ETC CE Report 2025/4

Ambitions towards food waste prevention in the EU-27 Member States

A review of 2023 country information

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Summary / Description

This report by the European Topic Centre on Circular Economy and Resource Use (ETC CE), assesses the ambitions in the European Union towards increased food waste prevention instead of food waste management. It reviews food waste actions and policy measures as of 2023 and categorises them according to the waste hierarchy which has been further developed as a guidance model in the form of a "food use hierarchy[1]" by the JRC.

The 332 actions by the EU-27 countries – collected from Member States and extracted from the EU Food Loss and Waste Prevention Hub (Hub) in the year 2023 – provide evidence of the ongoing efforts to fight food waste. Overall, the review also shows the willingness of EU-27 Member States to prioritise actions towards the higher levels of the food use hierarchy.

The report highlights key factors to consider when assessing the feasibility of food waste prevention and the application of the food use hierarchy. It provides insights into tracking progress and an overview of the available tools and methodological approaches available to help make decisions regarding actions for preventing food waste.

Thereby, this report offers support to national authorities in the implementation of actions covered by the Waste Framework Directive towards prioritising food waste prevention.

Note

This report was prepared in 2023 and is based on the data and analyses available at that time. Relevant information, figures and framework conditions have or may have changed since then. The following exemplary sources provide access to more recent information on:

- EU Food Waste Statistics reference year 2022 (updated on this earlier provided Eurostat website (Eurostat, 2023c):
- the Food Loss and Waste Hierarchy: (De Laurentiis et al., 2024)
- EU Food Waste voluntary metadata (Eurostat, 2024)
- Revision of the Waste Framework Directive, including agreement on binding food waste targets (EC, 2025)

[1] Presented in 2020 by the Joint Research Centre as an illustration on how to prioritise food waste management strategies. It represents a pyramid ranking the preferred strategies, focusing first on prevention actions, including possibilities of donation and/or redistribution of surplus food, or sending food no longer intended for human consumption to animal feed, then on to waste management, including the recycling of material into high added-value products, recycling of nutrients, recovery of energy and, as the least preferable option, the disposal of food waste (Sanchez Lopez et al., 2020). The food use hierarchy uses the wording "re-use" for the donation and redistribution of surplus food, and for the delivery of food no longer intended for human consumption to animal feed. Note that an updated version has been published in 2024 (De Laurentiis et al., 2024), which could no longer be taken into consideration for this already written report.

Foreword

This ETC report "*Ambitions towards food waste prevention in the EU-27 Member States. A review of 2023 country information"* reviews actions taken by the EU-27 countries to combat food waste. It was prepared in 2023 and serves as a foundational analysis of progress at that time. Its findings have been incorporated into the EEA Waste Prevention Report called *"Preventing Waste in Europe: Progress and Challenges, with a focus on Food Waste",* scheduled for simultaneous publication in March/April 2025.

While this ETC report was completed in 2023, its publication is only taking place in 2025. This delay is due to the substantial amount of country-specific information contained in both, ETC and EEA documents, which necessitated an efficient as joint review process through Eionet members at the beginning of 2025.

As this ETC report reflects the state of knowledge and framework conditions as of 2023, readers should interpret its findings in light of potential changes since its preparation. Unless country-specific updates were provided by individual countries during the Eionet review in early 2025, the original dataset remains unchanged. Despite this, the ETC report provides valuable insights into the actions to fight food waste taken by EU-27 countries and serves as a complementary resource to the EEA Waste Prevention Report. For the most up-to-date figures and contextual insights, readers are strongly encouraged to consult EEA's *"Preventing Waste in Europe: Progress and Challenges, with a focus on Food Waste"* report (forthcoming, 2025).

1. The rationale and methodology

1.1. What is the implementation status of food waste prevention in the EU-27 in 2023?

Reducing food loss and waste is an urgent and necessary strategy for ensuring food security and combating climate change, as well as biodiversity loss. The European Union committed itself to reaching the United Nations Sustainable Development Goal (SDG) Target 12.3 to halve per capita global food waste at retail and consumer levels, and to reduce food losses along production and supply chain, by 2030. To this end, the revised EU Waste Legislation (EU, 2018), adopted on 30 May 2018, requires the EU Member States to develop specific food waste prevention programs contributing to the reduction of food waste at each stage of the food supply chain. In 2019, the European Food Loss and Food Waste Platform[2] recommended that these strategies, roadmaps and action plans should be based on the three-step 'target, measure, act' approach and involve all key players. It also suggested to integrate food loss and waste reduction both as part of food policy strategies and programs, as well as of climate action strategies and programmes (EU Platform on Food Losses and Food Waste, 2019b). In accordance with the waste hierarchy, priority is to be given to preventing food waste and prioritising the donation or redistribution of food for human consumption over animal feed and other uses. A 2020 "Brief on food waste in the European Union" by the Joint Research Centre (JRC) presented the so called "food use hierarchy", to act as a guiding principle for food use and valorisation of food waste (Sanchez Lopez et al., 2020). This hierarchy builds upon the traditional waste management hierarchy but is tailored specifically to food, providing clearer pathways for managing food before it becomes waste.

In 2023, the outlook is mixed. On the one side, there is growing awareness of the negative impacts of food waste and political commitments are being made at European and Member State levels, with various actions and measures being undertaken. On the other side, the European Commission has observed that food waste generation is not decreasing as required to make a solid contribution towards achieving Sustainable Development Goal (SDG) Target 12.3 (EC, 2023c).

Against this background, the European Commission proposed in July 2023 to set a food waste reduction target of 10% in processing and manufacturing, and a reduction target of 30% per capita within retail and consumption, i.e., restaurants, food services and households (EC, 2023c). Pending adoption, these targets for the end of 2030 will assign clear responsibility to Member States for accelerating reduction of food waste along the food supply chain and in households, and to ensure a sufficient and consistent response by all Member States to reduce food waste, in line with that of the current front-runners (EC, 2018c).

By reviewing food waste actions and policies of EU-27 Member States – collected from Member States and extracted from EU Food Loss and Waste Prevention Hub (Hub) in the year 2023 – and categorising them according to the guidance provided by the "food use hierarchy", this European Topic Centre on Circular Economy and Resource Use (ETC CE) report aims to identify opportunities to further accelerate efforts in reducing food waste. Its particular focus lies on food waste prevention, including the avoidance of food surplus as well as its redistribution for human consumption and for animal feed. Additionally, it provides an overview of the inclusion of food waste in EU-27 Member States' climate and biodiversity strategies as of 2023.

