the food industry and households is relatively low. In relation to total production, food loss in the food industry is 1.5%, and 4% in agriculture. In households, food loss in relation to total food consumption is 5.9%. This proportion is also limited in the other links in the chain.

Figure 1: Valorisation of food commodities and products in the agri-food chain, Flanders, 2015



Food waste cascade as included in the OVAM Action Plan for the Sustainable Management of (Residual) Biomass Streams 2015-2020 (approved by FG 10/7/15), layout: Department of the Environment & Spatial Development

1 FRAMEWORK AND OBJECTIVE OF THE MONITOR

1.1 THE FLEMISH AGRI-FOOD CHAIN: DRIVING FORCE BEHIND THE CIRCULAR ECONOMY

The agri-food chain is the concatenated set of economic actors that produce, process, distribute and prepare our food. In addition to food supply, the agri-food chain also makes an important contribution to the Flemish (and European) economy. Flanders is a genuine food region. Flanders' Agrofood Valley has high-performing agricultural production and the food industry is the most important industrial sector (in terms of e.g. turnover and employment) in Flanders. The export of agri-food products contributes significantly to the balance of trade. Retail ensures that the food is distributed to the consumer efficiently and through various channels. The hospitality sector plays a key role in the local economic fabric, but also in Flemish culinary culture. Catering is a strongly expanding and innovative sector.

The consumer completes the chain. Flanders has around six million consumers who like to eat well, but at the same time are becoming more aware of their food in terms of health and sustainability. From the demand side, every day the sectors are encouraged to keep innovating. A detailed description of the Flemish agri-food chain as well as food consumption in Flanders can be found in the report 'Food for thought - Agriculture and Fisheries Report 2016' (Platteau et al., 2016 & 2017). In the remainder of the text, whenever we refer to the agri-food chain or the chain, this includes the link of the consumer.

Farmers, food companies, retailers, caterers and hospitality businesses use their raw materials as efficiently as possible. From an economic rationale, but also in line with their approach to sustainability. In terms of resource efficiency, the Flemish agri-food chain is one of the best in Europe. The fact that we score strongly here is the joint result of sustained efforts by the sectors, the government, civil society and citizens.

The chain invests heavily in avoiding losses and limiting waste. Where losses cannot be avoided or waste nevertheless occurs, an attempt is always made to valorise these to the highest possible standards according to the food waste cascade (discussed at length in title 0). This contributes significantly to the closure of circuits, a key principle within sustainable materials management (Strategic Advisory Board for Agriculture and Fisheries, 2012). The closure of circuits, often a collaboration between sectors, is something in which the agri-food chain has traditionally been involved. Thus, for example, the agriculture sector is responsible for the high-quality valorisation of vegetable waste flows from the food industry in the form of livestock feed or soil improver. The agri-food chain is therefore an example of circular economy *avant la lettre* (Van Buggenhout et al., 2016).

Despite the care with which professionals from the chain as well as consumers deal with food, food losses may still occur. This involves food that, in the present circumstances, could not be used in the intended sales channel (human food). These are 'human food losses', which in most cases can still be valorised in some other way.

The shared vision of the Flemish chain and government is that we want to avoid food losses and valorise food waste as much as possible. There is a growing awareness that this offers significant opportunities on an economic, innovative, environmental and social level. This vision creates a positive dynamic, one in which we discover opportunities to make the Flemish agri-food chain even more economically efficient, more innovative and more sustainable. Consumers are also paying more and more attention to the prevention of food loss for financial, ethical or environmental reasons. Citizens are adapting their purchasing, storage and cooking habits. Businesses and consumers are raising awareness between themselves and inspiring each other to take care of food as much as possible.

In the first place, this monitor shows the strengths of the Flemish agri-food chain. It then indicates where efficiency gains can still be made. The monitor underpins, enriches and guides the actions of the existing public-private partnership on food waste and food losses.

1.2 PUBLIC-PRIVATE PARTNERSHIP FOR THE PREVENTION AND HIGH-QUALITY VALORISATION OF FOOD WASTE

The optimum valorisation of food waste and the prevention of food loss has developed into a key objective. The United Nations (2017) have included the fight against food loss in their sustainable development goals (Sustainable Development Goal 12.3). The European Commission (2015) considers it a priority action area to make the European Economy Circular and the Flemish Government (2014a) is striving for a high-performing Flanders Agrofood Valley in which every effort is made to minimise food losses. Cooperation between government and chain and within that chain is being highlighted as a key success factor in achieving these objectives.

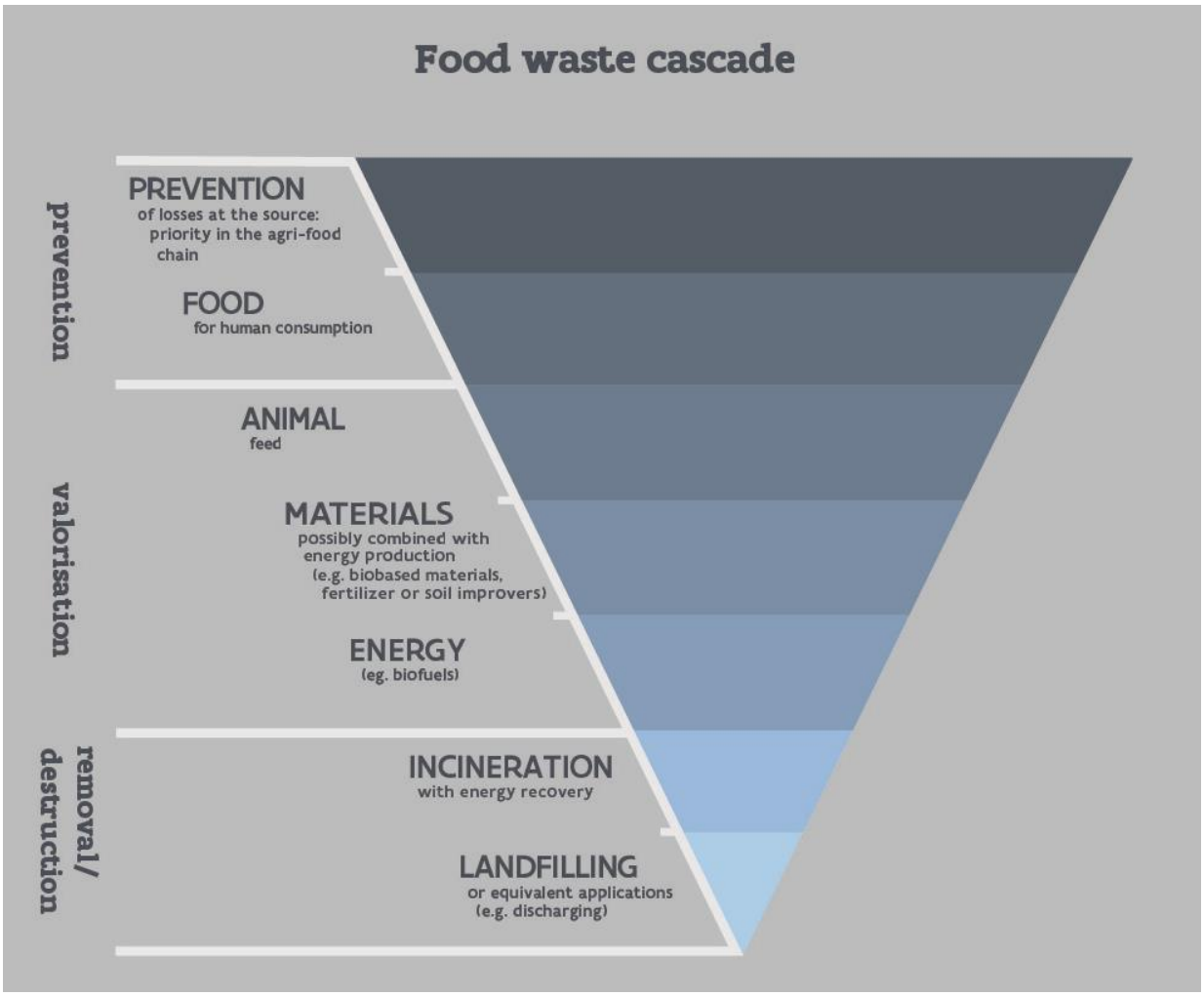
Early in 2014, the Flemish Government and partners from the Flemish agri-food chain expressed the desire jointly to take on a voluntary but ambitious commitment. In March 2014 this was made official with the signing of the declaration of commitment 'Samen tegen Voedselverlies' ('Together against Food Loss'), elaborated in the Vlaams Ketenplatform Voedselverlies ('Flemish Food Supply Chain Platform for Food Loss') (Flemish Government et al., 2014b). At the beginning of 2015 the Food supply chain roadmap followed with 9 targeted action programmes with concrete actions (Flemish Government et al., 2015). Validated by Minister Schauvliege and Minister Homans for the Flemish Government, the objective was set of jointly reducing food losses in Flanders by 15% by 2020 (and by 30% by 2025).

An overview of the achievements of this collaboration can be found in the publication "Ketenroadmap Voedselverlies: realisaties 2016" ("Food supply chain roadmap on Food loss: achievements 2016"). The associated portfolio describes ten clear example initiatives. Both documents can be found on the website http://www.voedselverlies.be/en through which the Flemish Government and its chain partners communicate with professionals and citizens on actions undertaken.

1.3 THE FOOD WASTE CASCADE AS A GUIDE

The food waste cascade is the guide used by government and chain in dealing with food surpluses (prevention section) and food waste (valorisation section). Both edible food waste (food losses) and inedible food waste (residues) can be valorised one way or another with a view to retaining value. Thus, material flows are efficiently used and the environmental impact remains limited. The aim is to get food waste as high as possible up the food waste cascade. The higher the destination is up the cascade, the greater the value retention.

Figure 2: Food waste cascade



Food waste cascade as included in the OVAM Action Plan for the Sustainable Management of (Residual) Biomass Streams 2015-2020 (approved by FG 10/7/15), layout: Department of the Environment & Spatial Development

Preventing food loss at the source is at the top of the cascade. This can be done by eliminating loss items, optimising operations, avoiding surpluses, but also by processing or reprocessing the commodity or product as a raw material for new food products.

In second place is the social re-purposing of food surpluses, e.g. donating food to social organisations and food banks. Both avoidance at the source and socially re-purposing food surpluses are forms of prevention: food remains destined for human consumption.

If we descend down the cascade, we no longer speak of prevention but of valorisation of food waste. Food waste can be used as animal feed, thereby contributing indirectly to the supply of food for people[1].

Then come the other material applications, possibly combined with energy production. With applications in e.g. biochemistry, food waste could serve as raw material for other sectors of the industry, thus contributing to the development of the biobased economy. Composting results in soil improvers. Through anaerobic digestion , food waste is converted into fertilisers and energy. Flows can also be anaerobically digested and after-composted. Food waste can then be converted into energy (only energy application), e.g. by being converted into biofuel.

If we descend further down the cascade, we talk of destruction or removal. This can be done by incineration (with energy recovery) or landfilling and actions seen as equivalent in this monitor such as discharging[2], etc. The destinations 'incineration without energy recovery' (for all waste) and 'landfilling' (for all household waste and for selectively collected biomass waste) are prohibited by law in Flanders.

[1] The Materials Decree encourages the use of materials. The Materials Decree regards the non-direct use of food waste for livestock feed as a use of materials on the same level as other applications of materials. Direct use as feed is seen as reuse (higher up the hierarchy). Within the context of this monitor, the use of feed (regardless of in which form and for which type of animal) is not subdivided and is a step above other materials, because of the direct link with human food supply.
[2] e.g. discharge into the sewers, into watercourses, into toilets/sinks, but also e.g. discarding in fishing.

2 APPROACH OF THE MONITOR

Action programme 9 of the Food supply chain roadmap is entitled "Meten is weten, voor bedrijf en beleid" ('Knowledge is power, for business and policy"). A sound knowledge base is required to establish an evidence-based policy and make correct strategic choices. Central to this is the statistical and coherent underpinning of the valorisation of food losses and residues through the chain. Monitoring over time must make the progress measurable. The Flemish Government and the chain partners have decided to enter into collective agreements regarding monitoring. Each partner contributed to the gathering of data (Flemish Government et al., 2015).

This monitoring is a first in Flanders, on three levels.

- First, it provides an integrated view of the efficiency with which the agri-food chain deals with food commodities, the extent to which food waste is valorised to a high standard and what food losses still occur.
- The measurement method is aligned with the European and international state of the art in relation to monitoring.
- The monitoring is the result of a transparent public-private partnership, to which all links in the chain contributed.

Despite the methodological limitations, the results presented are, at the time of publication, the best available figures on the subject in Flanders. The monitoring counts as the baseline measurement used by chain partners and policy for achieving the reduction targets of the Food supply chain roadmap.

We wish to thank all those individuals and organisations that contributed to the monitor (see Colophon).

2.1 STARTING POINTS

The monitoring is based on the structural data collection on waste and material flows of OVAM (the Integrated Environmental Report, deepened with the Eurostat Food Waste Plug-in) and was supplemented with data collection by and for several sectors.

The monitor has been aligned as much as possible with the European methodological quality guide of the EU FUSIONS "Food Waste Quantification Manual" (which in turn is aligned with the global "Food Loss and Waste Protocol") (Tostivint et al., 2016; World Resources Institute, 2016). The conceptual framework was further developed according to the Flemish context, definitions and objectives.

The data collection for the monitor was aligned with the data collection for the food cycle in the update of the 'Biomass Inventory' published simultaneously by OVAM. This inventory maps the biomass waste flows in the cycles of wood, open space and food. The biomass waste flows in food include, among other things, food waste (but also extend further).

This report shows the results for the 2015 calendar year and counts as a baseline measurement. When it was not possible to collect figures for 2015, the most recently available figures were used. At the end of the Food supply chain roadmap, a final measurement will be taken (will appear in 2021). In 2019 an interim monitoring will be published, relating to 2017.

We express food waste in weight (kilograms or tonnes) and give this flow both in its entirety (edible food losses + inedible residues) and broken down. Figures were collected up to the level of the chain link and per destination. In principle, the monitoring covers all food product groups, all chain links (except wholesale, apart from auctions) and the entire Flemish territory.

2.2 POINTS FOR CONSIDERATION

When reading and interpreting the figures, the reader must be aware that they concern the results of an initial baseline measurement according to a recently developed monitoring instrument. It is a measurement that is open to improvement. Caution is required when interpreting the results. Because of the complexity of the subject matter and the limited availability of data, the monitoring contains uncertainties. There is therefore a margin of error in the calculations and the results. Where data was lacking, use was made of expert estimates and assumptions, in consultation with representatives of the various chain links.

The expression of food waste in weight (tonnes) provides a sound basis. But it also has its limitations. A tonne of food waste in e.g. catering is different from a tonne of food waste in e.g. agriculture. A tonnage says nothing per se about the content or composition of the food waste, or about e.g. its environmental impact or financial costs. Such a 'translation' of the quantities in kilos into quantities in impact (euros, CO2, etc.) would undoubtedly give a different picture, but was not among the options within this monitoring. In general it can be said that the financial or environmental impact of a food product increases the further along the chain it is (regardless of the type of product), and the same is true for an associated food waste flow.

It is important to also state that we measure food waste and food losses in the sector in which they occur. It is not the case that all the food waste and food losses in sector B can also be attributed to sector B. The causes or levers for avoiding this may lie elsewhere in the chain (sector A or sector C) or are the joint responsibility of different chain links. Take the example of cosmetic or aesthetic quality requirements. Recent studies show that the application of high cosmetic quality requirements can lead to food losses in horticulture (Gellynck et al., 2017). The loss occurs in the horticulture sector, but its cause lies in a chain practice in which several links are involved. Communication and cooperation between the different links is therefore so important.

The figures on food waste and food losses in different links of the chain cannot simply be compared with each other. Each sector has its specific context, which brings with it differences in order of magnitude, composition, causes and opportunities for prevention and valorisation of food waste. Thus, the context in e.g. the fisheries sector is fundamentally different from the context in e.g. households. This means that without the necessary indication of context, it is hard simply to put the figures alongside each other and draw general conclusions.

Where possible, the absolute figures (tonnages) are framed against the total production volume or turnover of the sectors in question. This gives a more relative picture of food waste and food losses in these sectors.

It should also be clear that this involves a snapshot in time. The link with the context at that moment is important: economic parameters (e.g. economic growth or the export/import ratio), possible disasters (e.g. crisis), etc.

The data collection, and therefore also the methodology, differs for each link in the chain. Important sector-specific methodological points for consideration are discussed in chapter 4: 4 Results per chain **link**.

2.3 THEORETICAL FRAMEWORK

2.3.1 Terminology and definitions

Figure 3 schematically shows the different food-related flows in the agri-food chain. We shall discuss the various concepts used.

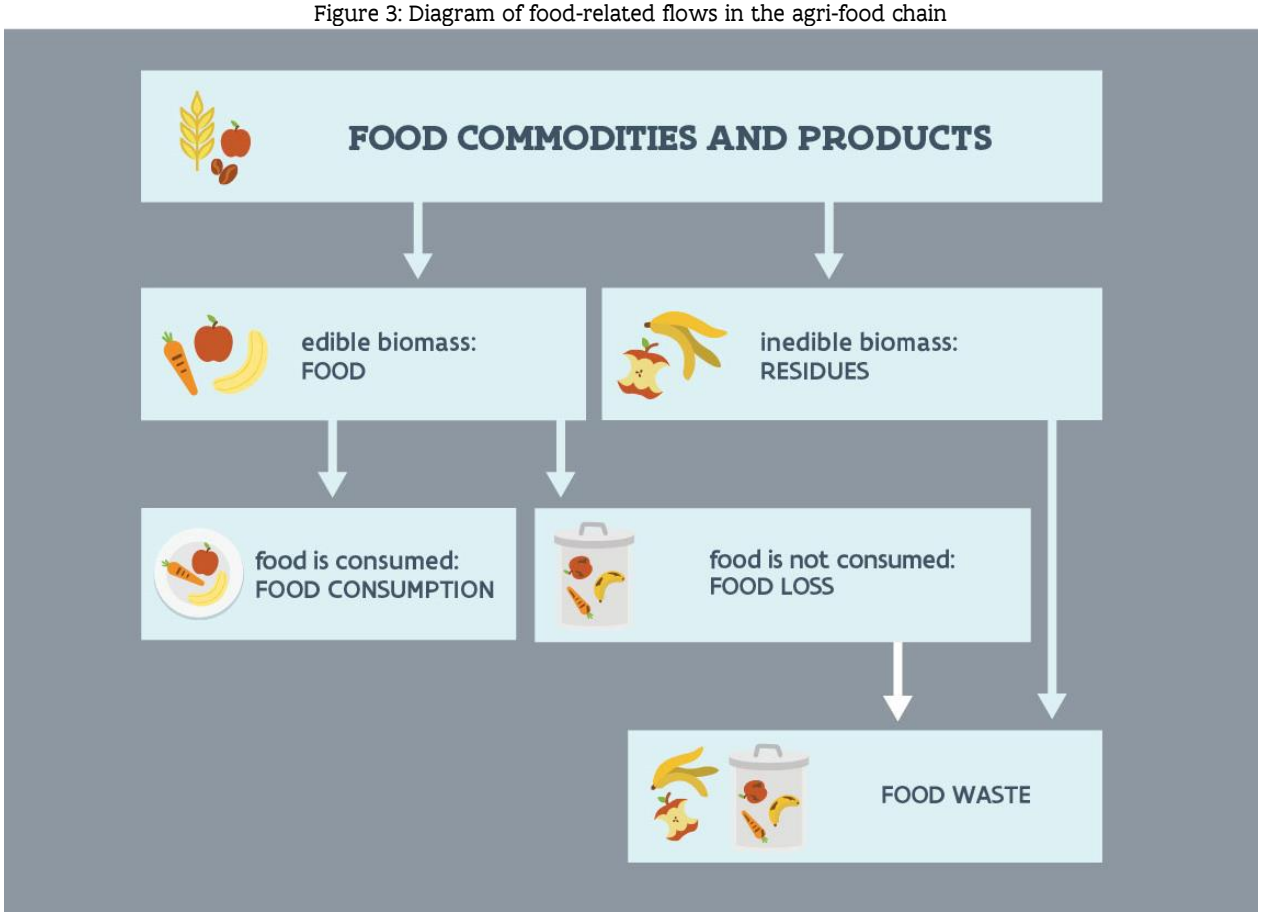
1. Food commodities and food products

If a commodity or a product is designated for human food consumption, we refer to this as a FOOD COMMODITY OR FOOD PRODUCT. A food commodity or food product consists of an edible fraction (=FOOD (B)) and an inedible fraction (= RESIDUE).

2. Food consumption and food loss

When food is consumed by people (FOOD CONSUMPTION), it has achieved its original purpose. If food is ultimately not consumed by people, we refer to this as FOOD LOSS. This is the Flemish concept and the definition that is used in the declaration of commitment and the Food supply chain roadmap. The term 'loss' merely indicates a loss of food for human consumption. It does not mean that this flow is not given a useful destination or valorisation. There is a loss of food for human consumption, but the material can still be given a useful, even high-quality valorisation.

Figure 3: Diagram of food-related flows in the agri-food chain



layout: Department of the Environment & Spatial Development

3. Inedible residues

Food commodities or products also contain a portion of (for man) inedible biomass, which is released during processing or consumption. We refer to this as a RESIDUE. This is inedible organic material associated with food, but is not a component of the food.