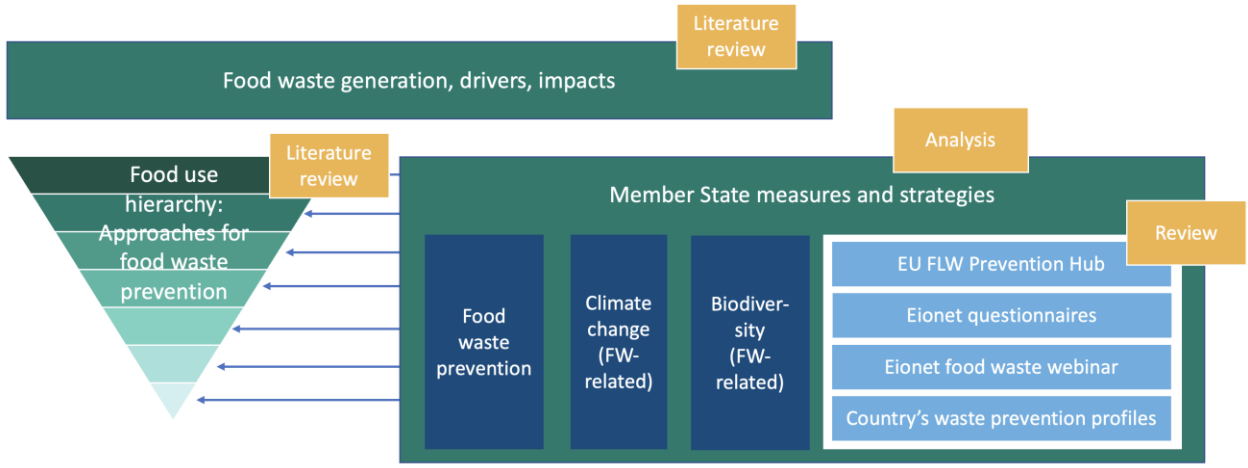
[2] The EU Food Loss and Waste Prevention Hub is a website for stakeholders who take action to fight food losses and food waste. The main objective of this EU Commission hosted platform is to foster the exchange of knowledge and experience and to help disseminate the different initiatives carried out to tackle food losses and food waste, in order to inspire and drive further action on ground, across the EU and beyond. It provides a sections on good practices, information on national actions such as policies and legislative developments, and news (EC, 2022b)

Ultimately, this ETC CE work aims to provide insights on how Member States implemented measures for the prevention of food waste and other measures to reduce food waste in order to support national authorities in the implementation of actions covered by the Waste Framework Directive towards prioritising food waste prevention.[3]

1.2. Reviewing EU-27 Member States' food waste prevention ambitions

To assess the ambitions towards more food waste prevention and less food waste management in the European Union as of 2023, this report compares evidence from the literature to information from self-reported country practices (see Figure 1.1).

Figure 1.1 Overview of ETC CE report methodology



Source: Author's own compilation.

The following research was carried out for this report:

- Information on EU-27 Member States' food waste prevention and reduction actions (see definition in Box 1.1.) was collected from questionnaires (see template in Annex 1) provided to Eionet[4] members in April 2023, from the countries' waste prevention profiles[5], and from additional data from the EU Food Loss and Waste Prevention Hub (Hub) in September 2023.
- A literature review was conducted on various policy measures to address food waste. This review specifically focused on research from earlier EU-funded food waste projects, such as REFRESH (REFRESH, n.d.) and FUSION
- S (EU FUSIONS, n.d.), which were identified as critical information sources at the outset the research for this report. In cases where specific information was lacking in these reference projects, additional literature searches were undertaken.
- Information on the inclusion of food waste prevention and reduction actions in EU-27 Member States' climate and biodiversity plans and strategies was collected from Eionet questionnaire responses and desk research (this included use of the EEA database on greenhouse gas policies and measures in Europe (EEA, n.d.)).
- Statistics were collected from the Eurostat database for waste-related data.

[3] In support of the impact assessment of the legislative proposal, the JRC reviewed in 2023 the progress of the Member States in implementing food waste prevention initiatives at national level (De Laurentiis, V. et al., 2023).

[4] The European Environment Information and Observation Network (Eionet) is a partnership network of the European Environment Agency (EEA) and its 38 member and cooperating countries. EEA and Eionet gather and develop data, knowledge, and advice to policy makers about Europe's environment. For more information see: https://www.eionet.europa.eu/

[5] See for example the Country waste prevention profiles of 2023 (European Environment Agency, 2023).

- Insights were gained during an online workshop organised in June 2023 with members of two Eionet groups ('Circular Economy and Resource Use' and 'Food Systems') were used to provide valuable input regarding the report's potential content.

Box 1.1. Definition of food waste prevention and reduction actions used in this ETC CE report

In this report, an 'action' is an initiative or a policy-related work with the objective of concretely preventing or reducing food waste, carried out within an EU-27 Member State. These actions were then classified according to type of policy measures to address food waste (see Box 1.2), and then with regards to the approaches suggested by the food use hierarchy. It must be noted that an action can cover several hierarchy levels, so double counting in this report might occur and total action numbers might sometimes go beyond the total number of actions (332).

It must be noted that the information screened during the ETC mapping revealed many more than the 332 counted actions. As the intention of this report was however to assesses efforts in the European Union towards more food waste prevention and less food waste management, the analysis focused on actions supporting concrete implementation instead of those setting targets or overarching policy or supporting measuring and monitoring.

Box 1.2. Descriptions of policy measures used to classify food waste prevention and reduction actions in this ETC CE report.

- **Regulatory interventions** encompass bans, restrictions, or other mandatory requirements and obligations imposed on relevant actors.
- **Market-based** measures are economic measures designed to incentivise changes in consumption and production patterns, with the goal of promoting less waste-intensive alternatives. These measures, such as tax regulations, subsidies, or fees aim to make more sustainable choices (products or services) more competitive and economically attractive. Most of the market-based measures require regulatory interventions beforehand.
- **Voluntary initiatives or agreements** are measures taken by governmental and non-governmental stakeholders and are characterised by their non-binding nature and lack of legal obligation. Voluntary agreements among stakeholders do not necessarily require a formal political decision-making process but rather rely on negotiation.
- **Informative and educational measures** encompass informational communication campaigns, educational or training actions, as well as awareness-raising materials (e.g. leaflets, posters) that target consumers, food businesses, or other target audiences. These measures operate under the assumption that improved access to information can influence consumer behaviour or encourage companies to seize cost-saving opportunities.
- **Research and innovation** include research funding of projects not only exploring consumer behaviours, how to increase the use of surplus food, but also developing innovative solutions for the actors in the value chain.
- **Other projects** and **initiatives** encompass other actions that do not fit into the above definitions covering different topics linked to food waste: introducing digital platforms, round table discussions.

Note: The **c**ategorisation of policy measures builds on a previous ETC report (EEA, 2023c).
Source: Author's compilation based on (EEA, 2023c).

A certain level of uncertainty remains on the accuracy of this report's analysis. First, the self-reporting of the EU-27 Member States obtained either from the questionnaires, waste prevention country profiles, or the Hub might not have been fully complete (for example, Cyprus and Malta data were not confirmed). Also, the ETC team only included information provided directly by the questionnaires and the Hub and did not further check other shared external references. Furthermore, the absence of any information about the last update of the Hub's pages adds uncertainty regarding what the actual status of available information was. Second, specific waste management plans separate from the waste prevention programs of the EU-27 Member States were beyond the scope of the ETC mapping, as they were not mentioned in the information collected for the waste prevention country profiles.

The general trends observed can still be considered robust since the information collected includes 26 out of 27 EU Member States.

2. Overview of food waste generation and impact in the European Union

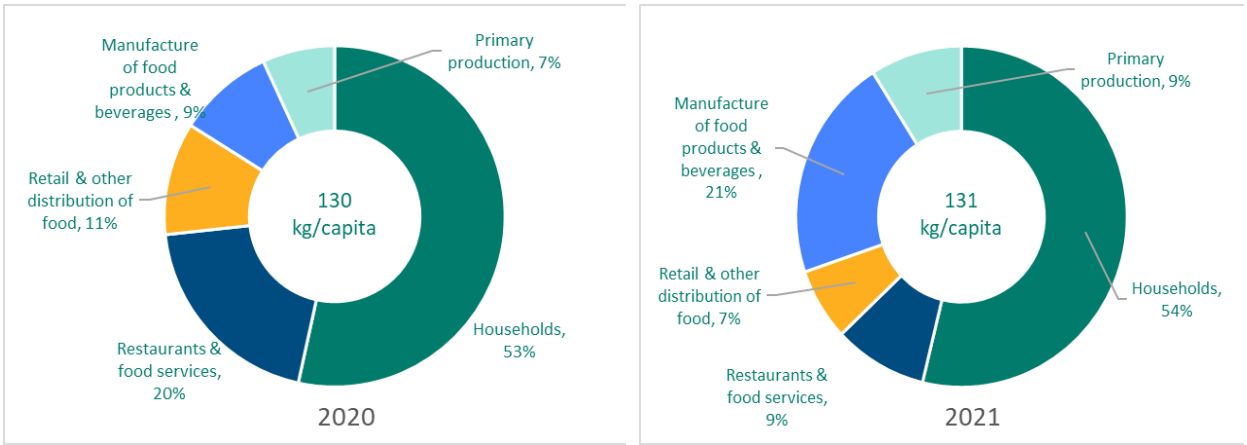
2.1. Food waste generation in the EU

- Food waste generation corresponds to at least 10% of food supplied to final consumption in the EU, making the need for more effective prevention and reduction efforts high.
- Up to 50% of generated food waste could be avoided, as demonstrated by examples from some countries.

EU Member States have since the amendment of the Waste Framework Directive in 2018 been obliged to measure their food waste, starting from the reference year 2020, in line with EU Delegated Decision (EU) 2019/1597 and its EU Implementing Decision (EU) 2019/2000 (see paragraph 3.3.2. Developing monitoring systems and methodologies). According to the official data from the first two years of reporting (2020 and 2021), approximately 58 million tonnes, or around 130 kg per capita of food waste, is generated annually in the EU-27 Member States (Eurostat, 2023c).

Official statistics by Eurostat indicate that there was no significant change in the total amount of food waste generated between 2020 to 2021 (Figure 2.1). Overall, food waste generation corresponds to about 10% of the food supplied for final consumption in the EU (Eurostat, 2023a). More than half is food wasted by households, equating to around 70 kg per capita. The remaining waste is distributed among other sectors, with primary production and retail each contributing about 10%, while manufacturing and restaurants and food services exhibit more variable shares (see Figure 2.1). Notably, the restaurants and food service sector and the manufacturing sector experienced significant fluctuations in waste generation in 2020 and 2021, with food waste decreasing in restaurants and increasing in manufacturing during the last year of the reporting. The primary drivers of these changes remain unclear, but they may be linked to the COVID-19 lockdowns (Eurostat, 2023a). Additionally, some variations between years could be attributed to the early stage of reporting and to using or adapting different methods for quantification. While further changes are expected as monitoring systems (Eurostat, 2022c) continue to develop, certain fluctuations may be considered inevitable.

Figure 2.1 Food waste generation by stages of the value chain in the EU-27, 2020-2021



Source: Author's compilation based on Eurostat data (env_wasfw dataset)(Eurostat, 2023b), the last update 28-09-2023.

The official Eurostat statistics present more conservative figures. Other attempts quantified food waste and loss with a range from 100 to 153 million tonnes annually (Stenmarck et al., 2015; Feedback EU, 2022). These disparities can be attributed at least partially to variations in definitions, making the previous estimates and Eurostat statistics not directly comparable. For instance, food loss that occurs pre-harvest

on farms, or surpluses used as animal feed are not classified as waste according to the EU legislation and are therefore excluded from the official statistics on food waste (Box 2.1.).