Some food commodities or products consist almost 100% of food (e.g. mushrooms), while other food commodities or products consist partly of food and partly of inedible residues (e.g. a carcass (inedible bones), fruit (inedible seeds), etc.). We do, however, speak of an edible and inedible fraction of food commodities and products.

For most food products, the distinction between edible and inedible is fairly clear: e.g. the flesh of the banana is edible, the banana skin is inedible. We are also basing ourselves here on the conventional cultural norm. In our culinary culture, certain vegetable peelings or organs are not normally eaten, so we do not count these as food loss, but as a residue. In other cultures, however, these same flows are eaten, and we would count them as food loss.

Before we can talk of (finished) products, specifically in primary production and processing, it is sometimes difficult to say what is edible and what is not. We therefore view the distinction on a purely theoretical level. If in theory it can, could or might be eaten or drunk by man, it is regarded as edible and we therefore talk of food loss. Otherwise we refer to a residue. Food that e.g. is left lying around too long and as a result can no longer be consumed (no longer safe to eat), but was at one point edible. Such a flow is therefore covered by food loss.

4. Food losses + residues = food waste

If the edible fraction of food commodities or products (in the form of FOOD LOSS) or the inedible fraction of food commodities or products (in the form of RESIDUES) disappear from the agri-food chain aimed at human food (read: they are given a non-human destination), we talk of FOOD WASTE.

5. Starting and end points of the agri-food chain

The agri-food chain begins at the time the food commodities are ready to enter the food system: they are ready for harvest or slaughter. The end point of the agri-food chain is when food is consumed or was removed from the chain as a food waste flow.

Waste flows released during primary production before the crops are ready for harvest or the animals are ready for slaughter are not part of the agri-food chain and therefore fall outside the definition of 'food waste'.

Agricultural crops are not always grown as human food. The production of animal feed crops and production of biomass for other non-food purposes (e.g. energy crops) are, however, obviously linked to the agri-food chain, but lie outside it as regards the monitoring of food waste.

6. Other inedible biomass

Besides residues, there are other inedible biomass flows that are released at the beginning of the chain, namely in the primary sector and the food industry. We refer to 'inedible biomass waste flows not linked to food' to highlight the difference from residues. This concerns inedible biomass that we do not regard as a component of the food commodity or product and which does not therefore enter the food chain. This can also therefore never become food waste. Examples: a fruit tree, straw from corn, leaves and stalks of certain crops that are not harvested as standard and are left in the field, (earth) sludges that result from the washing of commodities, etc.

7. Avoidable versus unavoidable

In principle, residues are unavoidable. They form an integral part of food commodities or products, but are not suitable for human consumption because they are simply not edible. In the case of food losses this concerns edible biomass that could in theory have been consumed. In the context of this monitor, we do not comment on the 'avoidability or otherwise' of certain food losses in practice. What is regarded as an 'avoidable' or 'unavoidable' food loss is, after all, largely dependent on the view one takes of the food loss. What is avoidable for one person is not avoidable for another. In addition, there are also different types of avoidability: e.g. a food loss that is technically 'avoidable' may be 'difficult to avoid' from an economic perspective because there is no market demand or it is not economically viable.

The fact that we do not include avoidability in this analysis obviously does not mean that some food losses probably are difficult or almost impossible to avoid in practice due to a lack of economic viability, technological limitations, weather conditions or legal provisions.

2.3.2 Examples

We will clarify the theoretical framework by means of several examples.

Example 1: Apples
Apples are grown for human food. When apples are ripe they are ready for harvesting and are picked by the grower and thus enter the agri-food chain. The food product apple consists of an edible fraction (flesh and skin) and an inedible fraction (core with pips, crown and stalk).

- *Imagine that during the growing process, the apple suffers from a disease and rots, then the apple does not reach the 'ready for harvesting' stage, and so does not enter the agri-food chain and can therefore also not be a food waste flow.*
- *Imagine that the apple is ready for harvesting, but because of e.g. a price crisis in the fruit sector, remains on the tree until it falls, then we can talk of a food waste flow consisting of a food loss fraction and a residue fraction.*
- *Imagine that the apple is eaten (apart from the inedible fraction, obviously), then there is only a (unavoidable) residue.*
- *Imagine that the apple is not (wholly) eaten, then there is also a food loss in addition to the residue.*

Example 2: Pigs
A pig is bred for the purpose of human food consumption (meat). When a pig is fully grown and is ready to be slaughtered, it enters the agri-food chain. In the processing industry the pig is slaughtered and processed into various meat products. The inedible parts of the pig (e.g. bones) form the residues. These residues may be released during processing, but also further along the chain, right up to the consumer (e.g. the bone of the chop that is left after eating). The meat itself is eaten (food consumption) or not, or partially (food loss). Certain organs are in principle edible, but do not (any longer) belong to our culinary culture; these organs are regarded as residues. If the pig were to die while growing on the pig farm, there is no food commodity or product and therefore also no food waste flow.

Example 3: Wheat
A farmer grows wheat and hopes to be able to sell it for bread-making. However, the destination of the grain is not fixed at the time of sowing, as this depends on the quality of grain, which in turn depends on e.g. the weather. If certain parameters are not met, the grain can only be marketed as livestock feed or an energy crop. If the grain is marketed as livestock feed, it cannot become food waste. If it is marketed as grain for bread-making, however, food waste may arise. When harvesting wheat for grain for bread-making, the straw is separated from the grain. The straw never enters the agri-food chain aimed at human consumption. The straw from grains will therefore never be regarded as a residue and therefore can also never be food waste.

The grain for bread-making is processed into different types of flour in mills. In the production of white flour, bran is released, which only has limited scope for sale in our culture/market. This is regarded as a residue.

Example 4: Cauliflower

Cauliflower is grown for human consumption, both for the fresh market and for processing. When the cauliflower is ready for harvesting, it is harvested for the fresh market, including leaves. These leaves also enter the agri-food chain, and if they are released become inedible food waste: residues. Cauliflowers for industry, conversely, are harvested without leaves. These leaves remain in the field, do not enter the food chain and therefore belong to the inedible biomass waste flows that we do not monitor as food waste flows.

Example 5: Beer

The production of beer begins with the raw material malt. The malt is first produced in malthouses. To obtain malt, wheat, barley or other grains are germinated and then dried. During this process residues are released that cannot be consumed by man. These are mainly malt germ pellets, which are used for livestock feed. In a brewery the malt is mixed with water and heated, forming sugars. This mixture (known as the wort) is then filtered, leaving the spent grain behind. Hops and/or herbs are added for taste and then filtered off. After fermenting, the yeast and any floating particles are also filtered off. The various flows that are filtered off during the brewing process are not suitable for human consumption. However, these residues are valorised, mainly for livestock feed.

3 SUMMARY OF RESULTS AT CHAIN LEVEL

This chapter and chapter 4: 'Results per chain link' are structured according to the rationale of the food waste cascade.

The prevention of food losses is first discussed. Figures on the elimination or reduction of loss items and the (re)processing of intermediate raw materials and surpluses into new food products are not available. To honour the importance of the preventive efforts undertaken in the various links of the chain, an example of a current preventive effort will be given for each link. Figures are available on the donation of food surpluses to social organisations, albeit on a limited basis.

Secondly, we will discuss the valorisation of food waste according to the various steps in the food waste cascade: as animal feed, as material (possibly in combination with energy) and as energy. We will discuss the results of the cascade index, a handy indicator for showing in a single figure the extent to which a sector applies the cascade in practice.

Thirdly, we will monitor the food losses, both in absolute quantities (tonnes) and in relative terms (% of total production or other indicator).

3.1 PREVENTION

In accordance with the food waste cascade, the various links in the chain initially make every effort to ensure the preservation of food for people, in other words: prevention of loss for human food.

Prevention consists of the prevention of losses at the source (by eliminating and reducing loss items and the (re)processing of intermediate raw materials and surpluses into new food commodities and products) and the social repurposing of food surpluses. Given the economic context in which companies operate, that order shall also be followed at all times. After all, the prevention of losses as well as (re)processing ensures that the commodities or products can still be marketed. However, investment or other costs are required to achieve this. The donation of surpluses mainly fulfils a social purpose. It does not produce any direct economic benefit, but can contribute to the company vision on corporate social responsibility.

3.1.1 Prevention at the source

Prevention at the source is not examined in this monitor. This was neither the intention nor a realistic option. To honour the importance of the preventive efforts undertaken in the various links of the chain, the following table shows an example of a current preventive effort for each link.

An overview of all the results achieved at sector level, within the framework of the Food supply chain roadmap on food loss, can be found in "Food supply chain roadmap on food loss: achievements 2016". The associated portfolio describes ten clear example initiatives (only available in Dutch - see www.voedselverlies.be).

Table 1: Examples of preventive efforts in practice, for each chain link

Chain link	Example of preventive effort in practice
Fisheries	Companies from the fisheries sector adapt the equipment on their vessels to refine the selectivity of the fishing gear by size and species to reduce or prevent unwanted by-catches.
Agriculture	Optimisation and innovation in harvesting and storage techniques allow more precise and more efficient harvesting and storage, enabling losses during the harvest (and also during storage and further processing) to be further reduced.
Auctions	The auction system is focused on aligning supply and demand as much as possible and avoiding losses. Products taken 'off the market' to neutralise a surplus or oversupply are initially offered for free distribution to social organisations.
Food industry	By optimising packaging, food companies ensure that their products remain preserved in the best possible way, increasing their shelf life and allowing them to reach their final destination safely. The packaging also helps reduce food loss at the consumer. Innovative packaging technologies that avoid food losses and minimise the overall environmental impact of product and packaging are being investigated further.
Retail	In retail the main focus is on optimising the provisioning system (e.g. IT systems that take as much account as possible of external factors such as the weather), with a view to optimum stocks in stores. Not too little, because retailers want to be able to serve their customers, but also not too much. In this way retailers avoid having products that are approaching their sell-by date and will become unsellable.
Hospitality sector	Hospitality businesses owners can sign the Chefs' Charter, within the 'No Food To Waste' campaign of Horeca Vlaanderen. This campaign encourages owners to combat food loss by means of a practical checklist with tips and tricks. Three well-known chefs are setting the example as sponsors of the action.
Catering	In catering, innovative concepts are being tested to reduce food losses as much as possible. After a detailed baseline measurement, the caterer of the Flemish Government (Agentschap Facilitair Bedrijf) introduced the 'freedom of choice' concept (serve yourself) for the 'self-service' hot dishes. Other caterers are offering their customers different portion sizes. Such initiatives will lead to a significant reduction in food loss.
Households	Through proper shopping planning (e.g. weekly menu or shopping list), smart organisation of the fridge (e.g. is everything where it should be?) and the creative use of leftovers (e.g. using old bread to make bread pudding), the individual consumer can also help prevent food losses.
The chain as a whole	With the Food supply chain roadmap on food loss a public-private partnership has been set up in which the chain partners and the Flemish Government implement concrete actions to prevent food losses across the entire chain (including consumers).

3.1.2 Donating food surpluses

Redistribution of food surpluses through social (emergency aid) organisations to people living in poverty is a possibility and for some people living in poverty even (temporarily) the only access to food. By making existing food surpluses safely accessible to disadvantaged groups, they can be offered healthy, cheap and varied food they might not otherwise be able to afford. This in anticipation of a more structural solution that gives a person currently living in poverty a regular income such as e.g. through employment. In recent years we have seen increasing attention both from companies in the agri-food

chain to making donations and from organisations, authorities and citizens to (socially) addressing food surpluses.

In addition, donating and redistributing is also a way of avoiding food losses. Dealing socially with food surpluses is not prevention in the strict sense of the word, but a fully-fledged strategy for preventing food loss because the food is used for human consumption.

In 2015, a total of around 16,400 tonnes of surplus food was given a social purpose in Flanders. This involves the total of identified food surpluses given a social purpose in the sectors of producer organisations (= auctions, 1,477 tonnes), food industry (12,599 tonnes) and retail (2,356 tonnes). The figures come from an inventory on the supply side (based on sector and government data). This is an underestimate, since not all food surpluses that were given a social destination could be included in the inventory. No figures are available for primary production (agriculture and fisheries) and food services (hospitality sector and catering).

The figures from the supply side are currently the most detailed inventory of food surpluses with a social destination, even though this figure is just part of the puzzle. There is a lack of structural monitoring and reporting among actors on both the supply and the demand side (social organisations).

We will zoom in further on the producer organisations, food industry and retail. Through the intervention scheme in the context of the Common Organisation of the Fruit and Vegetable Markets, surpluses with producer organisations are taken off the market. Unsold products are initially distributed to social institutions. There is a legislative framework in this regard. In 2015, 14,337 tonnes of marketable product were taken off the market by producer organisations. In total, 1,477 tonnes of fruit and vegetables were distributed free of charge (good for 10%). This is mainly vegetables (mainly tomato, chicory, leek, lettuce and courgette), just 4% is fruit (mainly apples and pears). What is not collected for free distribution goes to other non-human valorisations (e.g. animal feed): in 2015 this involved 12,860 tonnes of marketable product (Department of Agriculture and Fisheries, 2016a).

In collaboration with FEVIA, OVAM organised a specific survey of food companies in 2012 (OVAM, 2013). In total, 13,000 tonnes of products, around 10% of the total quantity of unsold products is donated. 33% of unsold products are processed into saleable products. Not all unsold products are still suitable for social redistribution.

From a survey of its retail members, COMEOS (2016) concludes that the participating Belgian companies donate at least 1,876 tonnes (or 3.5% of all unsold surpluses). It has not been possible to map all donations. More and more local actions are also being organised. Translated to Flanders, we get 1,130 tonnes of donated food surpluses by large distribution and hard discount. A striking trend is that (almost) all supermarket chains are in the process of introducing a central policy (if they did not previously have one) for donating from their stores.

From a survey of its members, Buurtsuper.be (2016) concludes that in an average neighbourhood supermarket, 3.47% of the turnover in food is not sold. A little less than 1/4 (23%) of that is donated to social organisations. Almost 6 out of 10 of the neighbourhood supermarkets donate food surpluses to social organisations. According to estimates, neighbourhood supermarkets account for around 1,226

tonnes of donated food surpluses on an annual basis. The lack of alignment between the time goods are offered (on the expiry date) and organisations that can organise themselves to collect them systematically seems to be the main difficulty for neighbourhood supermarkets that do not donate food surpluses.

In the case of producer organisations, this always involves consumable products. There are still various difficulties to being able to donate more products, e.g. the strong seasonal fluctuations in the offer of surpluses and the limited capacity of social organisations that have to distribute them free of charge. A major portion of the food surpluses in industry and retail are no longer suitable to being offered for social redistribution. This involves, for example, products with quality problems or products for which the use-by date has expired. In addition, food losses also occur in the food industry during production processes. In terms of kind and quality, these are mostly also not suitable for donating. Despite this, there also seems to be more as yet untapped potential in retail and industry for social redistribution (apart from existing difficulties on the demand and supply sides).

3.2 VALORISATION

3.2.1 Creation of food waste

In the Flemish agri-food chain, from harvest to consumption, an estimated 3,485,000 tonnes of food waste was released in 2015 (both edible food losses and inedible residues). The following table shows the quantities per link in the chain.

Table 2: Overview of food waste (food losses + inedible unavoidable residues) in the Flemish agri-food chain, tonnes, 2015

Sector	Food waste	
	tonnes	proportion in the total chain
Fisheries	10,402	>1%
Agriculture*	449,352	13%
Auctions	15,277	>1%
Food industry*	2,349,445	67%
Retail	64,828	2%
Hospitality sector	67,450	2%
Catering	60,098	2%
Households	468,305	13%
Total chain	**3,485,157**	**100%**

*Flemish agriculture and food industry are strongly and increasingly export-oriented. Production for export is included in the figures.

Most of the Flemish food waste, expressed in tonnes, is released in the links of food industry and, to a lesser extent, agriculture and households. There are two obvious explanations for this. On the one hand, Flemish agriculture and the food industry has a massive production volume (high production per capita compared with other countries) due to the strong and increasing focus on exports. Thus, exports account for around half the turnover of the food industry. The links from retail to households, on the other hand, only concern the domestic market. A major portion of the food waste in agriculture and the food industry can therefore be attributed to production for foreign markets. It is not, however, possible to express how many of the food waste created can be linked to domestic and foreign consumption respectively. Conversely, within the food industry the process also takes place that relatively speaking generates the most inedible food waste, namely the processing of raw materials into finished food products. This is because large quantities of inedible food waste (residues) are released here: skins, bones, pulp, scrap, etc. Within the chain, the emergence of these residues is therefore concentrated in the link of the food industry. Inedible food waste accounts for 90% of the food waste in the food industry.

3.2.2 Valorisation of food waste

The most important valorisation of food waste released annually in the Flemish agri-food chain is animal feed. This is also the highest possible valorisation of food waste according to the food waste cascade. Animal feed is the destination of 43% of all food waste, anaerobic digestion accounts for 21% of all food waste. Returning to the land as a destination accounts for 17% of all food waste. Together, these three forms of valorisation account for 81% of all food waste. However, up to 92% of all Flemish food waste is valorised (as animal feed, material or energy). Just 6% is incinerated with energy recovery, 1% is landfilled/discharged, and 1% has an unknown destination.

Figure 4: Distribution of destinations of food waste, tonnes, Flanders, 2015

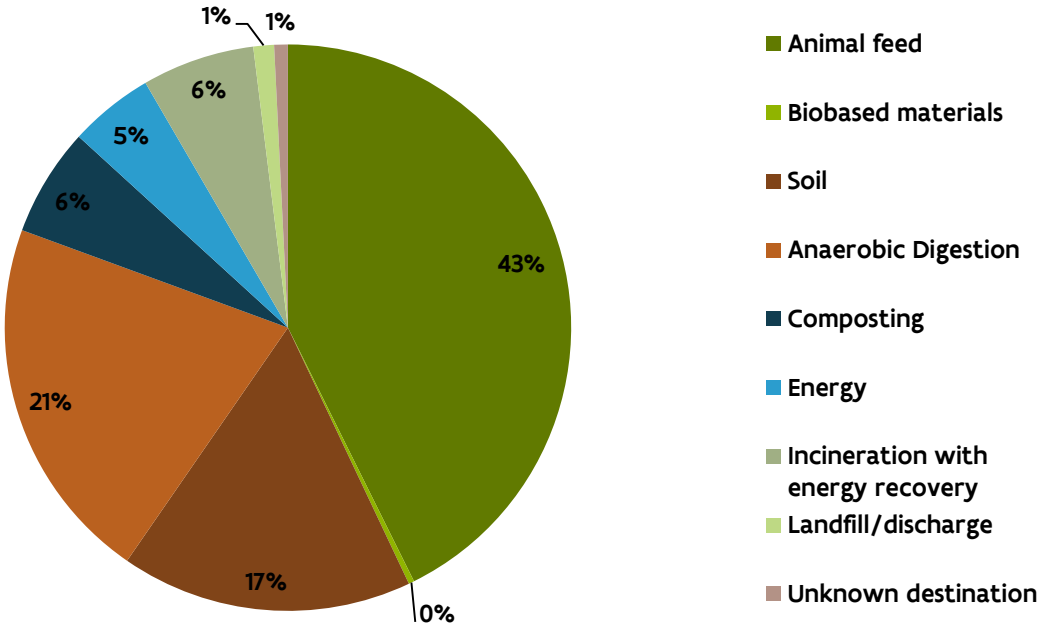


Table 3 offers a total overview of the destinations of food waste in the various links of the chain. Animal food as valorisation plays an important role in the food industry (55%), auctions (36%), agriculture (11%) and, somewhat surprisingly, households (28%). In agriculture, auctions and retail this involves the feeding of agricultural animals (livestock feed). In the food industry it largely involves livestock feed, but some is also valorised as pet food. With households, it involves both the feeding of farmed animals (e.g. chickens) and pets (e.g. dogs).

Table 3: Destinations of food waste, % in relation to sector total, Flanders, 2015

Sector	Animal feed	Biobased materials	Soil	Anaerobic digestion	Composting	Energy	Incineration with energy recovery	Landfill/ discharge*	Unknown destination	Total
Fisheries	-	-	-	-	-	-	-	100%	-	100%
Agriculture	11%	-	70%	4%	4%	1%	-	4%	6%	100%
Auctions	36%	-	28%	11%	17%	-	-	-	8%	100%
Food industry	55%	0%	11%	26%	-	7%	0%	-	-	100%
Retail	3%	2%	-	49%	16%	-	29%	-	-	100%
Hospitality sector	-	-	-	31%	-	-	69%	-	-	100%
Catering	-	-	-	24%	-	-	76%	-	-	100%
Households	28%	-	-	6%	40%	-	24%	3%	0%	100%
Total chain	**43%**	**0%**	**17%**	**21%**	**6%**	**5%**	**6%**	**1%**	**1%**	**100%**

* discharge includes discards in fishing, discharges of milk into slurry pits in agriculture and discharges into sewers/toilets in households.

Application onto the land plays a very important role in agriculture (70%), auctions (28%) and the food industry (11%). Anaerobic digestion is a valorisation that, with the exception of fisheries, is important throughout the chain: the proportions fluctuate between 4% (agriculture) and 49% (retail). At 40%, composting is mainly important for households (both vegetable, fruit and garden (VFG) waste collection and at-home composting), and it also matters in retail and for auctions. Incineration with energy recovery is the main destination in food services, in both hospitality sector (69%) and catering (76%).

3.2.3 Cascade index

To be able to express the valorisation of food waste clearly, we calculate a cascade index for each link in the chain. The cascade index is a variant of the Moerman index[3], an indicator developed in connection with the feasibility study into an environmentally neutral Walloon food industry (FEVIA, 2013).

The cascade index weights the food waste released in a sector according to its position on the food waste cascade. Prevention of food waste could not be included because these figures are not available. Only the valorisation of food waste is therefore involved. If a sector valorises as much as possible (all

[3] The Moerman ladder is the Dutch equivalent of the Flemish food waste cascade. Both cascades largely correspond.

food waste goes to animal feed), the cascade index is 10 (out of 10). If a sector does not valorise (everything goes to landfill or applications regarded as equivalent in this exercise), the cascade index is 0 (out of 10). The cascade index indicates the quality level at which a sector is valorising, aside from the absolute quantity of food waste that it produces. It is important to place the index value of a sector within its context. Thus, not all valorisations are technically possible or legally permissible in each sector. Experience also shows that a low cascade index is often the result of certain obstacles that prevent companies from progressing. More information about the calculation of the cascade index can be found in the annex.

Table 4 shows the calculated cascade index per sector. Agriculture and the food industry score highly in terms of valorisation (7.9 and 8.8 respectively). The valorisation of food waste as animal feed (livestock feed, pet food) or soil improver is intrinsically linked to their operational management. The cascade system built into the public and private policy of auctions also bore fruit, with a cascade index of 8.8. A high degree of selective collection of food waste flows by households, allowing valorisation to a higher standard, gives a cascade index of 6.9. Selective collection of food waste is still relatively low in the hospitality sector and catering, which is also reflected in their cascade index. In the hospitality sector, further efforts are being made to encourage the selective collection of food waste. In the contract catering sector, the decision whether or not to collect selectively often lies with the customers who sign a contract with a caterer. Raising awareness among customers plays an important role here. Increased selective collection in retail has resulted in a cascade index of 6.3. Reducing discards is a priority in fisheries. Valorisation possibilities in the direction of animal feed offer potential to sharply increase the valorisation of food waste flows in fisheries.

Table 4: Cascade index, value per link, Flanders, 2015

Sector	Value of cascade index*
Fisheries	0
Agriculture	7.9
Auctions	8.8
Food industry	8.8
Retail	6.3
Hospitality sector	3.9
Catering	3.4
Households	6.9
The chain	**8.2**

*minimum (lowest possible score) = 0, maximum (highest possible score) = 10.

Analysis shows that the sectors with the relatively highest tonnage of food waste score highest for valorisation. Auctions are an exception, with a relatively low tonnage and a high cascade index. The cascade index of the agri-food chain in total is 8.2. We can conclude that the Flemish agri-food chain is very strong when it comes to the valorisation of food waste.

3.3 FOOD LOSSES AND RESIDUES

If, within food waste, we distinguish between the edible and inedible fraction, we gain insight into the food losses and residues.

Table 5 shows the food loss per link (edible food waste) and the residues (unavoidable inedible food waste) in tonnes, as well as the proportion of the link in the total of the chain. The food losses are also expressed relatively in relation to production or turnover.

Table 5: Food losses and residues per link, absolute (tonnes) and relative (%), Flanders, 2015

Flow→	Food losses (=edible food waste)			Residues (=inedible food waste)	
Indicator → **Link↓**	*Absolute quantity (tonnes)*	*Proportion in chain (%)*	*Food loss (tonnes) in relation to total production in the link ∗ (%)*	*Absolute quantity (tonnes)*	*Proportion in chain (%)*
Fisheries	5,201	1%	21%	5,201	0%
Agriculture	330,319	36%	4.0%	119,033	5%
Auctions	14,629	2%	1.4%	647	0%
Food industry	225,481	25%	1.5%	2,123,964	82%
Retail	43,391	5%	2.6%	21,437	1%
Hospitality sector	19,108	2%	nk	48,342	2%
Catering	57,090	6%	nk	3,005	0%
Households	211,858	23%	5.9%	256,447	10%
Total chain	**907,077**	**100%**	**nk**	**2,578,076**	**100%**

∗ Total production sector is calculated differently for each sector. This concerns supplies at fisheries, production in agriculture (excluding livestock farming because this largely falls outside the definition of food waste), supplies at VBT auctions, an estimate of production in industry (FEVIA, 2017), total food turnover in retail (figure is estimate based on figures for large retailer and survey of neighbourhood supermarkets) and total food consumption in Flanders for households (Food Consumption Survey 2014-2015). It was not possible to express food losses in the hospitality sector and catering relatively, because of the lack of insight into total consumption in those sectors (nk = not known).

We will discuss the example of households to illustrate the table.

Example:
In 2015, households produced almost 212,000 tonnes of food losses, these are the edible food waste flows. Inedible food waste flows are the residues, and account for 256,000 tonnes in 2015. The proportion of the food loss of households in the total food loss in Flanders is 23%. The proportion of the residues of households in the total residues is 10%. Based on the results of the Food Consumption Survey 2014-2015 (De Ridder et al., 2016), we estimate the relative food loss at 5.9% in relation to the total consumption by households in Flanders.

In the Flemish agri-food chain, from harvest to consumption, 3,485,000 tonnes of food waste were released in 2015. Three quarters (74%) of food waste were unavoidable residues. Just one quarter (26%) of food waste is food loss. Expressed in absolute figures, this equates to 2,587,000 tonnes of residues and 907,000 tonnes of food losses across the entire chain.

82% of the total quantity of residues is released in the food industry, followed by households (10%). It is not surprising that the majority of the inedible parts of food commodities and products are released in those links where the food commodities are processed (industry) and most of the food is consumed (households).

Of the 907,000 tonnes of food losses in Flanders, 36% comes from agriculture, 25% from the food industry and 23% from households. This is closely linked to the high production volume of the food industry and agriculture (significant portion for export), as well as the specific production conditions in agriculture. After all, the farmer is directly dependent on 'natural' production conditions (such as e.g. the climate) over which he has no control. These circumstances can have a major impact on e.g. harvesting, sorting and storage losses. Examples include glassy potatoes due to drought or apples and pears with hail damage. This can also have an impact on quality and outcome further along the chain. Other links are also faced with specific external factors that are sometimes beyond their control.

In relation to total production, there appears to be little food loss in almost all sectors. In relation to total production, food loss in the food industry is 1.5%, and 4% in agriculture. In households, food loss in relation to total food consumption is 5.9%. In proportion to total production, food loss in agriculture, the food industry and households is relatively low.

Table 6 shows the proportion of the edible and inedible fraction of food waste per link and in the chain total. The edible fraction of food waste is the food loss, the inedible fraction of food waste are the residues.

Table 6: Proportion of food losses and residues in total food waste, by link, Flanders, 2015

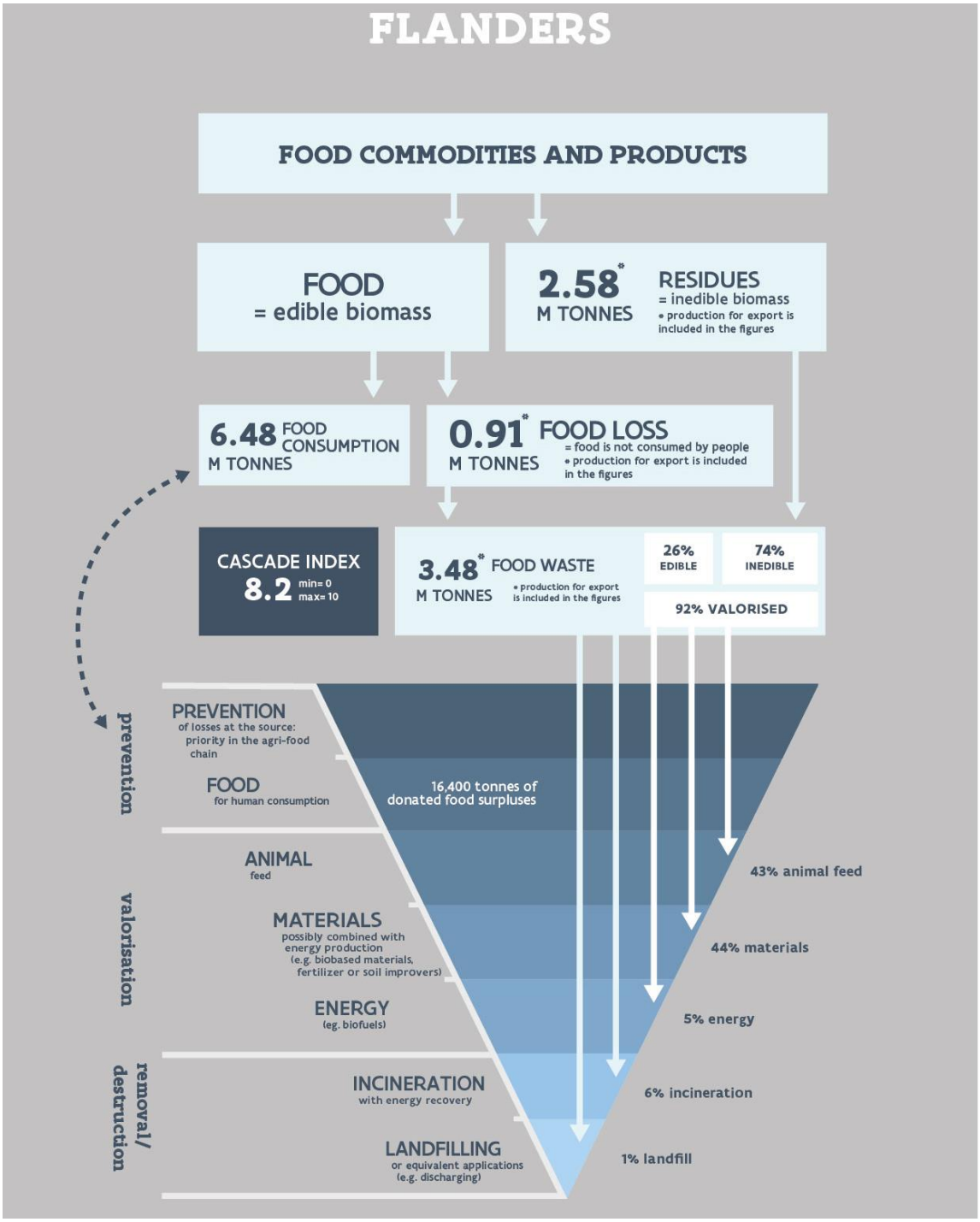
Link	Edible fraction of the food waste (= food losses) (%) *	Inedible fraction of the food waste (= residues) (%) *
Fisheries	50%	50%
Agriculture	74%	26%
Auctions	96%	4%
Food industry	10%	90%
Retail	67%	33%
Hospitality sector	28%	72%
Catering	95%	5%
Households	45%	55%
Total chain	**26%**	**74%**

** Food waste flows consist of an edible fraction (=food loss) and an inedible fraction (=residues). The proportion of food loss in the food waste plus the proportion of residues in the food waste is always 100%. This concerns the food waste at link level.*

In the links of food industry, hospitality sector and households, the edible fraction of food waste is 10%, 28% and 45% respectively. In the links of auctions, catering and agriculture, the edible fraction of food waste is 96%, 95% and 74% respectively. In the links where a lot of 'processing' takes place (mainly industry, but also hospitality sector), the fraction of inedible food waste is higher. In the other links of the chain, the fraction of inedible food waste is lower. This is because there is little to no processing (agriculture) or because the focus lies on distribution (auctions and retail) or because prepared products are mainly used (catering). In fisheries and households, the percentage of inedible food waste is approximately the same as the percentage of edible food waste (50%-50% in fisheries and 45%-55% in households).

3.4 VISUAL PRESENTATION OF RESULTS

Figure 5: Valorisation of food commodities and products in the agri-food chain, Flanders, 2015



Food waste cascade as included in the OVAM Action Plan for the Sustainable Management of (Residual) Biomass Streams 2015-2020 (approved by FG 10/7/15), layout: Department of the Environment & Spatial Development

4 RESULTS PER CHAIN LINK

The sector chapters are structured as follows:

- Results according to the rationale of the food waste cascade
    - Prevention: if figures are available, focus is on the donation of food surpluses, which is only one component of prevention efforts
    - Valorisation: the steps in the food waste cascade and the cascade index
    - Food losses (absolute and relative) and residues
    - Visual presentation of results
- Data collection
    - Definition
    - Methodology
- Findings in relation to the results and data collection

From the Flemish Government, the Department of Agriculture and Fisheries, OVAM and the Department of Environment & Spatial Development contributed to all sector chapters. For each chapter it is indicated with which partners collaborations took place.

4.1 FISHERIES

This chapter was prepared in collaboration with Bart Vanelslander and Mike van 't Land (ILVO).

The Flemish fleet is mixed and therefore fishes several stocks simultaneously. The fleet specialises in flatfish. Plaice and sole account for 32% and 13% respectively of the volume of fish supplied. Cod, skate and monkfish follow at a distance, with a share of 6%, 5% and 5% respectively (Department of Agriculture and Fisheries, 2016b).

4.1.1 Results

4.1.1.1 Prevention

Figures on prevention at the source are not available. An example of a prevention effort in fishing is the adaptation of the equipment of ships to refine the selectivity of the fishing gear by size and species to reduce or prevent unwanted by-catches.

This monitoring in fishing focuses on the creation of food waste by the discarding of unwanted by-catches. Prevention by donating to social organisations does not therefore apply.

4.1.1.2 Valorisation

Creation of food waste

Table 7 shows that discard volumes are greatest for plaice, dogfish and shrimp. For dogfish and shrimp the survival figures are fairly high, as a result of which a large proportion of this discard cannot be regarded as food waste. The survival of plaice varies considerably, making it difficult to estimate food waste. Other species with high chances of survival are skate and scallops. Sole, cod, squid and lemon sole have lower chances of survival. No survival percentage has yet been determined for monkfish, and the remainder group is much too heterogeneous to be able to determine a survival percentage. Monkfish and the remainder group are not included in the inventory of food waste. The survival percentages are taken from the scientific literature and concern the most recent available data.

For some species, the discarded tonnage is greater than the landed tonnage. This can be explained by the presence of many young, undersized fish that are not allowed to be landed (e.g. plaice and shrimp), or by a very low commercial value, meaning it is often not profitable for the fisherman to process and land this fish (e.g. dogfish). For the total of all fish species, the proportion of discards in relation to landings is 77%.

We obtain food waste by multiplying the discard tonnage for each fish species by the percentage of fish that does not survive. In total, this amounts to 10,402 tonnes of food waste. With 9,407 tonnes, plaice accounts for 90% of total food waste.

Table 7: Landing, discard, survival and food waste in Belgian fishing, by fish species, Flanders, 2015

Fish species	Landing	Discard	Discard in relation to landing	Survival percentage	Food waste (= discard x (100% - survival percentage))
	tonnes	tonnes	%	%	tonnes
Plaice	7,787	12,377	159%	24% (0-48%)	9,407
Sole	3,083	330	11%	27% (4-71%)	241
Cod	1,434	70	5%	38% (0-68%)	43
Skate	1,248	441	35%	72%	123
Squid	1,067	14	1%	16%	12
Monkfish	1,118	260	23%	*not known*	*not known*
Lemon sole	837	192	23%	12%	169
Scallops	766	28	4%	100%	0
Dogfish	693	1,757	254%	88% (78-98%)	211
Grey shrimps	670	853	127%	77%	196
Remainder group	5,823	3,004	52%	*not known*	*not known*
Total	**24,526**	**18,834**	**77%**	***not known***	**10,402**

Source: ILVO, 2017a

Valorisation of food waste and cascade index

All food waste is discharged into the sea. There are no other relevant destinations.

Table 8: Destinations of food waste in fishing (discards), % in relation to sector total, Flanders, 2015

Sector	Animal feed	Biobased materials	Soil	Anaerobic digestion	Composting	Energy	Incineration with energy recovery	Landfill/discharge *	Unknown destination	Total
Fisheries	-	-	-	-	-	-	-	100%	-	100%

* discharge includes discards in fishing.

The cascade index weighs the food waste released in a sector according to its position on the food waste cascade. The cascade index of fishing is 0. Processing of food waste in animal feed offers potential to sharply increase the valorisation of food waste in fishing and the associated cascade index.

Table 9: Cascade index for fishing, Flanders, 2015

Sector	Value of cascade index*
Fishing	0

*minimum (lowest possible score)=0, maximum (highest possible score)=10.

4.1.1.3 Food losses and residues

If, within food waste, we distinguish between the edible and inedible fraction, we gain insight into the food losses and/or residues.

The edible fraction of food waste varies between 40 and 65% (Rehbein & Oehlenschläger 2009). No species-specific data for Flemish fishing is currently available, and a fixed proportion of 50% was used.

Of the 10,402 tonnes of food waste in Belgian fishing, there is an estimated 5,201 tonnes of food losses and as many residues. The relative food loss or the proportion of food losses in relation to the total fish landed is 21%.

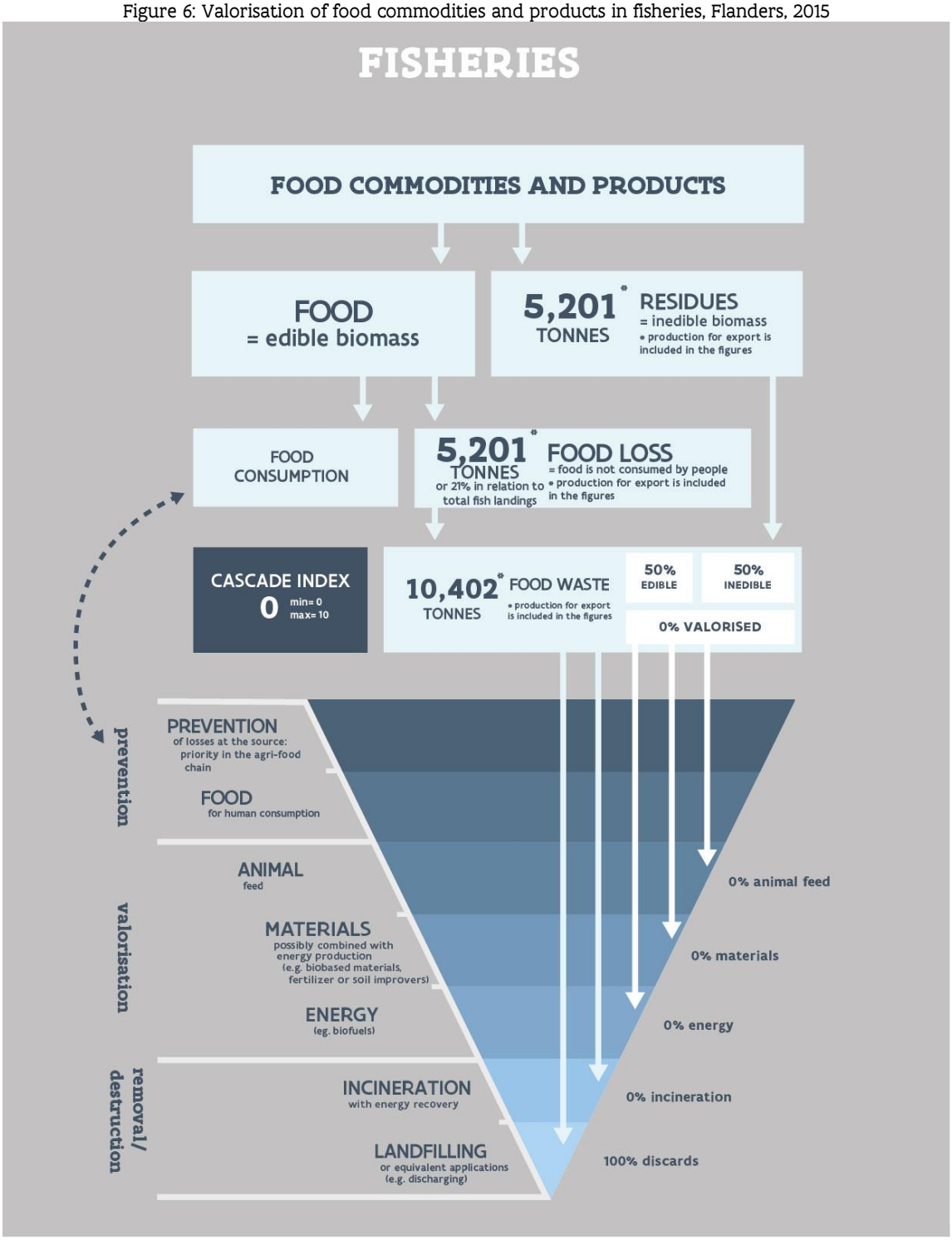
Table 10: Food losses and residues, by fish species, tonnes, fisheries, Flanders, 2015

Fish species	Food losses (=edible food waste) (tonnes)	Residues (=inedible food waste) (tonnes)
Plaice	4,703	4,703
Sole	120	120
Cod	22	22
Skate	62	62
Squid	6	6
Lemon sole	84	84
Scallops	0	0
Dogfish	105	105
Grey shrimps	98	98
Total	**5,201**	**5,201**

Source: ILVO, 2017a

4.1.1.4 Visual presentation of results

Figure 6: Valorisation of food commodities and products in fisheries, Flanders, 2015



Food waste cascade as included in the OVAM Action Plan for the Sustainable Management of (Residual) Biomass Streams 2015-2020 (approved by FG 10/7/15), layout: Department of the Environment & Spatial Development

4.1.2 Data collection

4.1.2.1 Definition

Discards in sea fishing concerns the unwanted part of a catch that is not landed but is thrown back overboard. On a global scale, discards are estimated at 8% (Kelleher, 2005). Sea-bed fishing accounts for a relatively high proportion of total discards and is responsible for around half of total global discards. Fishing in the North Sea is responsible for around 13% (Kelleher, 2005) of global discards, or around 800,000 to 950,000 tonnes (Tasker *et al.,* 2000).