Box 2.1. Food waste and food loss: what's included/excluded in EU waste statistics[6]

According to the Waste Framework Directive Art. 3 (4a) 'food waste' means all food as defined in Article 2 of Regulation(EC) No 178/2002 of the European Parliament and of the Council that has become waste (EC, 2018c). The scope of the official EU statistics covers only food waste, which consists of both edible and inedible parts of food. Food waste is described as any food that meets the following three criteria (Eurostat, 2023a):

"1. it has entered the food supply chain
2. it then has been removed or discarded from the food supply chain or at the final consumption stage
3. it is finally destined to be processed as waste

Food losses occurring before crops and/or animals become "food" (occurring at the stage prior to crops being harvested or during the rearing of animals) and are not accounted for as food and hence are not quantified as "food waste". These may include:

- *crops not harvested*
- *unharvested fruit and vegetables ploughed directly into the fields*
- *death of animals before slaughtering*
- *food that cannot enter the food supply chain due to food safety requirements (e.g., contamination),*
- *fishes or fish parts discarded off board in the sea or rivers before reaching the port."*

The greatest potential for waste reduction lies in addressing what is commonly referred to as "edible food[7]", which distinguishes food intended for human consumption from inedible food items (such as bones or orange peels). The reporting of edible parts of food waste is voluntary for Member States, and these data – if reported – have not yet been published by Eurostat. This is because there are not enough reporters to establish coherent criteria for validating these data. Additionally, voluntary data are estimated based on studies with lower measurement accuracy than mandatory reported data. As a result, mandatory and voluntary quantities cannot be compared under the same baseline and assumptions. However, specific examples from individual Member States reveal that the proportion of preventable food waste from edible sources remains substantial (

[6] In this report, following the Eurostat clarifications as described in Box 2.1., we address food waste but not food losses.

[7] To date, there is no legally binding or even common definition on edible food fractions. According to Eurostat's guidance for reporting (Eurostat, 2022c) edible food is described as follows: "*Edible food parts are the components associated with a food, in its fresh mass status, that are usually consumed by humans, either as-is (raw consumption) or after processing or cooking. The definition of edible food parts might differ from country to country, or from region to region, according to local culture and habits*". In the literature on the food waste, the terms "edible" and "avoidable" are often used interchangeably. In this report, the term edible is used, unless there is a specific reason to highlight that food could have been avoided from becoming waste through certain actions.

Table 2.1).

Table 2.1 Examples of edible parts of food waste generation at national level

Country and reference year	Edible parts of food waste (FW)		Value chain stage	Reference
	%	kg/capita/year		
Sweden, 2020	28 % of HFW	17	HFW	(SMED, 2022)
Estonia, 2020	42% of HFW	26	HFW	(SEI, 2022)
Netherlands, 2019	-	34	HFW	(EEA, 2020)
Belgium, 2022	-	27	HFW	
Norway, 2015	-	42	HFW	(EEA, 2020)
Estonia, 2020	50% of total FW	63.5	Total FW	(SEI, 2022)
Germany, 2020	49% of FW	59.6	Total FW	(Hermanussen et al., 2022)

Note: It is unclear whether the data provided in the examples fully align with the EU requirements for food waste reporting (e.g., whether the fresh mass was measured).
Source: Author's compilation based on the above-mentioned references.

2.2. How significant is the impact of food waste generation on climate, biodiversity, pollution, and food security?

- In the EU, food waste accounts for 16% of the EU's total greenhouse gas emissions generated by the food system (Sala et al., 2023; EC, 2018b).
- Animal-based products make up less than 20% of the total mass of food waste but they are responsible for more than 50% of the overall environmental impacts, including eutrophication of water resources and changes in land use that negatively impact biodiversity (Sala et al., 2023).

Food waste has significant environmental implications, straining natural resources and ecosystems without benefiting human nutrition. Most environmental impacts arise along the food supply chain, with only a minor share linked to waste treatment operations (Sala et al., 2023). This is due to the energy and resources used to produce the food products being wasted, and the environmental consequences linked to them along the supply chain. From farm to fork, energy and resources are spent on the production of pesticides, cultivation of land, transport of goods, processing of food, cooling and storage, etc. Given that these impacts accumulate along the supply chain, food waste at the consumption stage has the highest environmental burden, surpassing losses at farm level (EC, 2023a).

However, reducing food waste alone is not enough; it must be addressed alongside deeper structural issues in the global agri-food system. The current model, which prioritizes quantity over quality, contributes to unsustainable resource use, biodiversity loss, and nutritional imbalances. Agricultural soils, often treated in ways that turn them into greenhouse gas emitters rather than carbon sinks, further exacerbate environmental crises. A truly circular food economy requires more than waste reduction—it demands systemic changes in production, consumption, and public health, shifting from excess and inefficiency to sustainability and quality.

While precise data may not always be available, it is evident that the European food system, including food waste, substantially exacerbates the three major and interconnected environmental crises of climate change, biodiversity loss, and pollution.

2.2.1. Climate Change

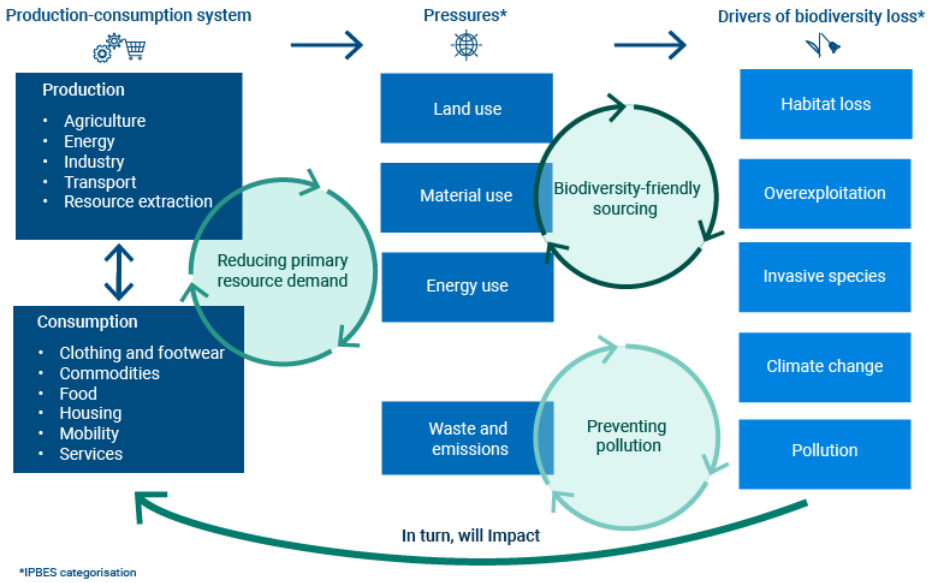
Food waste across the value chains accounts for approximately 8-10 % of total global greenhouse gas emissions (UNEP, 2021), including all emissions across the life cycle of food products. In the EU, food that is thrown away at production, manufacture, retail, and consumer level accounts for 16% of the EU's total

greenhouse gas emissions from the food system (Sala et al., 2023; EC, 2018b).[8] A recent study by JRC demonstrated that food waste is the EU's 5th largest greenhouse gas emitter when compared with the direct emissions reported by EU Member States. This underscores the critical role of food waste prevention in the achievement of climate targets (De Jong et al., 2023).