The principal drivers behind discards are regulations and the market. Discarding can happen because the fish is too small and falls below the legal minimum size, because the fisherman has no (more) quota for certain species or because of legal rules on catch composition. Discarding can also happen because the fish has little economic value, such as non-commercial fish or damaged fish.

On 1 January 2016, the obligation to land for demersal fisheries was introduced in the EU. This obligation to land is being phased in over the period 2016-2019. The aim is to encourage fishermen to fish more selectively and in so doing counter fish losses. More selective fishing is sometimes difficult to achieve in a mixed fishing industry. Under the obligation to land, fish below a species-dependent legal minimum size may no longer be thrown overboard, but must be landed. These fish may not be used for human consumption, and are deducted from the quota. Exceptional measures have been provided for some species.

Because of the importance and scope of the problem of discards in fishing, the focus of this monitoring is on mapping food waste created as a result of these discards. The food waste released during processing of the caught fish on board or during transportation to the processor, as well as the subsector of aquaculture, are not included in the monitoring. We map the discards of the entire Belgian/Flemish fishing industry, regardless of whether the catch was landed in a Belgian or foreign port.

4.1.2.2 Methodology

The discard data was collected by the ILVO as part of the 'National Data Gathering Program', except for survival percentages, which are taken from the scientific literature. Under the provisions of the 'Data Collection Framework' (EU Council Regulation 199/2008), European Member States must collect data on discards by their commercial fleet. Seagoing observers will be sent on board commercial vessels during normal commercial voyages to map the entire catch (including discards). There, the observers will record information on the composition of the catch, the vessel and the fishing gear used, mesh size, selectivity adjustments, fishing ground, climatological conditions, etc.

Using the data collected, estimates will be made of the discard by species, age, sex, area, quarter and type of fishing. These sampling programmes have the potential to provide good data, but are relatively expensive and have a relatively low coverage, approximately 1% of all fishing activity. The low coverage and the high degree of variation in discards between different voyages, even by the same vessel and fishing gear, results in variable data.

The survival figures come from experiments at sea in which caught fish that would normally be thrown back are kept in aquaria for a number of days to monitor survival. These are time-consuming and

expensive tests, and we can therefore not collect data for all species, which means we sometimes also had to base ourselves on experiments from neighbouring countries in similar conditions. The survival percentages seem highly variable and dependent on, among other things, the type of fishing gear, the duration of a trawl, the depth of fishing, weather conditions, water temperature, time of processing on board, etc. Because of this high degree of variability, ranges were sometimes given for survival percentages and the average of the percentages found was used.

Extrapolations were made on the basis of the available discard and survival percentages. These extrapolations are merely guidelines and not precise estimates, and should therefore also be interpreted in this spirit.

4.1.3 Findings

Efforts must focus on further refining the monitoring of discards and in particular survival percentages per species. The results show that the focus of reduction and valorisation efforts must clearly be on plaice, because of the lion's share in the volume of food waste flows. This applies regardless of the food loss/residues distribution. European and Flemish fishing policy regards the reduction of discards as a priority. The European obligation to land is an instrument that will be used to achieve this objective. A double path is being walked: on the one hand fishing more selectively (prevention) and on the other trying to valorise the unwanted landed fish.

For fish that cannot legally be sold (i.e. human consumption is not an option), valorisation into fishmeal or fish silage is a realistic option. This is also the second-best option on the food waste cascade, after prevention. Fishmeal is a sought-after product and is rising in value as a result of competition and declining raw materials. Fish silage is comparable with fishmeal, but is less well known. Fish silage is a more profitable solution for lower landing volumes, as is the case with Belgian fishing. A use as dish hydrolysates (with functional and/or bioactive properties) or the isolation of collagen, fatty acids, enzymes, etc. is of higher value but requires a stable land and often costly processing techniques. Within the 'Genesys' project ILVO (2017b) is developing a valorisation process for food waste from fishing and industry.

The landed fish that can still be sold are mainly less popular species or of lower quality. These can still be sold for human consumption. However, considerable efforts still have to be made to convince consumers to buy, for example with marketing campaigns (e.g. 'North Sea Chefs'). If necessary, these species can also be processed.

4.2 AGRICULTURE

This chapter was prepared in collaboration with Nathalie Bernaert and Lies Kips (ILVO), François Huyghe (Boerenbond) and Nele Cattoor (VEGEBE/Belgapom).

Together with the fisheries sector, Flemish agriculture constitutes the primary production. The sector is subdivided into horticulture, arable farming and livestock farming. Flemish agriculture is characterised by specialisation, upscaling, broadening and innovation. Agriculture accounts for 70% of businesses, 30% of investments and 42% of employment in the Flemish agrobusiness complex (Platteau *et al.*, 2016).

4.2.1 Results

4.2.1.1 Prevention

Figures on prevention at the source are not available. An example of a prevention effort in agriculture is the optimisation of and innovation in harvesting and storage techniques. This allows more precise and more efficient harvesting and storage, enabling losses during the harvest (and also during storage and further processing) to be further reduced.

Donations do occur in practice, but figures are not as yet available. However, donating is expected to be relatively low in agriculture compared with other sectors: as the first link in the chain, farmers are further away from consumers than e.g. retailers. Also, this often involves products that are yet to be harvested.

'Gleaning' is the practice whereby volunteers harvest fields that have been 'given up' (as non-harvestable) by farmers (for various reasons), with permission, and donate the harvest to social organisations. For the time being, however, this remains a phenomenon of limited scope in Belgium.

4.2.1.2 Valorisation

Creation of food waste

The entire agricultural sector produces an estimated 449,000 tonnes of food waste, of which 63% in horticulture, 32% in arable farming and 5% in livestock farming. The high tonnage of food waste can be explained by the large production volume (high production per capita compared with other countries) that is growing thanks to the strong and increasing focus on exports. A major (but unknown) portion of the food waste in agriculture can be attributed to production for foreign markets.

The specific production conditions in agriculture also play an important role. After all, the farmer is directly dependent on 'natural' production conditions (such as e.g. the climate) over which he has no control. These circumstances can have a major impact on e.g. harvesting, sorting and storage losses. Examples include glassy potatoes due to drought or apples and pears with hail damage. This can also have an impact on quality and outcome further along the chain.

Table 11: Food waste in agriculture, by sector and subsector, tonnes, Flanders, 2015

Sector	Subsector	Food waste (tonnes)
Horticulture	vegetables open air	228,509
	vegetables sheltered cultivation	21,070
	fruit	33,242
	Total	*282,821*
Arable farming	cereals	4,809
	sugar beets	45,240
	potatoes	93,103
	Total	*143,153*
Livestock farming	milk	18,967
	meat	3,171
	eggs	1,240
	Total	*23,378*
Total agriculture		**449,352**

Horticulture produces around 283,000 tonnes of food waste, distributed across vegetables open air, vegetables sheltered cultivation and fruit. The most important horticultural crops in terms of volume of food waste are leeks (for the fresh market - 30% of food waste in horticulture), onions (for industry, 12% of food waste in horticulture) and spinach (for industry, 7% of food waste in horticulture). Other principal crops, in terms of volume of food waste, are pears, cauliflower (for industry), carrots (for industry), leeks (for industry) and apples.

Arable farming produces around 143,000 tonnes of food waste, 65% of which is from potato cultivation. Livestock farming produces around 23,000 tonnes of food waste. These figures are of a much smaller order of magnitude than previous surveys (Roels & Van Gijseghem, 2011). This monitoring ignores cattle deaths during production, since this does not involve animals that are ready for slaughter. The largest fraction of food waste comes from dairy farming (mainly non-consumable milk through mastitis).

Valorisation of food waste and cascade index

At the level of the whole agricultural sector, 70% of food waste returns to the soil, 11% is destined for animal feed (livestock feed). The main destination for food waste from horticulture is the soil (ploughing in), good for 62%. In second place is livestock feed (18%). By far the main destination for food waste from arable farming is the soil (ploughing in). The main destination for food waste in livestock farming, mostly unusable milk through mastitis, is discharge into the slurry pit (76% of food waste in livestock farming).

Table 12: Destinations of food waste in agriculture, % in relation to sector total, Flanders, 2015

Sector	Animal feed	Biobased materials	Soil	Anaerobic digestion	Composting	Energy	Incineration with energy recovery	Landfill/discharge *	Unknown destination	Total
horticulture	18%	-	62%	5%	6%	0%	-	0%	9%	100%
arable farming	0%	-	98%	2%	0%	0%	-	0%	0%	100%
livestock farming	0%	-	1%	0%	0%	23%	-	76%	0%	100%
Agriculture	**11%**	**-**	**70%**	**4%**	**4%**	**1%**	**-**	**4%**	**6%**	**100%**

* discharge of non-consumable milk into slurry pit in agriculture.

The cascade index weighs the food waste released in a sector according to its position on the food waste cascade. The cascade index of agriculture is 7.9. The agricultural sector scores highly in terms of valorisation. The valorisation of food waste as soil improver or livestock feed therefore forms an integral part of the core process of agriculture. This also contributes to the closure of natural cycles.

Table 13: Cascade index for agriculture, Flanders, 2015

Sector	Value of cascade index*
Agriculture	7.9

*minimum (lowest possible score) = 2, maximum (highest possible score) = 10.

4.2.1.3 Food losses and residues

If, within food waste, we distinguish between the edible and inedible fraction, we gain insight into the food losses and/or residues. The 449,000 tonnes of food waste in agriculture consist of 74% food losses (or 330,000 tonnes) and 26% residues (or 119,000 tonnes).

In horticulture, the food waste can be broken down into 79% food losses (223,000 tonnes) and 21% residues (60,000 tonnes). The most important horticultural crops in terms of volume of food losses are leeks (for the fresh market - 29% of food losses in horticulture), onions (for industry, 11% of food losses in horticulture) and carrots (for industry, 7% of food losses in horticulture). Other relevant crops are cauliflower (industry), leeks (industry), chicory (fresh), lettuce (fresh), pears and apples (fresh), all of which fluctuate around 5% of the total food loss in horticulture. Arable farming produces around 143,000 tonnes of food waste, of which 60% is food losses and 40% residues. Livestock farming produces around 22,000 tonnes of food waste, of which the majority is food loss.

If we express the food loss in relation to total production, we obtain the relative food loss. The relative food loss in Flemish agriculture is just 4%. In horticulture it is 11%, and in arable farming 2.4%. In livestock farming the proportion is less than 1%.

Table 14: Food losses and residues, by sector, tonnes, agriculture, Flanders, 2015

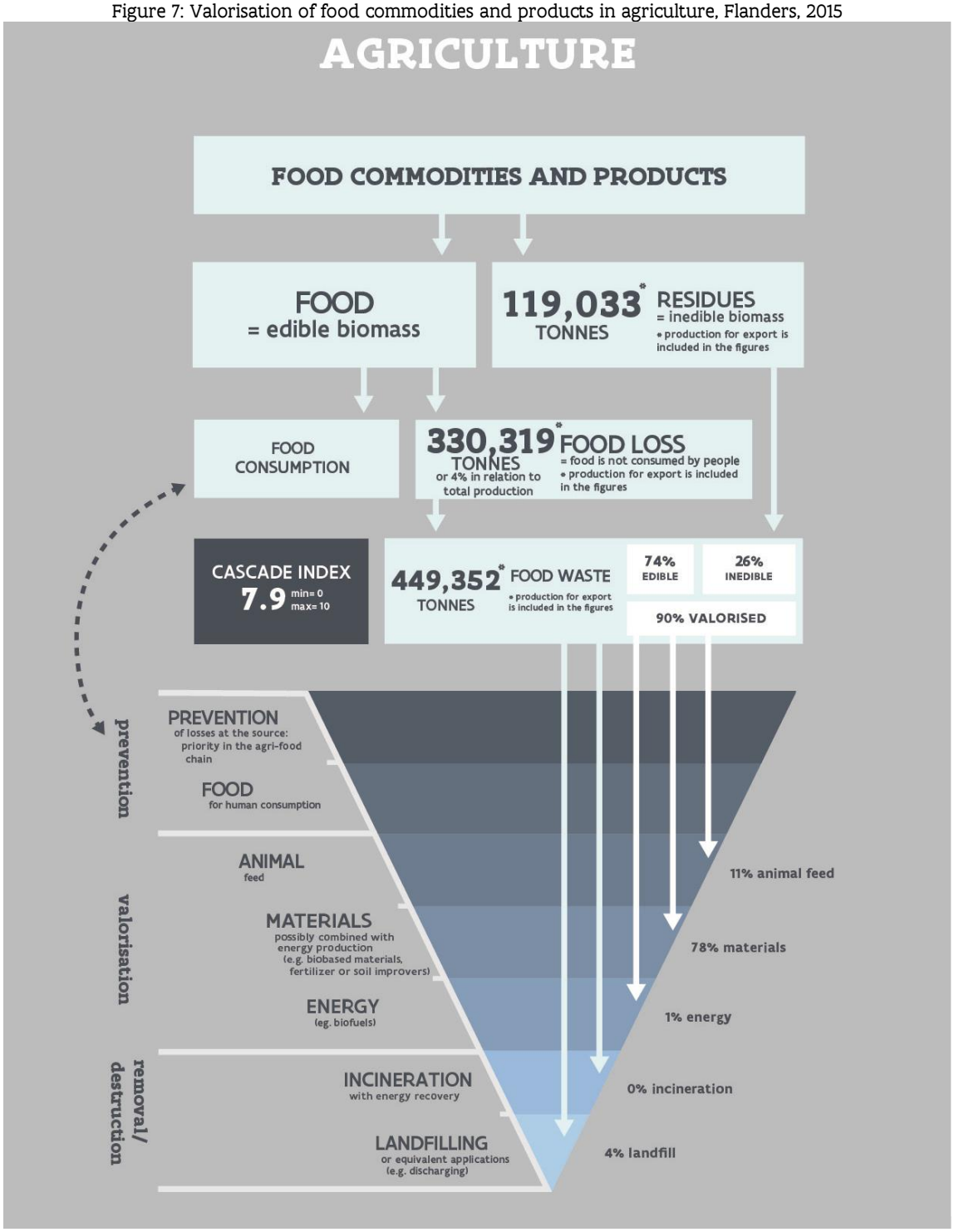
Sector	Subsector	Food losses: (=edible food waste) (tonnes)	Residues (=inedible food waste) (tonnes)
Horticulture	vegetables open air	174,900	53,609
	vegetables sheltered cultivation	21,015	55
	fruit	26,997	6,245
	Total	*222,912*	*59,909*
Arable farming	cereals	4,809	0
	sugar beets	7,872	37,369
	potatoes	72,993	20,110
	Total	*85,674*	*57,479*
Livestock farming	milk	18,967	0
	meat	1,650	1,522
	eggs	1,116	124
	Total	*21,732*	*1,646*
Total agriculture		**330,319**	**119,033**

Table 15: Proportion of food losses and residues in total food waste, agriculture, Flanders, 2015

Sector	Subsector	Edible fraction of food waste (=food losses) (%)	Inedible fraction of food waste (=residues) (%)
Horticulture	vegetables open air	77%	23%
	vegetables sheltered cultivation	100%	0%
	fruit	81%	19%
	Total	*79%*	*21%*
Arable farming	cereals	100%	0%
	sugar beets	17%	83%
	potatoes	78%	22%
	Total	*60%*	*40%*
Livestock farming	milk	100%	0%
	beef cattle	52%	48%
	eggs	90%	10%
	Total	*93%*	*7%*
Total agriculture		**74%**	**26%**

4.2.1.4 Visual presentation of results

Figure 7: Valorisation of food commodities and products in agriculture, Flanders, 2015



Food waste cascade as included in the OVAM Action Plan for the Sustainable Management of (Residual) Biomass Streams 2015-2020 (approved by FG 10/7/15), layout: Department of the Environment & Spatial Development

4.2.2 Data collection

4.2.2.1 Definition

The starting point for the monitoring is the point at which an organism (plant, animal, animal product) has reached its maturity and is ready to enter the (food) value chain. The organism is 'ready for harvesting' (vegetable) or 'ready for slaughter' (animal). Everything that happens before this moment lies outside the system under consideration, e.g. crop failures because disease or climate has damaged the crops, as a result of which they do not become 'ready for harvesting'. The end point is the point at which the product enters the processing phase, where the raw materials are converted into food products. Forms of preprocessing by the farmer are included. Transport from the farmer to processing also lies within the system boundaries.

We can only talk of food waste if food commodities and products are involved. Only if the crop was initially produced for human consumption (it is given the destination of human food) can it ever become food waste. In some cases the farmer does not know for what the final crop will be used (e.g. cereal cultivation), it concerns crops with different possible destinations (e.g. human food, livestock feed, energy crops, etc.). With such products we look at statistics on the respective proportions of food and non-food destinations of the crops. Only the proportion of crops with the destination of human food lies within the scope of this monitoring.

Besides inedible residues, there are other inedible biomass flows that are released at the beginning of the chain. We refer to 'inedible biomass waste flows not linked to food' to highlight the difference from residues. This concerns inedible biomass that we do not regard as a component of the food commodity or product and which does not therefore enter the food chain. This can also therefore never become food waste. Examples: a fruit tree, straw from corn, leaves and stalks of certain crops that are not harvested as standard and are left in the field, (earth) sludges that result from the washing of commodities, etc.

The 'food waste' surveyed in this monitoring are to be understood as a well-defined subgroup of the total quantity of 'biomass waste flows' released by primary production and which are the subject of other surveys (Kips & Van Droogenbroeck, 2012; OVAM, 2013). Biomass waste flows is the umbrella term for all released (waste) biomass.

Figure 8: Comparison of scope of monitoring of agriculture with scope of Genesys (ILVO) and Action plan for residual biomass streams (OVAM)

	Type of biomass waste	Agricultural phase *pre-harvest*	Agricultural phase *post-harvest*
Food waste	Edible fraction = food losses	A	B
	Inedible fraction = residues	C	D
Other biomass waste flows	Inedible biomass waste flows not linked to food (e.g. straw)	E	F

Scope of this monitoring = food waste from primary production post-harvest = B+D (green).
Scope of ILVO Genesys project and OVAM Biomass inventory = biomass residual flows from primary production = A+B+C+D+E+F (green+blue).

4.2.2.2 Methodology

The survey is based on the report 'Verlies en verspilling in de voedselketen' ('Loss and wastage in the food supply chain') (Roels & Van Gijseghem, 2011) and the update made on the basis of the SALV advice (update published in OVAM, 2012a). These documents mapped food waste for livestock farming, arable farming and horticulture. The definition used at the time was checked against the system boundaries of this monitor, as a result of which several food waste flows are no longer relevant and several extra food waste flows come into the picture. In general, the system boundaries corresponded well. In livestock farming in particular, there is a difference with a major impact on the figures. Thus, in the current survey we do not include the loss figures for cattle, as this concerns the 'pre-harvest' phase. Where arable farming is concerned, there are few differences. Food waste for vegetables is now mapped in more detail. For fruit we use the existing figures from 2011.

Based on the production figures for horticulture (tonnage of production) we examined whether the selection of crops from 2011 (based on area) still reflects the main crops in 2014 (most recent figures at start of data collection). Several crops were added, others removed. For the total production of vegetables, we have a coverage ratio with the selected crops of 80% of the total vegetable production. As regards fruit, we cover 99% of production with apples, pears and strawberries. We then extrapolated to total production (all crops). For arable farming, food waste is inventoried at the level of cereals, due to minor differences between crops of cereals. For industrial crops, we only looked at sugar beet (part intended for human consumption) and potatoes (excluding seed potatoes). For livestock farming, the main products were investigated: meat (cattle, pigs, chickens), milk and eggs.

The figures were compared with and supplemented on the basis of the figures from the GeNeSys project (ILVO, 2017b), the Action plan for Sustainable Management of (Residual) Biomass Streams 2015 of OVAM (2015a) and various other research projects (including ARBOR and CINBIOS). Differences in definition compared with this monitoring were also taken into account. Experts and farmers were then contacted on a targeted basis to make estimates for missing figures.

Specifically, during data collection the principal 'sources' of food waste were inventoried and quantified (absolutely (in tonnes) or relatively (in %)), as well as the destination of these food waste flows. Using production and area figures, we extrapolated to obtain a total for all cultivation. Calculations were then performed to be able to make a distinction within the food waste between the edible fraction of the food waste (=food loss) and the inedible fraction (=residue). Assumptions were used during this process. Mapping the destinations was no easy task. A particular food waste flow can often have various destinations, depending on crop, farmer, year, economic conditions, etc. When there was only a limited insight into the destinations, we chose to allocate the entire food waste flow to the principal common destination. The picture we have of valorisation is thus indicative.

4.2.3 Findings

The volumes of food waste and food losses in agriculture and horticulture are considerable. Key reasons for this are the high production volume (the higher the production, the more food waste) and the direct dependence on climatological conditions (more chance of food loss than in a controlled environment such as e.g. industrial processes). If we express the tonnages in relative terms, we get a more nuanced picture.

There is a lack of newly generated data on food waste in Flemish agriculture, mainly with regard to the plant sectors. Furthermore, the available figures are rarely based on actual measurements. They are often estimates by experts. This is an important point for consideration with regard to follow-up measurements: how can you measure evolution? It is therefore recommended to look for methods and ways of collecting data on waste flows in agriculture in a standardised manner, based on actual measurements. In this way, progress can be correctly monitored. If no measurements can be taken for all crops, the baseline measurement lets you determine which crops are best included in these measurements ('hotspots'). To be able to make as accurate an estimate as possible of the proportion of food loss in food waste, it must be determined for each product which fraction is edible and which is not; here too, a measurement of limited scope can deliver better data than the current assumptions.

It is not only difficult to find reliable figures on food waste quantities; determining their destination is also not obvious. For some products there is a good idea of where the food waste is currently going, while for other products it is harder to estimate or destinations fluctuate. Measuring valorisation over time is also an important point for consideration because this was also done on the basis of estimates.

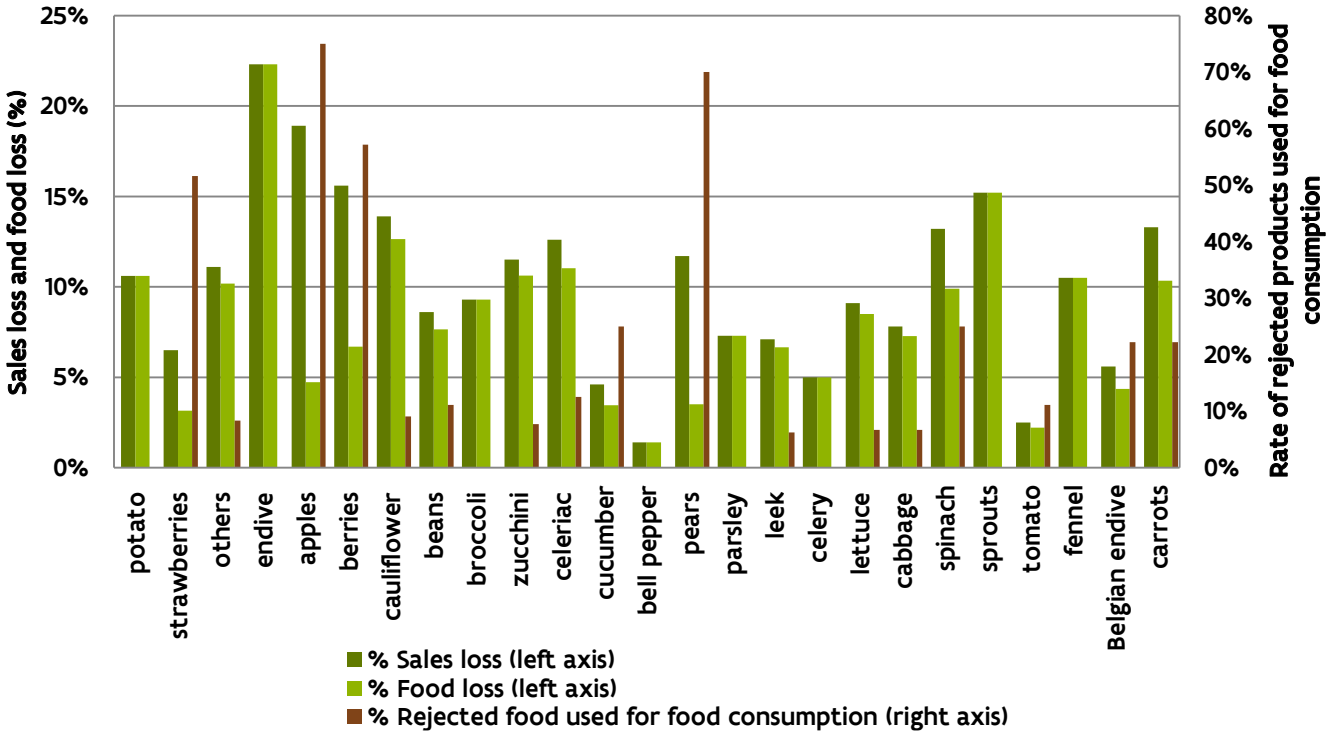
The data collection method used in particular offers an insight into the structural food waste and food losses in agriculture and is therefore to be understood as a barometer of the technological state of affairs in the sector. The present survey does not offer an insight into the food waste that arise from an economic or market reality. Possible examples include food waste because the prices for certain products are too low (price crisis) and harvesting/storage/transport is no longer economically viable. Another example is the existing practice in the fresh market of imposing quality requirements of a cosmetic nature that are not linked to the intrinsic quality or safety of the product. This can lead to food waste being created in agriculture if, as a result of these requirements, 'suboptimal' products can no longer be sold for human food. A recent study by Gent University for the Department of Agriculture and Fisheries, charts this specific issue. The following inset looks at the results of this study in greater detail.

Inset 1: Impact of cosmetic quality standards on food losses in the Flemish fruit and vegetable sector

Cosmetic quality requirements for vegetables and fruit are specific requirements with regard to colour, shape and size that must be met by harvested products after preparation and packaging. Their aim is to promote trade, optimise the packaging and logistical process and allow product differentiation. In the literature, cosmetic quality requirements are often linked to food losses. This is because complying with them means that part of the production does not enter the human food chain, but is being pushed towards lower value valorisations. Nowadays insights into concrete cosmetic quality requirements and consequences for product sales are fairly limited. Various studies argue that a large proportion of vegetables and fruit is lost, but few figures are available. The problem in the Flemish vegetable and fruit sector was mapped by means of a survey of growers and interviews with operators in the chain.

Unpredictable climatic conditions are suggested as being the main cause of cosmetic defects. More than two thirds of the horticulturalists questioned cannot sell some of their products in the intended sales channel because they do not meet the cosmetic quality requirements (=sales loss). On average, sales loss of 10.2% is cited, but mutual differences depending on the crop and the grower may be considerable. Figure 9 illustrates this. The left axis shows the sales loss, the right axis the percentage of rejected products that are still given the destination of human food. Based on this percentage, that part of the sales loss that effectively also becomes a food loss is calculated. The bigger the brown bar, the less food loss and the greater the difference between the dark-green and the light-green bars.

Figure 9: Sales loss and food loss as a result of cosmetic quality requirements, per crop, Flemish horticulture, 2016



Source: Roels & Van Gijseghem, 2017

In at least one third of cases, the sales loss is given a human valorisation through processing, social initiatives or selling at he farm. More than half of these suboptimal vegetables and fruit, approximately 120,000 tonnes if we add up the main crops, disappear from the human food chain, leading to food loss. They are used as livestock feed, anaerobically digested, composted, applied to the land or simply not harvested. The report closes with one or two suggestions for change. The various links in the chain that are involved each have the potential to reduce food losses through cosmetic requirements.

More information: Roels K. & Van Gijseghem D. (2017) *The impact of cosmetic quality standards on food losses in the Flemish fruit and vegetable sector*, summary report, Department of Agriculture and Fisheries, Brussels, http://www.vlaanderen.be/landbouw/studies.

4.3 AUCTIONS

This chapter was prepared in collaboration with Aranka Delombaerde (Department of Agriculture and Fisheries) and Laurien Danckaerts (VBT - Association of Belgian Horticultural Cooperatives).

Producer organisations play a major role in the Flemish chain of vegetables and fruit for the fresh market. This Flemish context is fairly unique in Europe and beyond. The producer organisations occupy a central position between the horticulturalists who deliver their product (supply) and the wholesalers and retailers who buy these products (demand).

The sale of fresh vegetables and fruit in Flanders has a long cooperative tradition, and traditionally takes place through auctions. In 1997 all auctions were accredited as producer organisations (PO) on the basis of a change in the Common Organisation of the Fruit and Vegetable Markets. POs were also created for the fresh market, separately from the auctions. In Flanders, almost 90% of all vegetables and fruit is placed on the market through producer organisations. In the European vegetable and fruit sector, Flanders is the forerunner in this regard. As of 2016 Flanders has thirteen accredited producer organisations. The Association of Belgian Horticultural Cooperatives (VBT) is the non-profit organisation that represents the interests of vegetable and fruit marketing cooperatives. In 2016 ten of the 13 accredited producer organisations are affiliated to the VBT. In 2014 the members of the VBT jointly accounted for 97% of sales of all POs (Department of Agriculture and Fisheries, 2016a).

4.3.1 Results

4.3.1.1 Prevention

The auction system is focused on aligning supply and demand as much as possible and avoiding losses. Products taken 'off the market' to neutralise a surplus or oversupply are initially offered for free distribution to social organisations.

Through the intervention scheme in the context of the Common Organisation of the Fruit and Vegetable Markets, surpluses with producer organisations are taken off the market. Unsold products are initially distributed to social institutions. There is a legislative framework in this regard. What is not collected for free distribution goes to non-human valorisations. In 2015, 14,337 tonnes of marketable product were taken off the market by producer organisations. In total, 1,477 tonnes of vegetables and fruit, or 10% of the total, ended up being distributed for free. 96% of this flow is vegetables (mainly tomato, chicory, leek, lettuce and courgette), the other 4% is fruit (mainly apples and pears) (Department of Agriculture and Fisheries, 2016a).

The proportion of donated products in relation to the total quantity of food surpluses among producer organisations is 10%. All these surpluses are perfectly consumable products at the time of intervention (removal from the market). In theory, these are 100% suitable for social redistribution. In practice, however, various problems arise: strong seasonal fluctuations in supply, limited capacity of the social organisations as a result of restrictions in logistics or manpower, having to distribute free of charge, etc.

4.3.1.2 Valorisation

Creation of food waste

Food waste in producer organisations in the fresh market amounts to 15,277 tonnes. 84% of the food waste consists of marketable product that has been taken off the market. 62% of the marketable product is vegetables, and 38% fruit. Apples (55%) and pears (41%) are the main varieties of fruit, supplemented with strawberries (4%). The main vegetables are tomatoes (37%), lettuce (28%) and 'other vegetables' (14%). The list is completed with peppers (9%), chicory (8%) and courgettes (5%).

Table 16: Food waste in POs, tonnes, Flanders, 2015

Type of flow	Food waste (tonnes)
non-marketable product	2,417
marketable product	12,860
total unsold product	**15,277**

Source: calculation based on VBT (2016) and Department of Agriculture and Fisheries (2016a)

Valorisation of food waste and cascade index

The main destinations of food waste are livestock feed (36%), soil (28%) and composting (17%). The non-marketable product ends up being anaerobically digested much more often (73% versus 0% for marketable product). The marketable product is more likely to find its way into livestock feed (41% versus 10% for non-marketable product), soil (30% versus 17% for non-marketable product) and composting (20% versus 1% for non-marketable product).

Table 17: Destinations of food waste, by type of flow, POs sector, % in relation to sector total, Flanders, 2015

Type of flow	Animal feed	Biobased materials	Soil	Anaerobic digestion	Composting	Energy	Incineration with energy recovery	Landfill/discharge	Unknown destination	Total
Non-marketable product	10%	-	17%	73%	1%	-	-	-	0%	100%
Marketable product	41%	-	30%	0%	20%	-	-	-	9%	100%
Total unsold product	**36%**	**-**	**28%**	**11%**	**17%**	**-**	**-**	**-**	**8%**	**100%**

Source: calculation based on VBT (2016) and Department of Agriculture and Fisheries (2016a)

The cascade index weighs the food waste released in a sector according to its position on the food waste cascade. The cascade index of the producer organisations is 8.8. The producer organisations score highly in terms of valorisation. The cascade system in the public and private policy of auctions also bore fruit.

Table 18: Cascade index for POs, Flanders, 2015

Sector	Value of cascade index*
Auctions	8.8

*minimum (lowest possible score) = 0, maximum (highest possible score) = 10.

4.3.1.3 Food losses and residues

The food waste consists almost entirely of food losses (96%, or 14,629 tonnes). The inedible fraction or the proportion of residues is 4% and accounts for 647 tonnes.

In 2015, 1,062,502 tonnes of product were delivered to VBT members. The food loss (of all POs) in relation to supply (to VBT marketing cooperatives) is just 1.4%.

Table 19: Food losses and residues, tonnes, POs, Flanders, 2015

	Food losses (=edible food waste) (tonnes)	Residues (=inedible food waste) (tonnes)
total unsold product with producer organisations	14,629	647

Source: calculation based on VBT (2016) and Department of Agriculture and Fisheries (2016a)

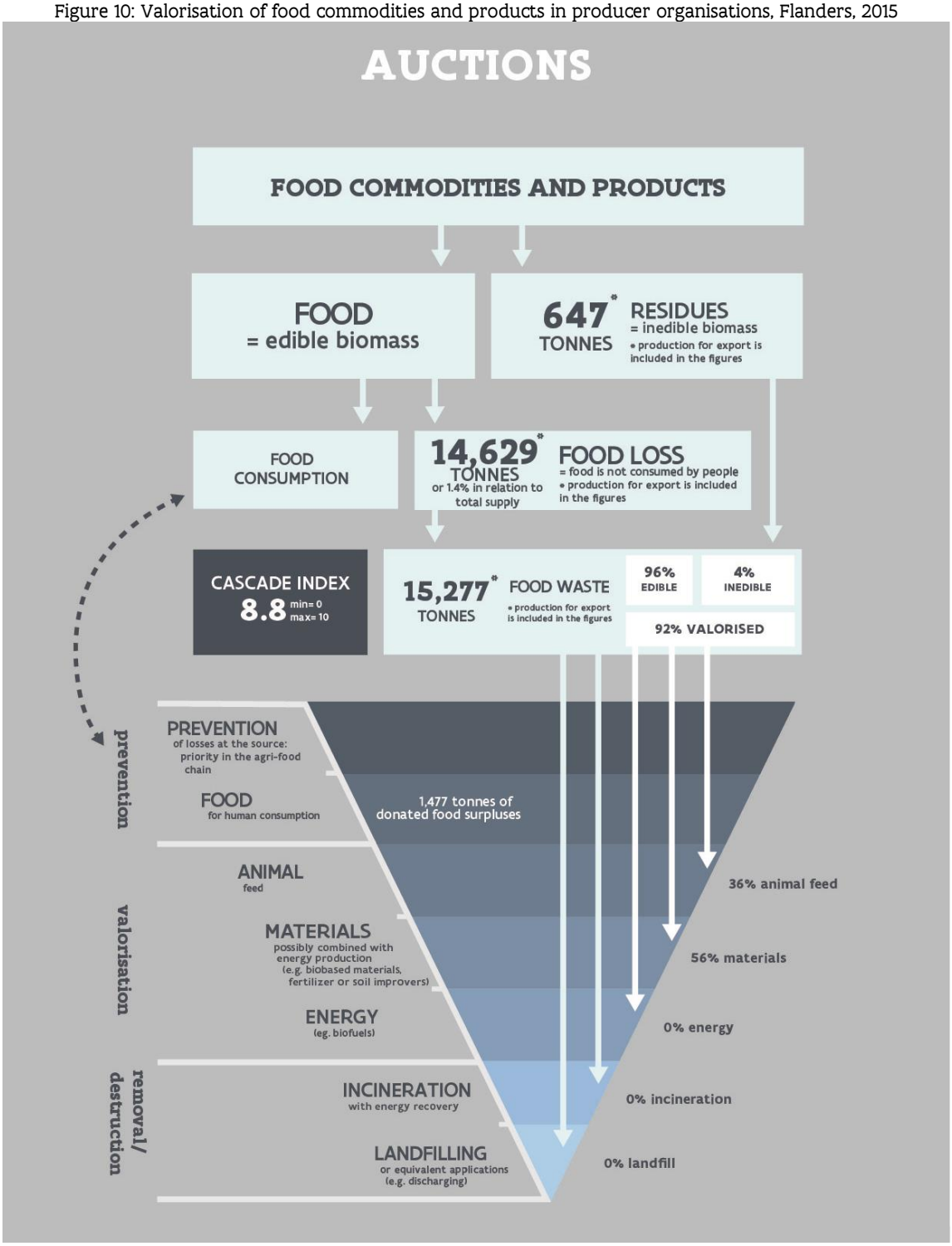
Table 20: Proportion of food losses and residues in total food waste, POs, Flanders, 2015

	Edible fraction of food waste (=food losses) (%)	Inedible fraction of food waste (=residues) (%)
total unsold product in producer organisations	96%	4%

Source: calculation based on VBT (2016) and Department of Agriculture and Fisheries (2016a)

4.3.1.4 Visual presentation of results

Figure 10: Valorisation of food commodities and products in producer organisations, Flanders, 2015



Food waste cascade as included in the OVAM Action Plan for the Sustainable Management of (Residual) Biomass Streams 2015-2020 (approved by FG 10/7/15), layout: Department of the Environment & Spatial Development

4.3.2 Data collection

4.3.2.1 Definition

To stabilise the market in difficult situations ('crises') and secure an economically viable price for horticulturalists and producer organisations, a decision can be taken to 'intervene' in the market. In that case, products are taken 'off the market' to neutralise a surplus or oversupply. Products that were offered for sale but not sold are also eligible for intervention. The figures on products taken off the market given in this report include all products taken off the market, through both crisis intervention and regular intervention.

These products follow the food waste cascade and are initially offered for free distribution. Products can be taken off the market both through the official intervention mechanism (intervention) and outside it (non-intervention). In 2015 the latter did not occur (VBT, 2016; Department of Agriculture and Fisheries, 2016a).

4.3.2.2 Methodology

The data on which we base ourselves come from the VBT (Association of Belgian Horticultural Cooperatives, 2016). Combating food loss is an element of the collective sustainability label 'Responsibly Fresh', managed by the VBT. Food waste at the level of auctions affiliated to the VBT are therefore monitored twice-yearly in connection with the Responsibly Fresh report. The VBT monitors unsold products, broken down into marketable product (from 'intervention' and from 'non-intervention') and non-marketable product (e.g. rotten or damaged products), and the destinations assigned to these products.

We supplement the VBT data with figures from the Department of Agriculture and Fisheries collected within the context of the official intervention mechanism (Department of Agriculture and Fisheries, 2016a). Because there are also several POs for the fresh market that are not covered by the umbrella of the VBT, we thus get a complete picture of all producer organisations, even though the proportion of these other POs (expressed in total turnover) is limited to 3%. In addition, growers who are not members of POs can also use the intervention mechanism. In 2015 this did not happen. The figures from the Department of Agriculture and Fisheries also allow a further breakdown at product level.

The missing figures for non-VBT members (destinations + tonnage for non-marketable product) were calculated using the VBT figures. To be able to make a distinction within the food waste between food losses (edible) and residues (inedible), for each product, we base ourselves on the assumptions made when monitoring food loss in agriculture. For the categories 'other fruit' and 'other vegetables' we take the average. We only use this breakdown for marketable product, because figures are available at product level. Where non-marketable products are concerned, we assume that the proportion of fruit to vegetables and the product composition are comparable with the marketable products.

4.3.3 Findings

Few food waste occurs at auction level. The cascade system, which is anchored in the policy and the sector, offers a good guarantee of optimum valorisation of food waste. Food waste at the level of the producer organisations consists mainly of peak flows with little market value, which makes structural

valorisation and economically viable marketing or distribution more difficult. Conversely, however, these are perfectly marketable products that have already been brought together centrally. This offers economies of scale in terms of food safety, processing and logistics. The good relationship with agriculture provides extra opportunities for valorisation in terms of soil and livestock feed.

Priority must lie with examining how valorisation towards food can be increased within the cascade system, i.e. how we can take steps up the cascade. The flow towards human food is currently negligible compared with the flow that is given a non-human destination. Other possibilities than free distribution of surpluses should be investigated as valid options (e.g. (social) processing outside the intervention programme). The sector should also look for innovative joint ventures (e.g. with social economy operators) to prevent food loss from marketable surpluses. The government can organise its policy framework to facilitate this as much as possible.

One example is the project implemented by Komosie (umbrella organisation of environmental entrepreneurs in the social economy) together with Belorta, with the support of the Flemish Government, to give more surpluses from auctions a social destination, possibly linked to social employment (Komosie, 2017). This project has given rise to specific policy recommendations in relation to improving regulations on the granting or processing of fruit and vegetable surpluses from auctions in Flanders on behalf of food aid organisations. These policy recommendations can further stimulate the cascading of food surpluses towards human consumption.

Within the various non-human applications, further efforts can be made to valorise as high as possible on the food waste cascade. Investigations could be carried out to see whether and in what way the auctions could act as central collection points for not only food products but also food waste flows from horticulture. These could flow towards other valorisations in a coordinated manner, with both human and non-human consumption as the outcome. A profitable win-win for horticulturist and auction is essential here.

Nowadays, food waste is monitored in detail by both the sector (Responsibly Fresh reports) and by the government (Common Organisation of the Fruit and Vegetable Markets). This monitoring should be maintained to allow subsequent measurements and monitor developments. The sector can try to minimise the flow with unknown destination. Reporting by government can be further refined in the future in terms of destinations.

4.4 FOOD INDUSTRY

This chapter was prepared in collaboration with Liesje De Schamphelaire (FEVIA Vlaanderen).

The food industry is a major sector in Flanders. However, with 28 subsectors, here grouped into 8 subsectors, the scope (production) and diversity of the food waste is also much greater compared with other sectors. The advantage is that there is already a strong focus on collecting data on food waste in the food industry.