2.2.2. Biodiversity Loss

The loss of biodiversity is a threat to food production and food security – it is the broad range of organisms that keep soils fertile, pollinate plants, purify water and air, and ultimately secure resilient production (Pilling and Bélanger, 2019). At the same time, the global food system is the primary driver of biodiversity loss, in which species loss is currently of a magnitude between at least tens and potentially hundreds of times higher than the average biodiversity loss over the past 10 million years (Benton T. G. et al., 2021; Summary for policymakers of the global assessment report on biodiversity and ecosystem services, 2019). EU food waste accounts for 16% of the land use footprint of the EU food production system (Sala et al., 2023). More than 60% of biodiversity losses related to EU food consumption are caused by the production of meat and dairy products. Animal-based products make up less than 20% of the total mass of food waste but they are responsible for more than 50% of the overall environmental impacts, including eutrophication of water resources and changes in land use, which are known to negatively impact biodiversity (Sala et al., 2023). Production of food contributes to plant and animal habitat destruction, via actions that include deforestation, establishment of monocultures, and drainage of wetlands to expand agricultural land (Benton T. G. et al., 2021). The loss of biodiversity is thus closely linked to the use of natural resources such as land and water. Pressure on land and ecosystems can be significantly decreased by reducing the demand for food production as a result of more efficient consumption (see Figure 2.2) – the effect of such a circular approach can be seen in Figure 2.2.

Figure 2.2 How the circular economy can reduce the loss of biodiversity attributed to our production and consumption systems



Source: European Topic Centre on Circular Economy and Resource Use and EEA (Benton T. G. et al., 2021)

[8] According to FAO food waste in EU (and other high-income countries) occurs further down the value chain with the largest proportion at households, than food waste generated in the low-income countries where production and early logistics holds a larger share, thus EU food waste will have more embedded greenhouse gas than global average (Food and Agricultural Organization of the United Nations, 2015).

The global agri-food system presents the main driving force of biodiversity loss (ETC, 2023, referring to (Tubiello et al., 2022)). The recent EEA briefing "The benefits to biodiversity of a strong circular economy"[9] set out 'reducing primary resource demand' and 'preventing pollution' as two of three key areas where the circular economy can benefit biodiversity. These areas could be seen to link directly to the causes and impacts of food waste, through the ways and scales at which food is being produced or wasted when demand is not effectively matched or food consumption behaviour not sustainable.

A 2022 study modelled a possible 2050 scenario in which the Circular Economy can halt and partially reverse global biodiversity loss. In this scenario restructuring of the food and agriculture sector is seen as having the highest potential impact on biodiversity recovery (73%), with 20% direct potential from reduction of food waste (Forslund et al., 2022).

2.2.3. Pollution

Additionally, the production of food is a key driver of soil, water and air pollution. Europe's food system as of 2023 requires high inputs of chemical pesticides to ensure stable outputs and efficient production (European Environment Agency, 2023). In 2019 it was found that 83% of agricultural soils contained residues from pesticides (Silva et al., 2019), and in 2022 9 to 25% of all surface water across Europe contained pesticides above effect thresholds (EEA, 2024). Moreover, about 23% of Europe's seas have a eutrophication problem, with nitrate pollution from industrial farming being a primary cause (EEA, 2019b).

Besides leading to biodiversity loss, the extensive use of pesticides in agriculture is also causing increased pest resistance, and human exposure to the chemicals used has been linked to chronic illnesses, such as cancer. It has been estimated that reducing chemical pesticides may lead to lower crop yields in Europe, but existing models tend to overlook the positive impacts that will result from shifting consumption patterns, including the reduction of food waste (European Environment Agency, 2023).

2.3. What are the economic and social impacts of food waste?

- Food waste has a significant impact, both economically and socially. It contributes to the global food crisis, affects food security in the EU, and causes financial losses throughout the food value chain. Additionally, it worsens the daily challenges faced by low-income households, especially in the current cost-of-living crisis.

2.3.1. Economic costs

The economic impacts of food waste relate to the direct costs (e.g., costs of disposal, waste sorting, collection and treatment) and lost value of the discarded food, as well as expenses related to production, manufacture, packaging, transportation, and labour through the food value chain. In 2012, the cost of edible parts of food waste in the EU-28 was estimated to be around EUR 143 billion (Fusions, 2016). Two-thirds of the total cost, or EUR 98 billion, relate to food waste from households, since households generate the largest portion of food waste in the value chain (Goossens et al., 2019). However, there is no updated cost estimate available according to the FUSION methodology taking into consideration the most recent data reported according to Delegated Decision (EU) 2019/1597 and published on Eurostat database.

In economic terms, the costs embodied in food waste are higher for households than for food producers, since the price of a product generally goes up as the product moves further along the food supply chain. The avoidable economic costs through food waste prevention and reduction measures can thus be assessed based on the market price of food products at the stage of food waste in the supply chain, while also taking into account the avoided disposal costs (e.g., costs for waste sorting, collection and treatment),

[9] https://www.eea.europa.eu/publications/the-benefits-to-biodiversity

and the implementation costs or savings (e.g., investments in new technologies or materials, or regarding time spent for changes in daily or continuous actions) (Goossens et al., 2019).