4.4.1 Results

It should be stressed that the results obtained are not precise figures. They are estimates, based on available figures, but for which assumptions must be made. Furthermore, the results depend on the chosen sample and market conditions. A sizeable margin of error should be borne in mind when looking at the results, among other things in relation to the division into food losses and residues.

4.4.1.1 Prevention

Figures on prevention at the source are not available. One example of a prevention effort in industry is the optimisation of packaging. By doing so, food companies ensure that their products remain preserved in the best possible way, increasing their shelf life and allowing them to reach their final destination safely. The packaging also helps reduce food loss during transport between companies and at the consumer. Innovative packaging technologies that avoid food losses and minimise the overall environmental impact of product and packaging are being investigated further.

Another example of prevention within the food industry is the use of (acclimatised) accumulation tables, towers and the like. If part of a production line is interrupted for a brief time, the intermediate products can be stored in optimal conditions for that time, allowing them to be finished once the production line is operational again. There are numerous similar examples in the food industry. Raw materials represent a major portion of a company's production costs. All measures to counter food losses are therefore very important.

In collaboration with FEVIA, OVAM organised a specific survey of food companies in 2012. The results are given in the report 'Biomass inventory 2011-2012' (OVAM, 2013). The survey maps food waste during and after the production process, including unsold foods and their destination.

In total, 13,000 tonnes of products, around 10% of the total quantity of unsold products, are donated to social organisations in the broad sense of the word (e.g. food banks, but also local associations such as youth movements who are off camping). 33% of unsold products are processed into saleable products.

A major portion of the food surpluses in industry are no longer suitable to being offered for social redistribution. This involves, for example, products with quality problems or products for which the use-by date has expired. In addition, food losses also occur during production processes. In terms of kind and quality, these are mostly also not suitable for donating. There is no insight into the proportion of unsold products still suitable for donation. Finished products are generally easier to donate than intermediates. In this regard, the division of food waste during and after production may be a possible

indication (see table 21). On the one hand, however, not all finished products can be donated, and on the other hand, non-finished products may be able to be donated.

Despite this, there also seems to be more as yet untapped potential in industry for social redistribution (apart from existing difficulties on the demand and supply sides, e.g. logistics).

4.4.1.2 Valorisation

Creation of food waste (sum of food losses and inedible residues)
Total food waste in the food industry is around 2.35 million tonnes, 97% of which is created during production and 3% after production, being unsold foodstuffs.

Table 21: Food waste (food losses + inedible residues) during and after production, tonnes, food industry, Flanders, 2015

Flow	Quantity (tonnes)
Food waste during production	2,274,662
Food waste after production	74,783
Total food waste in food industry	**2,349,445**

Source: calculation based on OVAM, 2013

The high tonnage of food waste can partly be explained by the fact that the food industry has a very large production volume (high production per capita compared with other countries) that is growing thanks to the strong and increasing focus on exports. Exports account for around half the turnover of the food industry. A major portion of the food waste flows can therefore be attributed to production for foreign markets. It is not, however, possible to express how many of the food waste created can be linked to domestic and foreign consumption respectively.

In the food industry, the process also takes place that relatively speaking generates the most inedible food waste (=residues), namely the processing of raw materials into food products. The creation of these residues is thus concentrated in the chain at the processing link. Inedible food waste accounts for 90% of the food waste in the food industry (see below).

Valorisation of food waste and cascade index
Based on estimated destinations, 99% of the food waste are given a useful destination, mainly livestock feed (55%), anaerobic digestion (26%) and soil (11%). Less than 1% has to be destroyed, mostly because of legal provisions.

Table 22: Destinations of food waste in food industry, % in relation to sector total, Flanders, 2015

Sector	Animal feed	Biobased materials	Soil	Anaerobic digestion	Composting	Energy	Incineration with energy recovery	Landfill/discharge	Unknown destination	Total
Food industry	55%	0%	11%	26%	-	7%	1%	-	-	100%

Source: calculation based on OVAM, 2013

High-quality valorisation of residues is structurally anchored in the food industry. We find important explanations in the nature (e.g. purity) and structural availability of food waste, which can contribute, for example, to the profitability of certain forms of valorisation. The industrial nature of the sector not only offers an advantage in terms of prevention (through high efficiency of production), but also provides opportunities to process food waste internally (presence of technology, capital, knowledge, etc.). The close relations with the agricultural sector, which supplies raw materials but can also process waste flows e.g. as animal feed or soil improver, and the livestock feed sector, also contribute to the exchange and recycling of food waste flows.

The cascade index weighs food waste released in a sector according to its position on the food waste cascade. The cascade index of the food industry is 8.8. The food industry scores highly in terms of valorisation. The valorisation of food waste flows as animal feed or soil improver is therefore intrinsically linked to operational management within the food industry.

Table 23: Cascade index for food industry, Flanders, 2015

Sector	Value of cascade index*
Food industry	8.8

*minimum (lowest possible score) = 0, maximum (highest possible score) = 10.

4.4.1.3 Food losses and residues

Based on the available figures and relying on assumptions (per destination x subsector), it is estimated that 10% of the food waste flows from the food industry consists of food losses (225,000 tonnes) and 90% of residues (2.12 million tonnes).

The high inedible fraction of food waste (the residues) is a direct consequence of the core business of the food industry, namely the processing of raw materials into finished food products. Most of the inedible parts of food commodities and products (the residues) are released during this processing. The creation of residues is thus concentrated in the chain at the processing link: the food industry.

Exact figures on the total production of the food industry for human consumption are not available. By combining several data sources, FEVIA (2017) estimates the production of the Flemish food industry in terms of magnitude at approximately 15 million tonnes. The proportion of food loss in relation to this production volume, expressed in tonnes, is 1.5%.

Table 24: Estimated quantities of food losses and residues in food industry, tonnes, Flanders, 2015

Sector	Food losses (=edible food waste) (tonnes)	Residues (=inedible food waste) (tonnes)
Food industry	225,481	2,123,964

Source: calculation based on OVAM, 2013

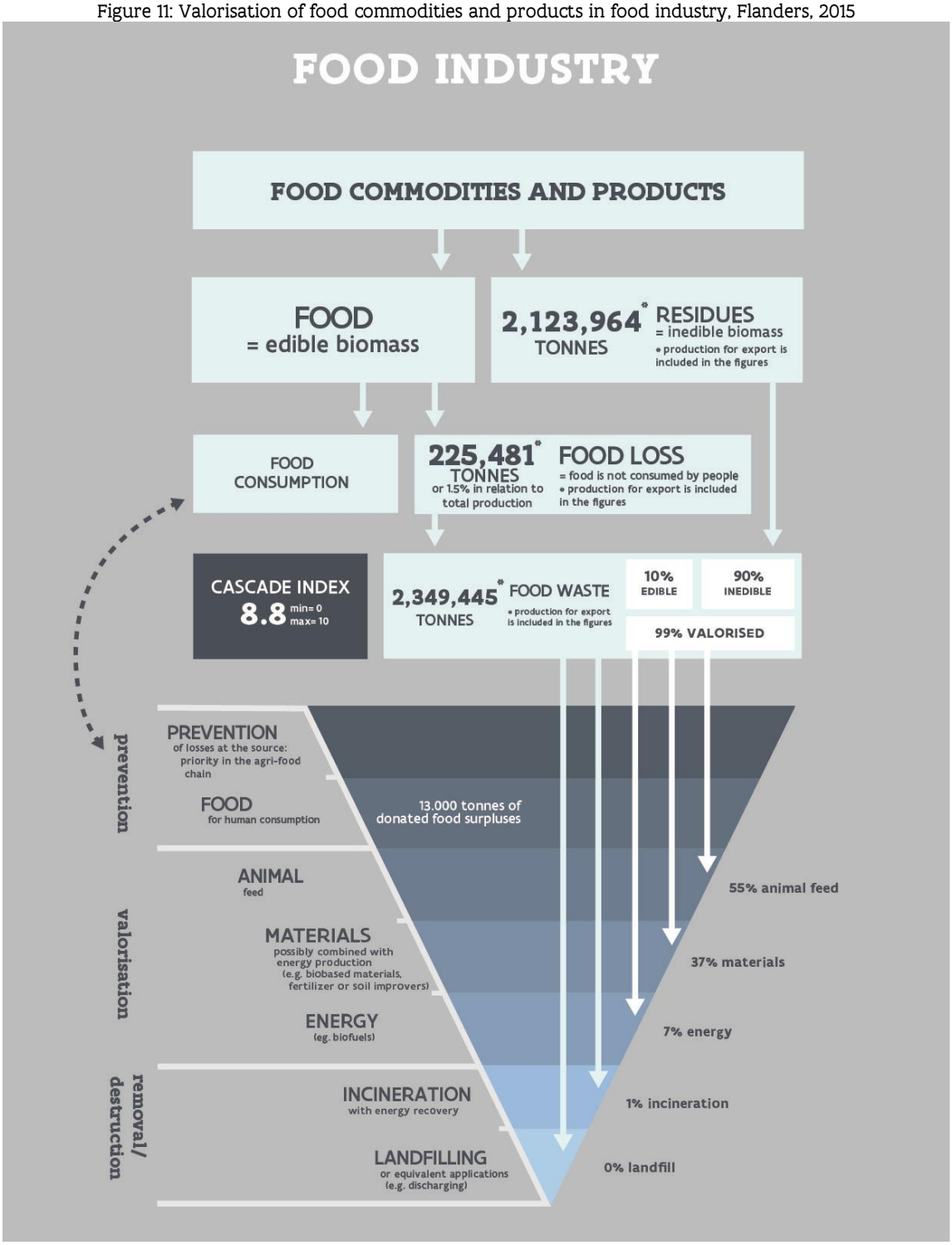
Table 25: Edible (food loss) and inedible (residues) fraction of food waste in food industry, tonnes, Flanders, 2015

Sector	Edible fraction of food waste (=food losses) (%)	Inedible fraction of food waste (=residues) (%)
Food industry	10%	90%

Source: calculation based on OVAM, 2013

4.4.1.4 Visual presentation of results

Figure 11: Valorisation of food commodities and products in food industry, Flanders, 2015



Food waste cascade as included in the OVAM Action Plan for the Sustainable Management of (Residual) Biomass Streams 2015-2020 (approved by FG 10/7/15), layout: Department of the Environment & Spatial Development

4.4.2 Data collection

4.4.2.1 Definition

Because in the food industry raw materials are processed into finished products, large numbers of organic flows are created. Edible (=food losses) and inedible parts of food commodities and products (=residues) come under food waste. 'Non-associable' inedible flows, such as e.g. soil released when cleaning the product, are ignored. There are regularly 'grey' flows, flows where it is unclear whether they are edible or not, e.g. whey in milk production, bran in the processing of cereals or watery flows containing an (unknown) portion of drinks. These flows are inedible *as such* or their 'edibility' is very much up for discussion. These flows are not a priority for reduction and are also already valorised in practice. To avoid making the quantification of food waste over-complicated, we therefore do not count these as food losses, but as residues.

The livestock feed industry, part of the food industry in terms of NACE code, is not included in the monitoring because it is not a sector that focuses on human food.

4.4.2.2 Methodology

OVAM and the Department of Agriculture and Fisheries have, together with FEVIA, plotted which data are available and best to use for the monitoring. For this the data from three different sources were analysed for conceptual definition, sample and representativeness, and the presence of exceptional circumstances.

In 2012-2014 FEVIA Vlaanderen, as part of the New Industrial Policy, implemented the project 'Voedselverlies in de voedingsindustrie' ('Food loss in the food industry') (FEVIA, 2014). This comprised two parts. The first part consisted of a survey of food companies looking at food losses and their destinations. The second part consisted of audits of food companies in which food losses and their causes were inventoried.

Every two years, companies from the food industry are questioned by OVAM about the quantity and destination of 'food waste' in their company in connection with the IER (Integrated Environmental Report). Specifically for food waste, OVAM uses the statistical module "Food Waste Plug-in", developed at European level. Companies are required to record the data and submit them to OVAM. This is a large sample, with the results being extrapolated at Flemish level. OVAM has such data for 2012 and 2014. As part of the Biomass Inventory 2011-2012, OVAM (2013) also conducted an extensive survey into the supply and destination of food waste during and after production (the latter are the unsold food goods) in the food industry. This supplemented the IER data.

The various data sources complement each other. The most important figures often corresponded in terms of magnitude. Not all differences at subsector level could be explained, so we only give certain figures at sector level in this chapter. The data from the Biomass Inventory, based on the structural approach via the IER (two-yearly measurement), go into most detail, highlight the most destinations and make subsequent measurements possible. It was therefore decided in consultation to use the (supplemented) data from the Biomass Inventory for the baseline measurement. The results were compared with the other data sources. This method can be further refined going forward. Via the IER (OVAM), the focus is on extra data collection.

Assumptions were used for the breakdown of food waste into food losses (edible) and residues (inedible). Exact data on this are not available within government or sector. The percentages relate to estimates, with an unknown margin of error. The percentages themselves can vary significantly by subsector and evolve over time, depending on fluctuating market conditions, disasters, etc. As a result, it was decided not to include the quantities per subsector in the monitoring report. For the food waste flows released during production, assumptions were made for each sector and destination concerning the proportion of edible and inedible fraction. For example, x% of the food waste from the meat industry that go towards anaerobic digestion consists of food loss and (100-x)% of residues. For the food waste released after production (the unsold food products excluding what is processed or donated), it is assumed that in principle, everything is (has been) edible. This is because these are mainly products with a deviation in quality, a packaging fault or products whose use-by date has past or is approaching, meaning they can no longer be sold.

4.4.3 Findings

Because of the large production volume and the nature of its activities (processing), the food industry produces a large number of food waste. However, only a small portion of this is edible (10%), so the food loss is relatively low. This fact can stay the same and improve further through continued attention to optimising processes and operations and by reprocessing surpluses as much as possible internally or externally into food products for human consumption. Surpluses that still remain should be passed on to social organisations wherever possible.

The sector scores highly in terms of valorisation of residues. The food industry depends on agriculture for its raw materials. Agriculture in turn depends on livestock feeds, which are also produced, among other things, by the food industry (often on the basis of food waste). Good relations and a win-win collaboration are important to maintain and further strengthen the existing symbiosis with food waste within the agrofood industry.

The pinnacle of high-quality valorisation is the upgrading of (substances from) inedible food waste to human food (which brings us back to prevention). You cannot take a greater step on the food waste cascade. The food industry has the residues, the necessary knowledge to process raw materials into finished food products and experience of seeking out markets for new products. Innovation and technological progress complete the puzzle. Numerous ongoing research projects therefore focus on the valorisation of residues in food.

4.5 RETAIL

This chapter was prepared in collaboration with Luc Ardies (Buurtsuper.be/Unizo) and Géraldine Verwilghen (COMEOS Vlaanderen).

Produced food finds its way to the end consumer via the distribution sector. The distribution sector comprises 3 subsectors: wholesale, retail and markets. Wholesale consists of *business to business* traders. Retail delivers physical goods for personal use to the consumer. Food retail can be further divided into different segments: non-specialised retail (the supermarkets) and specialised retail (e.g. butchers). Markets make up a very small subsector.

4.5.1 Results

4.5.1.1 Prevention

Figures on prevention at the source are not available. One example of a prevention effort in retail is the optimisation of the provisioning system with a view to optimum stocks in stores. Not too little, because retailers want to be able to serve their customers, but also not too much. In this way retailers avoid having products that are approaching their sell-by date and will become unsellable.

Within the context of their contribution to the collection of data on food waste, COMEOS (federation of supermarket chains, among others) and Buurtsuper.be (federation of independent supermarket owners) also supplied figures on donated food surpluses.

From a survey of its retail members, COMEOS (2016) concludes that the participating companies donate at least 1,876 tonnes (or 3.5% of all unsold surpluses). It has not been possible to map all donations. More and more local actions are being organised. This is therefore an underestimate. This is something that can be improved in a subsequent measurement. 97.9% of donations consist of recurring collections. Extrapolated, we get 1,130 tonnes of donated food surpluses in Flanders by large distribution and hard discount. A striking trend is that (almost) all supermarket chains are in the process of introducing a central policy (if they did not previously have one) for donating from their stores.

From a survey of its members, Buurtsuper.be (2016) concludes that in an average neighbourhood supermarket, 3.47% of the turnover in food is not sold. A little less than 1/4 (23%) is donated to social organisations. Almost 6 out of 10 of the neighbourhood supermarkets donate food surpluses to social organisations. According to estimates, the subsector of neighbourhood supermarkets accounts for a total of around 1,226 tonnes of donated food surpluses on an annual basis. The lack of alignment between the time goods are offered on the expiry date and organisations that can organise themselves to collect them systematically seems to be the main difficulty for neighbourhood supermarkets that do not yet donate food surpluses.

In total, an estimated 2,356 tonnes of food surpluses were thus donated in 2015 from retail. Not all food surpluses in retail are suitable to being offered for social redistribution. This involves, for example, products for which the use-by date has expired. Despite this, there also seems to be more as yet untapped potential in retail for social redistribution (apart from existing difficulties on the demand and supply sides).

4.5.1.2 Valorisation

Creation of food waste

Non-specialised retail produces 54,000 tonnes of food waste. Large distribution accounts for 58% of food waste, neighbourhood supermarkets have a share of 37%. The other retail sectors account for 11,000 tonnes of food waste, mainly due to specialised retail (butchers, cold bakers, fishmongers, etc.). In total, retail produces 65,000 tonnes of food waste.

Table 26: Food waste in retail, by subsector, tonnes, Flanders, 2015

Subsector retail	Food waste (tonnes)
non-specialised retail F1/HD	31,206
non-specialised retail F2	19,945
non-specialised retail F3	2,730
non-food retail	2,073
specialised retail	8,693
markets	181
Total	**64,828**

Source: calculation based on Buurtsuper.be, 2016; OVAM, 2016; COMEOS, 2016; Nielsen, 2016

Valorisation of food waste and cascade index

Three quarters (77%) of the food waste from retail are selectively collected. This percentage is highest in large distribution (90%) and lowest in non-food retail (25%) and markets (14%). In medium and small distribution and specialised retail, the percentage of selective collection is around 65%.

Table 27: Food waste in retail, according to collection method and by subsector, Flanders, 2015

Sector	In residual waste		Selectively collected		Food waste
	tonnes	*%*	*tonnes*	*%*	*tonnes*
non-specialised retail F1/HD	2,999	10%	28,207	90%	31,206
non-specialised retail F2	6,471	32%	13,474	68%	19,945
non-specialised retail F3	894	33%	1,836	67%	2,730
non-food retail	1,550	75%	523	25%	2,073
specialised retail	3,035	35%	5,658	65%	8,693
markets	156	86%	25	14%	181
Total	**15,105**	**23%**	**49,723**	**77%**	**64,828**

Source: calculation based on Buurtsuper.be, 2016; OVAM, 2016; Comeos, 2016; Nielsen, 2016

We may infer from the table below that almost half of all food waste from retail is anaerobically digested. Because of more selective collection (and so less residual waste), the food waste in large distribution and hard discount is incinerated to a lesser degree (10% of the subsector total) than the food waste in other sectors (29% of total food waste in retail is incinerated). However, we did not set up any specific measurements/surveys for the other subsectors. This may therefore lead to adjustments in the future. Composting follows in third place: 16% of the food waste in retail is given this use. Two

per cent goes to biobased materials, these being food waste from large distribution and hard discount that is used in biochemistry.

Table 28: Destinations of food waste in retail, % in relation to (sub)sector total, Flanders, 2015

Sector	Animal feed	Biobased materials	Soil	Anaerobic digestion	Composting	Energy	Incineration with energy recovery	Landfill/discharge	Unknown destination	Total
non-specialised retail F1/HD	7%	4%	-	74%	5%	-	10%	-	-	100%
non-specialised retail F2	0%	0%	-	27%	27%	-	46%	-	-	100%
non-specialised retail F3	0%	0%	-	27%	27%	-	46%	-	-	100%
non-food retail	0%	0%	-	11%	11%	-	78%	-	-	100%
specialised retail	0%	0%	-	29%	29%	-	41%	-	-	100%
markets	0%	0%	-	6%	6%	-	88%	-	-	100%
Total retail	**3%**	**2%**	**-**	**49%**	**16%**	**-**	**29%**	**-**	**-**	**100%**

Source: calculation based on Buurtsuper.be, 2016; OVAM, 2016; COMEOS, 2016; Nielsen, 2016

The cascade index weighs the food waste released in a sector according to its position on the food waste cascade. The cascade index of retail is 6.3%. Increasing selective collection takes food waste away from incineration with energy recovery and makes high-quality valorisation possible.

Table 29: Cascade index for retail, Flanders, 2015

Sector	Value of cascade index*
Retail	6.3

*minimum (lowest possible score) = 0, maximum (highest possible score) = 10.

4.5.1.3 Food losses and residues

Retail produces around 65,000 tonnes of food waste, of which an estimated 2/3 is food loss (67%, or 43,000 tonnes) and 1/3 (33%, or 21,000 tonnes) is residues. There are no figures on the total quantity of food products purchased and traded by Flemish retail. Based on a measurement from a large retailer and a survey of neighbourhood supermarkets, however, it is possible to estimate the food loss in relation to the total turnover of the sector. For Flemish retail, we estimate this relative food loss at 2.6%.

Table 30: Food losses and residues in retail, tonnes, Flanders, 2015

Subsector retail	Food losses (=edible food waste) (tonnes)	Residues (= inedible food waste) (tonnes)
Total	**43,391**	**21,437**

Source: calculation based on Buurtsuper.be, 2016; OVAM, 2016; COMEOS, 2016; Nielsen, 2016

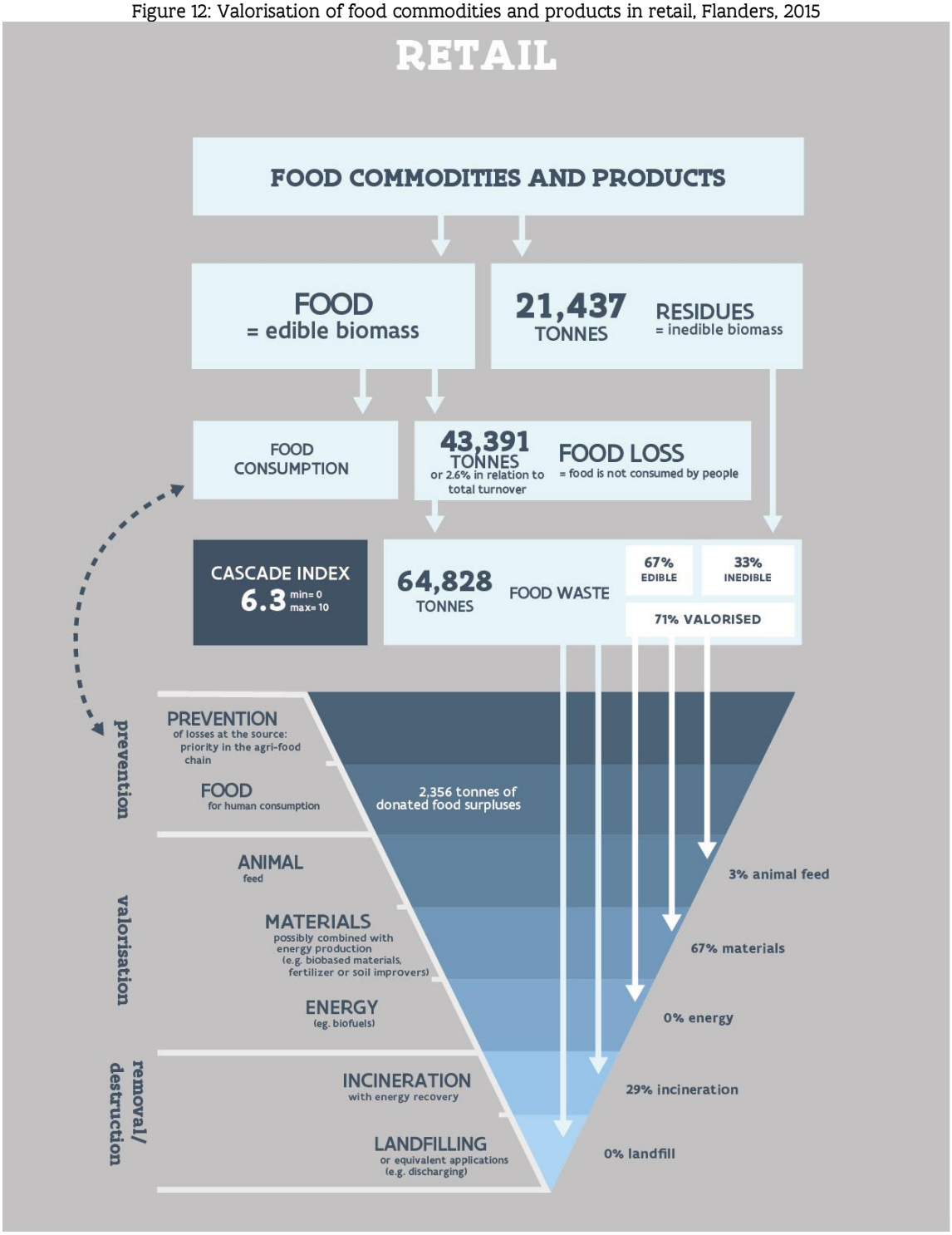
Table 31: Proportion of food losses and residues in total food waste, retail, Flanders, 2015

Subsector retail	Edible fraction of food waste (=food losses) (%)	Inedible fraction of food waste (=residues) (%)
Total	**67%**	**33%**

Source: calculation based on Buurtsuper.be, 2016; OVAM, 2016; COMEOS, 2016; Nielsen, 2016

4.5.1.4 Visual presentation of results

Figure 12: Valorisation of food commodities and products in retail, Flanders, 2015



Food waste cascade as included in the OVAM Action Plan for the Sustainable Management of (Residual) Biomass Streams 2015-2020 (approved by FG 10/7/15), layout: Department of the Environment & Spatial Development

4.5.2 Data collection

4.5.2.1 Definition

The focus of the monitoring in the distribution sector is on the retail sector, more specifically on non-specialised retail, which was examined in detail. This is, after all, the dominant channel in the distribution of food to the consumer.

Nielsen (2016) breaks non-specialised retail down as follows:

- large distribution (F1), e.g. Colruyt, Delhaize supermarkets, Carrefour Hypermarkets
- average size distribution (F2), e.g. Okay, Proxy Delhaize, Carrefour Market;
- small distribution (F3), independent shopkeepers and self-service stores of chains with an area of less than 400 m^2 (e.g. Carrefour Express);
- hard discounters (HD): Aldi and Lidl.

In Flanders in 2015, the market share of large distribution (expressed in turnover) is 43.4%. In second place is average size distribution (34.5%), followed by hard discount (17.5%). Despite the fact that small distribution still accounts for 63% of the number of stores in the sector, the market share is just 4.7%.

As far as wholesale is concerned, the monitoring of food waste flows focuses exclusively on producer organisations (see chapter 0 Auctions). This is because of the economic importance of this subsector in Flanders and the availability of data to a detailed level. The other branches of wholesale were not studied.

4.5.2.2 Methodology

To map the food waste flows in retail, we combine data from the Integrated Environmental Report (IER, OVAM) with a sector survey by COMEOS and Buurtsuper.be. Several additional calculations were made based on sales figures (Nielsen, 2016). The food waste was divided into 'selectively collected' and 'residual waste'.

COMEOS is the federation of trade and services and represents, among others, the supermarket chains (integrated stores). The food retail members of COMEOS belong to F1 (large distribution) and HD (hard discount). Buurtsuper.be is a member organisation of UNIZO and represents independent supermarket owners (mainly franchisees). The members of Buurtsuper.be belong to the average size distribution of Nielsen (F2). Both organisations collected figures from their members via a survey to map food waste in their sector.

The (Belgian) COMEOS figure for the quantity of food waste was extrapolated and translated to Flanders, based on sales figures. The tonnage of food waste from average size distribution was deduced from the IER, the proportion of food waste in residual waste was surveyed by Buurtsuper.be. Additional checks were carried out to validate the estimate for average size distribution. For small distribution, which was not mapped separately, we make an additional estimate based on share figures from Nielsen and IER figures. The total figure for non-specialised retail was compared with the corresponding figure from the IER; the order of magnitude and distribution for residual waste versus selective collection corresponded.

The figures on food waste in non-food retail (stores with a small proportion of turnover from food), specialised retail and markets were taken from the IER. We use the average of F1 and F2 for the share of food waste in residual waste.

To distinguish between food loss (edible food waste) and residues (inedible food waste) we use the factor from the COMEOS survey. The destinations of the food waste from F1/HD were mapped with the COMEOS survey. The destinations of the food waste in the other subsectors were derived from available data from the IER. Anaerobic digestion and/or composting is a joint destination in the IER, and we therefore assign 50% to anaerobic digestion and 50% to composting.

Via the IER (OVAM), the focus will be on extra data collection for the retail sector.

4.5.3 Findings

Selective collection is an absolute condition for the high-quality valorisation of food waste. The measurement in mass distribution shows that selective collection is possible up to 90%. However, consideration must obviously be given to the differences in context between large, average size and small distribution.

The destinations of food waste in the other sectors requires further study. Awareness-raising and measures tailored to smaller sectors and companies may further increase the percentage of selective collection in retail. The Action Plan for the Sustainable Management of (Residual) Biomass Streams 2015-2020 (OVAM, 2015a) focuses on this, among other things.

4.6 HOSPITALITY SECTOR AND CATERING

This chapter was prepared in collaboration with Eve Diels (Horeca Vlaanderen), Annemie D'haeninck (Guidea), Peter Serru (Guidea), Annabelle Casier (Guidea), Nina Van Hecke (Guidea) and Geraldine Verwilghen (UBC).

Food reaches the consumer through two main channels. On the one hand you have the retail channel. On the other hand you have food services, which have grown considerably in recent decades: this concerns meals that are prepared outside of the home (hence also the term 'out-of-home'). It is a highly diverse sector with widely varying subsectors, which makes collecting data 'extra' challenging and highlights the importance of a good understanding of the sector.

4.6.1 Results

4.6.1.1 Prevention

Figures on prevention at the source are not available. One example of a prevention effort in the hospitality sector is the Chefs' Charter that hospitality businesses owners can sign, within the 'No Food To Waste' campaign of Horeca Vlaanderen (2017). This campaign encourages owners to combat food loss by means of a practical checklist with tips and tricks. Three well-known chefs are setting the example as sponsors of the action.

In catering, innovative concepts are being tested to reduce food losses as much as possible. After a detailed baseline measurement, Het Facilitair Bedrijf, the caterer of the Flemish Government, introduced the 'freedom of choice' concept (serve yourself) for the 'self-service' hot dishes, which led to a sharp reduction in food loss (Het Facilitair Bedrijf, 2017). Other caterers offer their customers different portion sizes to avoid surpluses.

No figures on donations are available for the hospitality sector and catering. Donations will also be made to social initiatives in these sectors, but there is no information available. It is, however, expected to be relatively limited. Within the hospitality sector and catering there is the specific problem that it is difficult to donate prepared food in view of the strict food safety requirements.

4.6.1.2 Valorisation

Creation of food waste

The total food waste in the hospitality sector is estimated at 67,000 tonnes. More than 80% of the food waste in the hospitality sector originate in eating and drinking establishments.

Table 32: Food waste in hospitality sector, tonnes, Flanders, 2015

(Sub)sector	Food waste (tonnes)
Eating and drinking establishments	57,316
Accommodation	10,134
Total hospitality sector	**67,450**

Source: calculation based on Horeca Vlaanderen and Guidea, 2016; OVAM, 2011

For the catering sector, we estimate the quantity of food waste at approximately 60,000 tonnes, 59% of which from catering in education and 31% from catering in healthcare.

Table 33: Food waste in catering, tonnes, Flanders 2015

(Sub)sector	Food waste (tonnes)
Healthcare institutions	18,929
Government and non-profit	3,521
Education	35,705
Businesses	1,943
Total catering	**60,098**

Source: calculation based on Foodservice Alliance, 2016; OVAM, 2016

Valorisation of food waste and cascade index

One third of food waste (31%) in the hospitality sector is selectively collected and anaerobically digested. The rest of the food waste ends up in residual waste (69%) and is incinerated. In catering, 46,000 tonnes (or 76%) of food waste are incinerated, 14,000 tonnes (or 24%) of food waste are anaerobically digested.

Table 34: Destinations of food waste in hospitality sector and catering, % in relation to sector total, 2015

Sector	Animal feed	Biobased materials	Soil	Anaerobic digestion	Composting	Energy	Incineration with energy recovery	Landfill/discharge	Unknown destination	Total
Hospitality sector	-	-	-	31%	-	-	69%	-	-	100%
Catering	-	-	-	24%	-	-	76%	-	-	100%

Source: calculation based on Horeca Vlaanderen and Guidea, 2016; OVAM, 2011; Foodservice Alliance, 2016; OVAM, 2016

The cascade index weighs the food waste released in a sector according to its position on the food waste cascade. Selective collection of food waste is still relatively low (compared with other sectors) in the hospitality sector and catering, which is also reflected in their cascade index. The cascade index of the hospitality sector is 3.9; that of catering is 3.4.

Table 35: Cascade index for hospitality sector and catering, Flanders, 2015

Sector	Value of cascade index*
Hospitality sector	3.9
Catering	3.4

*minimum (lowest possible score) = 0, maximum (highest possible score) = 10.

4.6.1.3 Food losses and residues

Total food waste in the hospitality sector is estimated at around 67,000 tonnes. The share of food loss is approximately 28% or approximately 19,000 tonnes. More than 80% of the food losses in the hospitality sector originate in eating and drinking establishments. The percentage of food loss in the food waste of the hospitality sector is relatively low. This is because it is assumed that most food waste in hospitality sector arises during preparation in the kitchen and consist of inedible parts of, among other things, meat (e.g. bones) and vegetables (e.g. skins). Whether more use will be made in the future of (partially) ready-made meals and/or semi-finished products in the hospitality sector and what influence this will then have on food waste will need to be corroborated by future measurements.

For the catering sector, we estimate the quantity of food loss at approximately 57,000 tonnes, largely from the subsectors of education and healthcare. Food loss makes up 95% of the total quantity of food waste in the catering sector, which equates to approximately 60,000 tonnes. Because the preparation has largely already taken place in food companies, the residues created when preparing meals are not present. They do occur, but are included in the figure for residues of the food industry. Food loss that occurs in catering therefore carries much more weight, which explains the high percentage.

It was not possible to express food losses in the hospitality sector and catering relatively, because of the lack of insight into total consumption in those sectors.

Table 36: Food losses and residues in the hospitality sector and catering, tonnes, Flanders, 2015

(Sub)sector	Food losses (=edible food waste) (tonnes)	Residues (= inedible food waste) (tonnes)
Eating and drinking establishments	16,000	41,316
Accommodation	3,108	7,026
Total hospitality sector	**19,108**	**48,342**
Healthcare institutions	17,981	946
Government and non-profit	3,345	176
Education	33,919	1,786
Businesses	1,845	97
Total catering	**57,090**	**3,005**

Source: calculation based on Horeca Vlaanderen and Guidea, 2016; OVAM, 2011; Foodservice Alliance, 2016; OVAM, 2016

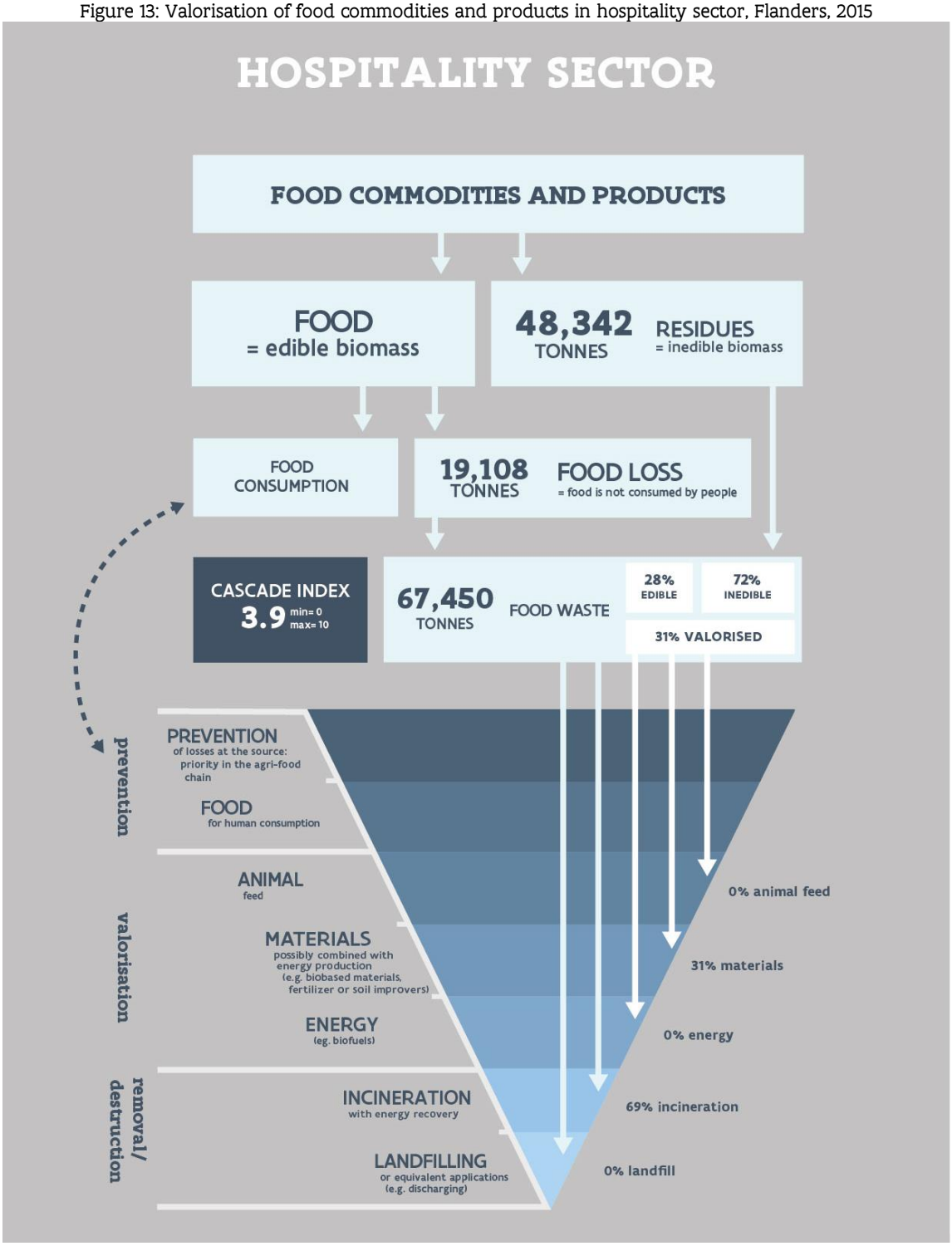
Table 37: Proportion of food losses and residues in total food waste, hospitality sector and catering, Flanders, 2015

Sector	Edible fraction of food waste (=food losses) (%)	Inedible fraction of food waste (=residues) (%)
Hospitality sector	28%	72%
Catering	95%	5%

Source: calculation based on Horeca Vlaanderen and Guidea, 2016; OVAM, 2011; Foodservice Alliance, 2016; OVAM, 2016

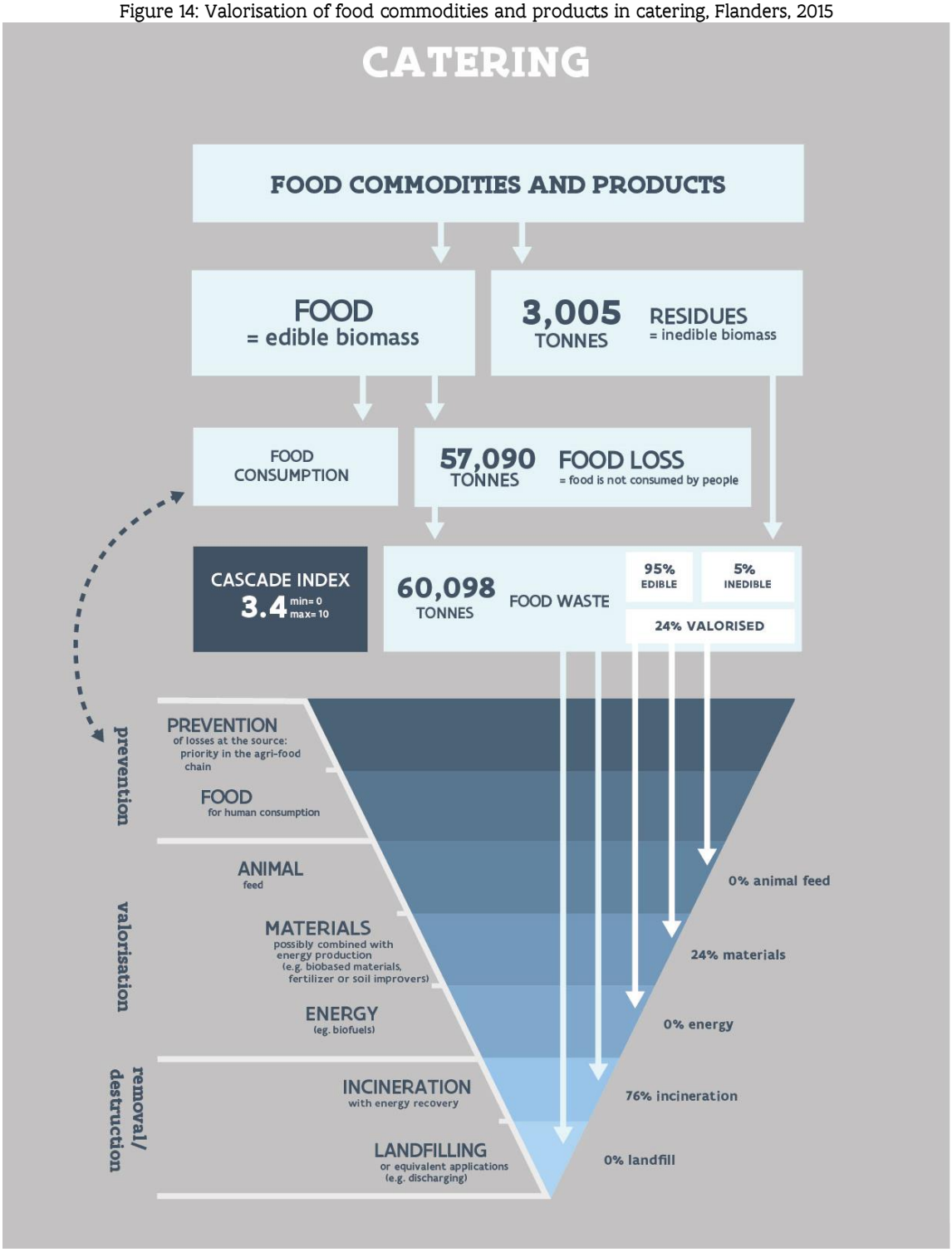
4.6.1.4 Visual presentation of results

Figure 13: Valorisation of food commodities and products in hospitality sector, Flanders, 2015



Food waste cascade as included in the OVAM Action Plan for the Sustainable Management of (Residual) Biomass Streams 2015-2020 (approved by FG 10/7/15), layout: Department of the Environment & Spatial Development

Figure 14: Valorisation of food commodities and products in catering, Flanders, 2015



Food waste cascade as included in the OVAM Action Plan for the Sustainable Management of (Residual) Biomass Streams 2015-2020 (approved by FG 10/7/15), layout: Department of the Environment & Spatial Development

4.6.2 Data collection

4.6.2.1 Definition

The Belgian food services sector comprises the subsectors of the hospitality sector, catering and impulse (Foodservice Alliance, 2016). The most well-known branch is the hospitality sector, and includes drinks providers (e.g. cafés), accommodation providers (e.g. hotels), 'full service' and 'quick service' restaurants and leisure businesses (e.g. nightlife). Catering consists of catering to businesses and industry, education, government and non-profit and healthcare institutions. The impulse branch includes points of sale in stores (e.g. kiosks) and points of sale while travelling (e.g. filling stations).