2.3.2. The implications of challenges threatening food security

The need for resilient food supply chains has become an increasing focus of the EU, recognizing the importance of building sustainable food systems (EESC, 2021). This is a reaction to recent crises. During the COVID-19 pandemic the status of food security deteriorated globally due to the disruption of agri-food chains and inaccessibility to distribution of food. Also instigating a financial crisis, the number of people facing hunger worldwide increased from 678 million pre-pandemic to 828 million in 2021 (EPRS, 2023). The challenges related to food security were further exacerbated by Russia's invasion of Ukraine in 2022, due to Russia's and Ukraine's roles as major exporters of grains, oilseeds, and fertilizers (Eurostat, 2022b). Disturbing the global markets, Russia's invasion has contributed to inflation in the EU to increase by over threefold, resulting in an average 11.9 % rise in the prices of food and non-alcoholic beverages (Eurostat, 2022b). Furthermore, extreme weather events such as heatwaves and heavy rain are already causing losses in EU agricultural production, and these adverse impacts are expected to increase (EEA, 2019a). At the same time, the EU continues to waste more food than it imports, according to findings by Feedback EU. In 2021, the EU imported almost 138 million tonnes of agricultural goods, while simultaneously 153.5 million tonnes of food were wasted within the EU, thereby compromising EU food security (Feedback EU, 2022). This figure is significantly higher than 59 million tonnes in 2020 measured by (Eurostat, 2023a), due to better data availability and coverage of food losses on farm level.

2.3.3. The ethical implications of food waste in a society where people go hungry

Food waste is a serious ethical concern in a world where hunger and malnutrition are major global challenges. The UN SDG 2 focuses on ending hunger, achieving food security, improving nutrition, and promoting sustainable agriculture by 2030 (UN DESA, 2022). Food waste is detrimental to the status of food security, by increasing demand for the remaining food which results in higher food prices. Thus, it negatively affects food availability and access (Santeramo, 2021). On a European level, rising food prices make it increasingly difficult for low-income households to access sufficient, healthy and nutritious food.[10] In 2022, 8.6 % of the overall EU population was unable to afford a meal with meat, fish, or a vegetarian equivalent every second day (Eurostat, 2022a). The present cost-of-living crisis is evident in food banks across Europe which struggle to meet an increase in the number of people depending on food donations (European Food Banks Federation, 2023). Given the simultaneously high amount of food waste generated, surplus food redistribution by food bank initiatives and charities is often considered a win-win situation alleviating food insecurity and reducing resource inefficiency. Letting charities take on the responsibility for securing the human right to food is however neither sustainable nor addressing the underlying mechanisms of social inequality (Papargyropoulou et al., 2022). Lastly, by exacerbating environmental deprivation and climate changes, which affect vulnerable people and marginalized communities disproportionately, food waste further contributes to social injustice (UN DESA, 2016).

[10] EU inflation rates for food rose from an average of 0.1% in April 2021 up to a peak of 19.19% in March 2023, as this report was being written (Statista, 2024).

3. Setting the framework for food waste prevention in the EU-27 Member States

3.1. What are the legal requirements in the EU for tackling food waste in 2023?

- The EU promotes waste prevention through the Waste Framework Directive, which includes some limited guidance. The food use hierarchy, developed by the JRC, expands upon the conventional waste hierarchy by introducing additional levels to provide more comprehensive guidance for food waste prevention, valorisation, and management, all with the aim to reduce the negative impacts of food waste.
- EU Member States are legally obliged to prepare specific food waste prevention programs.

The Waste Framework Directive (WFD) was initially adopted in 1975 and has since undergone several reviews, with the most recent one adopted in 2018. The WFD introduced the waste hierarchy, which prioritises waste management based on its environmental benefits. At the top of this hierarchy is waste prevention, considered the most preferable option, followed by preparing for re-use, recycling, recovery, and ultimately disposal. In the WFD, "waste prevention" is defined as actions taken prior to a substance, material, or product becoming waste, with the aim of decreasing the amount of waste generated (including reuse actions) and mitigating its negative effects (EC, 2018c).

The issue of food waste prevention has gained specific political importance at the EU level since 2015. This emphasis on food waste aligns with the EU's commitments under the UN 2030 Sustainable Development Agenda. The EU and its Member States pledged to achieve SDG Target 12.3 by 2030, which aims to reduce per capita global food waste by half at the retail and consumer levels, while also reducing food losses throughout production and supply chains, including post-harvest losses.

To achieve this, the WFD 2018 mandates Member States to undertake various actions aimed at reducing food waste throughout the food supply chain. Specifically, the directive imposed the following obligations on Member States:

- Reducing the generation of food waste in primary production, in processing and manufacturing, in retail and other distribution of food, in restaurants and food services as well as in households as a contribution to the United Nations SDG to reduce by 50 % the per capita global food waste at the retail and consumer levels and to reduce food losses along production and supply chains by 2030 (WFD Article 9(1), point (g)).
- Encouraging food donation and other means of redistributing food for human consumption, with a priority given to human use over animal feed and the reprocessing of food into non-food products (WFD Article 9(1), point (h)) (EC, 2018c).
- Monitoring and assessing the implementation of their waste prevention measures by measuring food waste levels (WFD Art. 9(5)) and reporting the data on an annual basis (WFD Art. 37(3) and Commission Implementing Decision (EU) 2019/2000).
- Adopting specific food waste prevention programmes within their waste prevention programmes (WFD Art. 30 (2a)).
- Developing and supporting information campaigns to raise awareness about waste prevention and littering (WFD Art. 9(1m)).

In July 2023, a new proposal for the revision of the WFD was adopted by the European Commission. This proposal includes the setting of legally binding food reduction targets to be met by Member States by the end of 2030, which involve a 10% reduction for processing and manufacturing and a 30% reduction for food waste at the retail and consumption levels (including restaurants, food services, and households).

These objectives establish distinct responsibilities for Member States to expedite the reduction of food waste throughout the food supply chain and within households (EC, 2023c).

3.2. How is the EU supporting implementation of food waste prevention?

3.2.1. Illustrating priority setting for food waste prevention over management

The traditional waste hierarchy, as defined in the WFD Art. 4(1), presents specific challenges when applied to food waste prevention in comparison to its application to other waste streams. For instance, the "preparing for re-use" (meaning in accordance to Art. 3(13) that products or components are used again for the same purpose for which they were conceived) does not readily apply to food waste. Furthermore, the opportunities for prevention and reduction within the context of food waste are more diverse compared to other waste streams (e.g. other use could be applied for human consumption and for animal feed; food waste and by products could also be managed at bio-refineries, etc.). While WFD Art. 9 prioritises donation and redistribution of surplus food over animal feed, this distinction is not clearly articulated within the conventional waste hierarchy (as outlined in Art. 4).

Over the years, several steps were therefore taken to support Member States as well as practioners with extended guidance and illustrations on how to best adapt the well-known WFD waste hierarchy's pyramid to the food environment (see Table 3.1).

First, the European Parliament proposed in 2017 to articulate a separate hierarchy for food waste, which used the same categories as the waste hierarchy of the WFD from 2008 but was more specific (European Parliament, 2017). The intention was to emphasize shifting towards preventing food waste and prioritizing use of surplus food for human consumption before use in animal feed, but still leave room for using food waste for material and energy recovery (Bow-Brouwers et al., 2020). This intention then materialised in the revised WFD of 2018, precisely by newly added information in Art. 9(1h), which more specifically describes Member States' requirements to reduce and prevent food waste. In 2019, the European Commission's Joint Research Centre (JRC) in a statement regarding the diversity of prevention actions and the lack of evaluation of effective measures, referred to the "Food waste hierarchy obtained from WRAP". This hierarchy identified and distinguished prevention, recycling, recovery and disposal as four different levels. Prevention here includes the reduction of arising waste of raw materials, ingredients, and (food) products, as well as food and drink being donated to people and sent to animal feed (Caldeira et al., 2019) – so considering how to use produced food so it is not wasted.

In 2020, a JRC briefing presented the "food use hierarchy". While not a formal document, its illustration and distinction of priorities of prevention actions was meant to help align bioeconomy policy with surplus food use and food waste valorisation to ultimately contribute towards reducing the negative environmental, economic and social impacts of food waste. The JRC food use hierarchy Figure 3.1enhances the conventional – and legally binding – waste hierarchy by introducing three new levels. With prevention being the highest priority, the food use hierarchy more clearly distinguishes the prior avoidance of surplus food generation from preventing surplus becoming food waste by the redistribution and donation of surplus food for human consumption and the delivery for animal feed as separate components. In addition, revalorization of food waste into high-value products (beyond nutrient recovery) has also been incorporated (Sanchez Lopez et al., 2020).

Table 3.1 Evolution from 'waste hierarchy' to 'food waste hierarchy' to 'food use hierarchy'

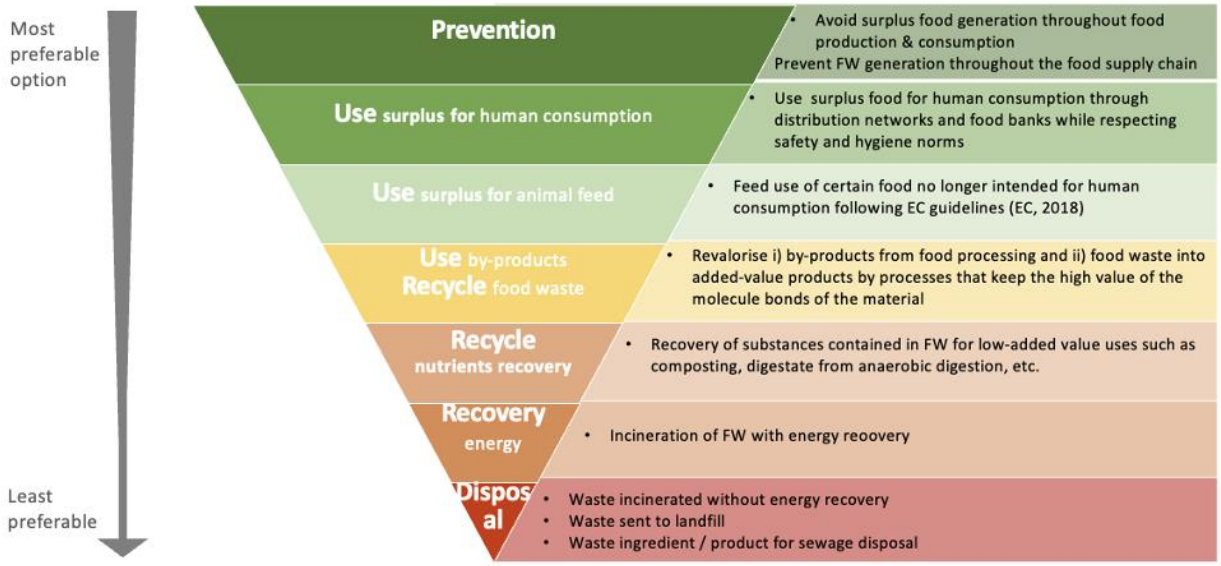
Waste hierarchy WFD Art. 4 (1) (EC, 2008)	**EP Food waste hierarchy** (European Parliament, 2017)	**WFD Art. 3(12) and Art.9(h)** (EC, 2018c)	**Food and drink material hierarchy by WRAP (WRAP, 2015)**	**Food use hierarchy** (Sanchez Lopez et al., 2020)
Prevention	Source prevention	Prevention so that a substance, material or product does not become waste	Prevention - Waste of raw materials, ingredients and product arising is reduced – measured in overall reduction	Prevention of surplus food generation
Preparing for reuse*	Edible food rescue	Food donation and other redistribution for human consumption	- Redistribution to people	Re-use human consumption
		Animal feed	- Sent to animal feed	Re-use animal feed
Recycling	Organic recycling	Reprocessing into non-food products	Recycling - Waste sent to anaerobic digestion; or	Reuse by-products Recycle food waste
			- Waste composted	Recycle nutrients recovery
Other recovery (e.g. energy recovery)	Energy recovery		Recovery - Incineration of waste with energy recovery	Recovery energy
Disposal	Disposal		Disposal - Waste incinerated without energy recovery - Waste sent to landfill - Waste ingredient / product going to sewer	Disposal

Source: Author's compilation based on the above-mentioned references.

The JRC Briefing's food use hierarchy refers to "re-use" for human consumption and animal feed, thereby indicating that while food is still used, it is not done so in the originally intended way. However, the term "re-use" can lead to irritation in view of the definition already set out in WFD Art. 3(16) stating that "'re-use' means any operation by which products or components that are not waste are used again for the same purpose for which they were conceived".

This ETC report therefore slightly adapted the JRC food use hierarchy (see Figure 3.1) to avoid misunderstandings – but still be able to map the Member States' action with regard to the most preferable options.

Figure 3.1 The (adapted) food use hierarchy



Source: Reproduced from (Sanchez Lopez et al., 2020) and adapted in so far as in changing JRC's formulation of "re-use" for human consumption and animal feed into "use of surplus food" for human consumption and animal feed.