The hospitality sector is the largest subsector with 80% of the number of outlets, 85% of the number of outlays and 78% of the number of visits. The catering channel accounts for 15% of the number of outlets, 11% of the number of outlays and 12% of the number of visits. Catering can take place both in-house and through outsourcing (contract catering). The ratio on the Belgian market is around 50/50 (UBC, 2016). The impulse channel is the smallest channel and accounts for 5% of the number of outlets, 4% of the number of outlays and 10% of the number of visits (Foodservice Alliance, 2016).

For almost all subsectors, the starting point is getting the food in at the 'points of sale' or places where the food/drink is provided or in own distribution centres (there are very few of these in practice). The end point is not the sale to the end consumer. The end point is when the food provided by the food services company is not consumed by people and is given another destination.

Food waste arises during storage (stock management), the preparation of meals, but also during consumption (e.g. leftovers). Even food waste during consumption is accounted for by the food services. 'Take-away' food that is taken away by the consumer and is given a non-human consumption destination is, however, accounted for by households.

4.6.2.2 Methodology

The collection of data in connection with this monitoring focuses on the main food service channels: the hospitality channel and catering (in the first instance contract catering). The impulse channel was not included. This definition covers roughly 85-90% of the market. For the data collection we worked with chain partners Horeca Vlaanderen and Unie Belgische Catering to gather figures from their members.

To gain an insight into the market and as support for extrapolating measurements and making assumptions in certain parts of the sector, the sector was quantified using the Annual Foodservice Monitor Belgium 2016 (Foodservice Alliance, 2016). Guidea (2016), the knowledge centre for the hospitality sector, provided the statistics for the Flemish hospitality sector.

The hospitality sector was surveyed in collaboration with Horeca Vlaanderen and Guidea. Based on the data reports from the hospitality companies in connection with the IER (food waste plug-in 2014), previous hospitality sector studies and the results of the survey, the quantities of food waste, food losses and residues as well as their destinations were calculated or estimated. The food waste was also broken down by collection: what is selectively collected (and has anaerobic digestion as its destination) and what ends up in residual waste (and is incinerated). For the distinction between edible (food loss) and inedible (residues), use was made of assumptions at product group level combined with the

inventoried distribution of the various product groups in the food waste in hospitality sector (OVAM, 2011). Going forward, efforts will be made to collect extra data from a representative number of hospitality sector companies via the two-yearly IER (OVAM).

The Unie Belgische Catering polled its members, but this failed to produce sufficient data. New measurements have since been started. To map the food waste in catering, we therefore combine data from a waste processor with statistical sector information and own calculations. An average quantity of food waste per person per day for each catering subsector can be deduced from the data from the waste processor. To know how many 'consumers' enjoy a meal in each subsector, we use an indicator for each subsector. For hospitals, for example, this is the number of beds, for schools the number of pupils, etc. We generally find these figures in the Food Service monitor 2016 (Food Service Alliance, 2016) and they are based on official statistics. The quantity of food waste per subsector is estimated based on the relative quantities and the number of consumers. It was indicated from the catering sector that 95% of food waste in the catering sector is food loss because it largely involves ready-made meals or semi-finished products (UBC, 2016). Residues are thus limited to 5%. Since there was no specific survey in the catering sector, however, no information is available on how many food waste is selectively collected and how many is collected through residual waste. Based on the IER collection figures from OVAM in the education and hospital sector, an indicative figure is nevertheless possible.

4.6.3 Findings

Because of the diversity in the food services sector, the priority focus of the monitoring was on the most important sectors: hospitality sector and catering. Via the IER (OVAM), the focus is on extra data collection for the hospitality sector and catering. The members of UBC (contract catering) are also busy collecting data.

In both the hospitality sector and catering, the focus is on preventing food waste. The hospitality sector has a relatively low proportion of food losses in relation to total food waste. In catering, preparation is largely outsourced to the food industry, which scores highly for preventing food losses (and valorising residues). The operating point in the sector is valorisation. Because barely 24% (catering) to 31% (hospitality sector) of the food waste is selectively collected, most of this flow disappears into residual waste, resulting in low-value valorisation. Converting this operating point into an opportunity is one of the challenges facing the sector. In the hospitality sector, further efforts are being made to encourage the selective collection of food waste. In the contract catering sector, the decision whether or not to collect selectively often lies with the customers who sign a contract with a caterer. Raising awareness among customers plays an important role here.

4.7 HOUSEHOLDS

This chapter was prepared in collaboration with Filip Fleurbaey (Department of Environment & Spatial Development), Jan Velghe (BV-OECD), Joke Van Cuyck (OVAM) and Elfriede Anthonissen (Vlaco).

At the end of the chain are the households that consume the produced, processed and distributed food. In 2015 Flanders has 6.4 million inhabitants (and thus also consumers) and 2.8 million households (FPS Economy, 2016).

4.7.1 Results

4.7.1.1 Prevention

Figures on prevention at the source are not available. By, for example, properly planning the purchase, storage and preparation of food, individual households can also do their bit to prevent food losses. Donating food surpluses to social organisations does not apply to households

4.7.1.2 Valorisation

Creation of food waste

The total food waste of households is around 468,000 tonnes. Per capita we get 72.3 kg of food waste per Fleming.

Table 38: Food waste in households, tonnes, Flanders, 2015

Sector	Food waste (tonnes)
Households	468,305

Source: calculation based on OVAM, 2012b; OVAM, 2014b; Steenhuizen, 2010

Valorisation of food waste and cascade index

The main destination of food waste is composting, both at-home composting and composting of VFG waste (vegetable, fruit and green waste - 40%). Almost one third (28%) of food waste is fed to animals (both farm animals e.g. chickens and pets e.g. dogs), almost one quarter (24%) is incinerated with energy recovery.

Table 39: Destinations of food waste, households, % in relation to sector total, 2015

Sector	Animal feed	Biobased materials	Soil	Anaerobic digestion	Composting	Energy	Incineration with energy recovery	Landfill/discharge *	Unknown destination	Total
Households	28%	-	-	6%	40%	-	24%	3%	-	100%

*Discharges via sink, toilets, etc.

Source: calculation based on OVAM, 2012b and OVAM, 2014b

The cascade index weighs the food waste released in a sector according to its position on the food waste cascade. A high degree of selective collection of food waste by households, allowing valorisation to a higher standard, gives a cascade index of 6.9.

Table 40: Cascade index for households, Flanders, 2015

Sector	Value of cascade index*
Households	6.9

*minimum (lowest possible score) = 0, maximum (highest possible score) = 10.

4.7.1.3 Food losses and residues

The total food waste of households is around 468,000 tonnes, of which 212,000 tonnes is food loss (or 45% of food waste) and 256,000 tonnes is residues (or 55% of food waste). Per capita we get 32.7 kg food losses and 39.6 kg of residues per Fleming.

The relative food loss is the food loss in tonnes in relation to the total consumption in tonnes. Based on the results of the Food Consumption Survey 2014-2015, we estimate the relative food loss by households in Flanders at 5.9% in relation to the total food consumption (De Ridder *et al.*, 2016)

Table 41: Food losses and residues in households, tonnes, Flanders, 2015

Sector	Food losses (=edible food waste) (tonnes)	Residues (= inedible food waste) (tonnes)
Households	211,858	256,447

Source: calculation based on OVAM, 2012b; OVAM, 2014b; Steenhuizen, 2010

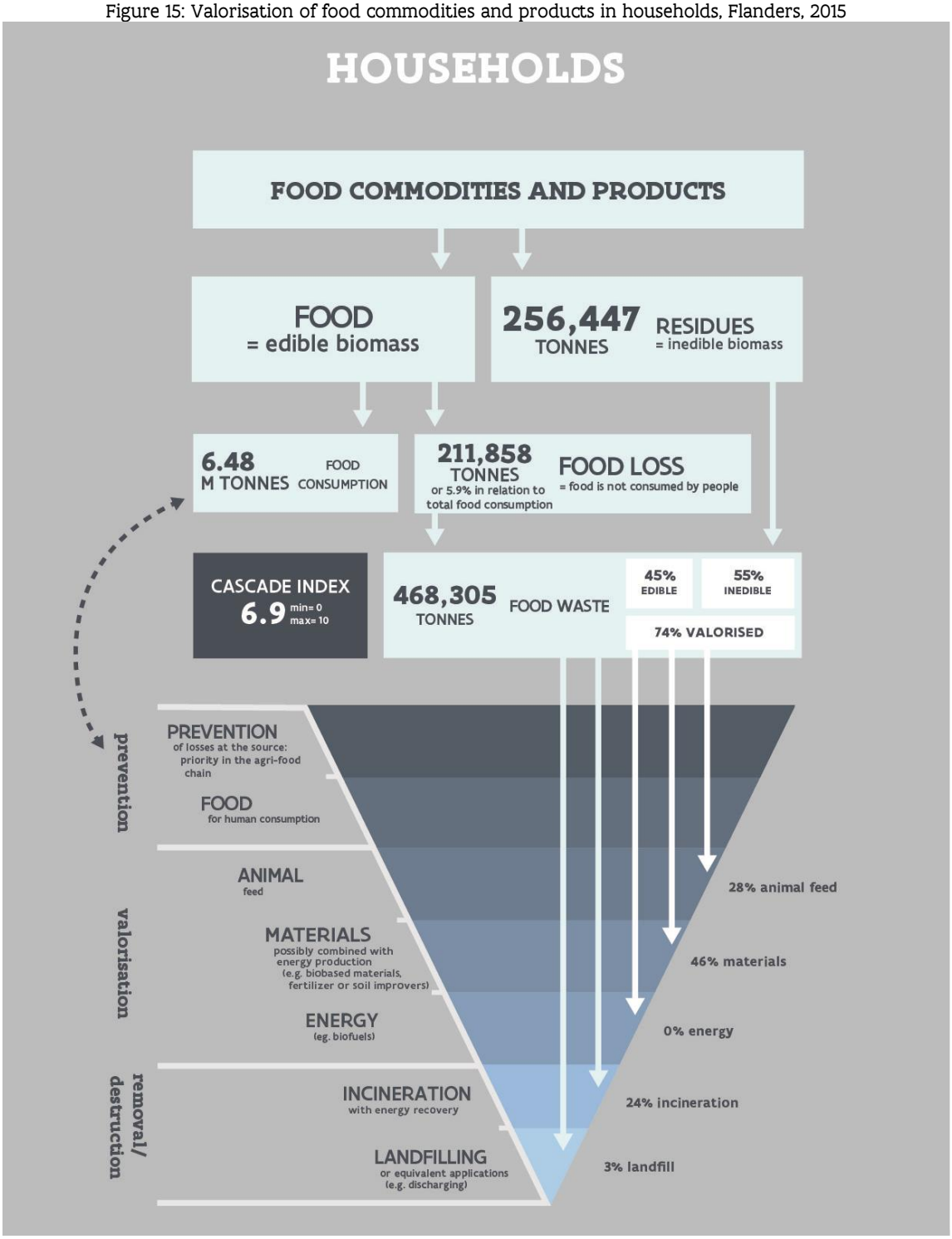
Table 42: Proportion of food losses and residues in total food waste, households, Flanders, 2015

Sector	Edible fraction of food waste (=food losses) (%)	Inedible fraction of food waste (=residues) (%)
Households	45%	55%

Source: calculation based on OVAM, 2012b; OVAM, 2014b; Steenhuizen, 2010

4.7.1.4 Visual presentation of results

Figure 15: Valorisation of food commodities and products in households, Flanders, 2015



Food waste cascade as included in the OVAM Action Plan for the Sustainable Management of (Residual) Biomass Streams 2015-2020 (approved by FG 10/7/15), layout: Department of the Environment & Spatial Development

4.7.2 Data collection

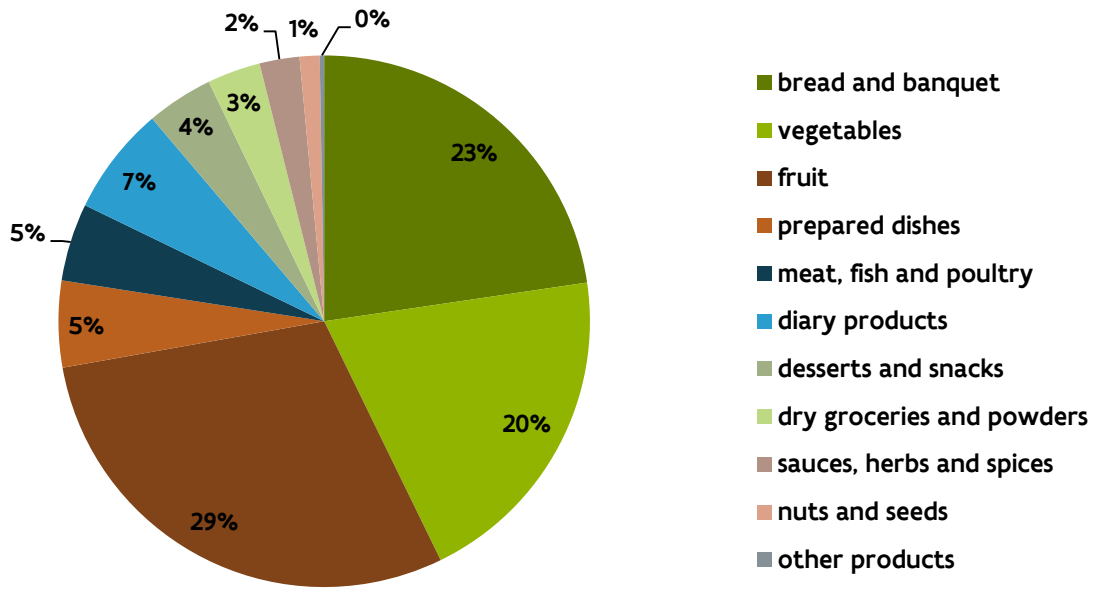
4.7.2.1 Definition

Food waste in households includes all food waste that is 'produced' at home. This therefore concerns food that was purchased and brought home, whether it originates in retail (specialised or not), wholesale, markets or directly from the farmer. This also includes food gathered in the wild (e.g. mushrooms or berries) or acquired food (e.g. food donation). Food cultivated by people themselves, e.g. in their own garden or allotment, should also be included. Food waste produced by consumers in restaurants, healthcare institutions, hotels, prisons, etc. come under the hospitality and catering sector. Food waste in households can leave the household through various channels.

4.7.2.2 Methodology

Previous estimates of food loss in Flemish households were based on the figures from the OVAM study 'Onderzoek van het voedselverlies bij Vlaamse gezinnen via sorteeranalyse van het huisvuil' ('Study of food loss in Flemish families by sorting analysis of the household residual waste) (OVAM, 2015b). This presents reliable figures for the quantity of food thrown away at home in residual waste and its composition, as shown in Figure 16.

Figure 16: Food waste in residual waste of households, share per product category, Flanders, 2014



Source: OVAM, 2015b

This leads to an underestimation of the food loss in households, because the other channels (separate collection of VFG-waste, at-home composting, etc.) are not included. We therefore need to obtain as good figures as possible for the other channels. In contrast to the Netherlands, no exact figures have hitherto been available for Flanders. Based on currently available studies, this monitoring report tries to estimate the size of the quantities. The figures presented will be further refined in the future.

OVAM (2012b) gives an overview of the various destinations of food waste in households at product group level (including residual waste). These figures were used to be able to estimate the quantity of food thrown away in VFG and on the compost heap, and the quantity of food given to animals. These figures are indicative and were obtained by calculating the other fractions relatively for different food products based on the known quantity/proportion of residual waste (sorting analysis/evaluation study). The survey of the various channels used to throw food away was conducted using self-reporting by means of multiple-choice questions. For each multiple-choice question, more than one answer was allowed. This means the total percentage is more than 100%, so there is a slight overestimation. The figure for food waste in the VFG fraction was validated by an extra calculation.

The study (OVAM, 2012b) does not gauge the quantity of food that is removed via the sink. This estimate was based on Dutch figures (Steenhuisen, 2010), adapted to the Belgian context. The breakdown into food loss and residues was based on the distribution in the residual waste. Because of a lack of data, we make the assumption that this also applies to other destinations. For the food waste flows that disappear down the sink, we assume that this was 100% edible and therefore 100% food loss. In Flanders the VFG fraction is partly composted, partly anaerobically digested. The anaerobically digested waste is subsequently composted.

4.7.3 Findings

The food waste (and food loss) in residual waste is relatively low in Flanders compared with the European average. Thanks to the sorting habits of Flemish households, relatively more food waste is valorised compared with other countries. This monitor gives another refinement based on current available figures.

The quantities obtained for food waste and food loss figures are higher than previously formulated extrapolations, but remain below the European average. A sizeable fraction (28%) of food waste at the consumer is given to animals, which is high-quality valorisation.

There is currently still no sound picture of the quantity and composition of the food that is valorised through alternative channels. Ongoing research by the Department of Environment & Spatial Development ('Voedselverlies en consumentengedrag bij huishoudens' ('Food loss and consumer behaviour in households') – begun in January 2017) ought to shed more light on this issue. Once these data are available, the method followed will allow the food loss in Flanders to be calculated retrospectively. The results will be incorporated into the next monitoring report.

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ANNEX: CALCULATION METHOD FOR CASCADE INDEX

The cascade index weighs the food waste produced by a sector according to its position on the food waste cascade. Prevention (the 'pure' prevention of surpluses, but also the social repurposing of food surpluses) could not be included because sufficient figures are not available, so this merely concerns the valorisation of food waste. For most sectors, a combination of valorisations is involved. Not all food waste is suitable for one specific valorisation.

If a sector valorises all its food waste as feed[4], the cascade index is 10 (out of 10). If a sector does not valorise (incineration, landfill or applications seen as equivalent in this exercise such as discharge[5]), the cascade index is 0 (out of 10). We distribute the inventoried destinations between 4 categories with a weighting coefficient between 0 and 10. There is no weighting coefficient 6, this was done deliberately to have a sufficiently great difference between use as feed or material on the one hand (possibly in combination with energy) and energy application and destruction on the other. Food waste which the destination is not known is not included in the calculation.

Table 43: Possible destinations of food waste, examples of applications and weighting coefficient

Possible destinations of food waste flows	Examples of concrete applications	Weighting coefficient
1. FEED	Feed unprocessed to livestock, process into livestock feeds, feed to pets or wild animals by households, etc.	10
2. MATERIALS	Both material application … • Production of biobased materials (e.g. bio-plastics, bio-chemicals, etc.) • Production of soil-improving agent via composting • The return of organic flows to the soil (not harvested, ploughing in, return to the field). as combination of material and energy application: • Production of fertiliser or soil-improving agent and energy through anaerobic digestion (possibly with subsequent composting) No hierarchy is proposed within these applications.	8
3. ENERGY	Other forms of energy generation than anaerobic digestion, e.g.. biofuels	4
4. DESTRUCTION/REMOVAL	Incineration (with energy recovery)[6]	2
	Landfilling or equivalent actions such as discharging (sewers, watercourses, toilets, discards in fishing, etc.)	0

[4] The Materials Decree encourages the use of materials. The Materials Decree regards the non-direct use of food waste for livestock feed as a use of materials on the same level as other applications of materials. Direct use as feed is seen as reuse (higher up the hierarchy). Within the context of this monitor, the use of feed (regardless of in which form and for which type of animal) is not subdivided and is assigned a higher weighting coefficient than other materials, because of the direct link with human food supply.

[5] In Flanders, the dumping in landfills of selectively collected food waste and food waste in residual waste is not permitted.

[6] In Flanders it is not permitted to incinerate selectively collected food waste (with or without energy recovery).

Table 44: Cascade index for food industry (example), calculated on the basis of total food waste in food industry, Flanders, 2015

Destination	tonnes	share	coefficient	coefficient x share
Feed	1,295,182	55%	10	5.51
Materials	888,878	38%	8	3.03
Energy	162,993	7%	4	0.28
Incineration with energy recovery	2,391	0%	2	0.00
Landfilling or equivalent applications	0	0%	0	0.00
Total	**2,349,444**	**100%**	-	**index: 8.82**