3.2.2. Guidance on the application of the waste hierarchy to food waste

Following requests from some Member States to further facilitate the practical implementation of the waste hierarchy and the food use hierarchy (Council of the European Union, 2020), the 2023 Impact Assessment of the European Commission (EC, 2023a) referenced to the following documents as established guidance:

- Guidelines on the preparation of food waste prevention programmes (2008) (EC, 2011),
- Bio-waste prevention guidelines (2011),
- Brief on food waste in the European Union (Sanchez Lopez et al., 2020),
- Recommendations for action in food waste prevention (EU Platform on Food Losses and Food Waste, 2019a),
- Voluntary Code of Conduct for Food Loss and Waste Reduction (FAO, 2022).

Further support available includes:

- Food donation guideline (EC, 2017).
- Guidelines for the feed use of food no longer intended for human consumption (EC, 2018a).
- Compendium of the European Consumer Food Waste Forum (Candael et al., 2023).

3.3. What is the status of food waste prevention in the EU-27 Member States?[11]

- 24 countries (here including Flanders and Brussels) integrated food waste prevention within their waste prevention programmes (or waste management plan). Another four Member States (here including Flanders) confirmed the existence of a standalone food waste prevention programme. 15 Member States have additionally introduced dedicated food waste strategies / action plans / acts,
- Nearly all the Member States that provided information (22 out of 26) self-reported a food waste reduction target. More than half of the countries (16 countries) mention a commitment to SDG 12.3. 13 countries stated to follow the prioritisation in accordance with the food use hierarchy. In addition. However, the ETC team could not see any differences in view of the extent of food waste

[11] In parallel to this ETC mapping, the JRC conducted a similar exercise in 2023 to support the Impact Assessment of the legislative proposal amending Directive 2008/98/EC, in relation to the part focusing on setting legally binding food waste reduction targets

prevention and reduction action efforts taken between countries that refer to SDG 12.3. or included the food use hierarchy and those that did neither.
- No findings (yet) in any country's Hub or questionnaires about evaluations to assess the effectiveness of actions.
- Actions specifically aimed at preventing food waste are becoming more common in the EU as 66% of the reported actions primarily focus on food waste prevention. A significant number of actions, 26%, also target use of surplus food for human consumption. One percent of the actions reviewed aims to use food surplus for animal feed. Further actions pertain to lower levels of the food use hierarchy, such as valorisation of food surplus and waste into higher-value products (2%) and recycling (4%). No actions have been found on recovery of energy.

This section presents the EU-27 Member States' targets, strategies, and actions, based on information retrieved from questionnaire answers, waste prevention profiles, and additional information retrieved from the FLW Prevention Hub (whole process referred hereafter as 'ETC mapping)' in 2023. Literature findings are used to provide context to the results obtained from the ETC mapping.

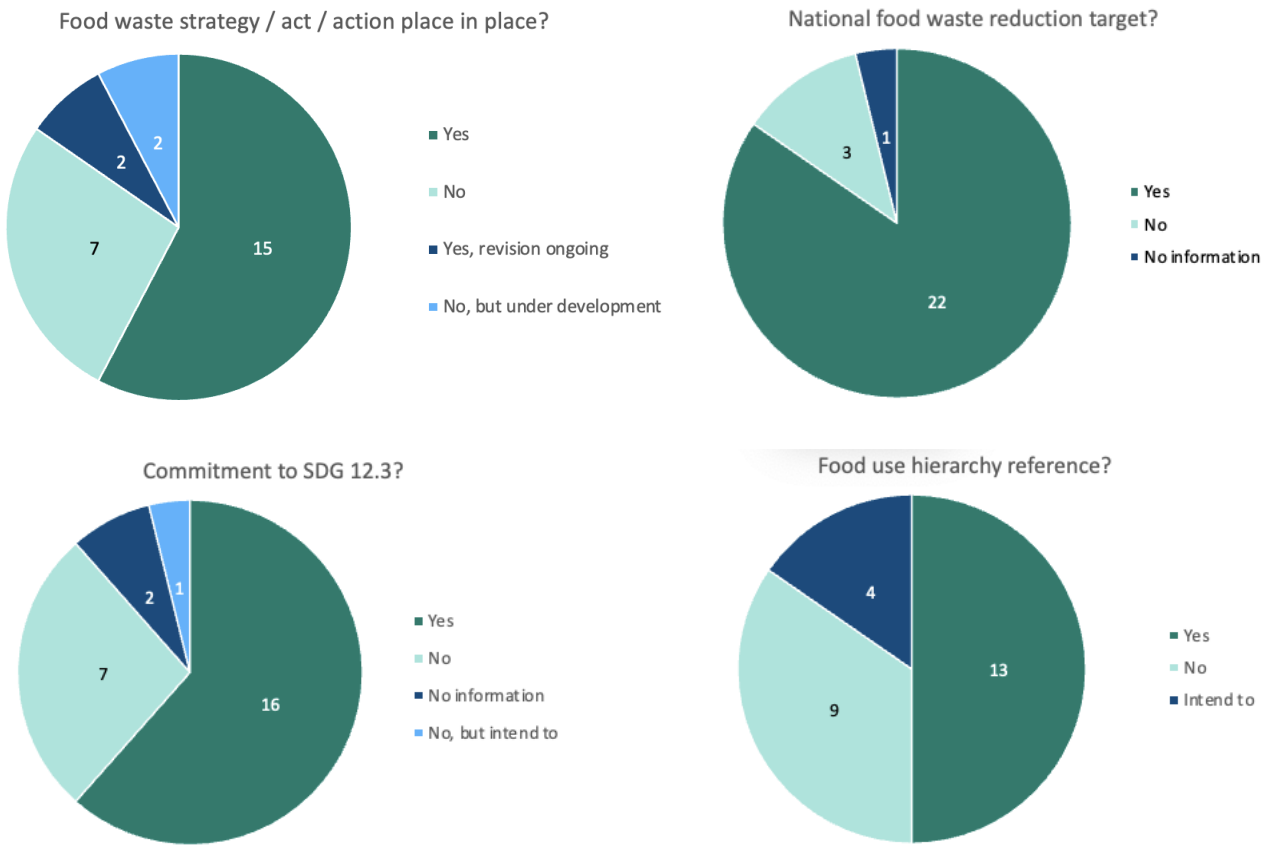
3.3.1. Incorporating food waste actions into national policy

EU-27 Member States are obliged to adopt specific food waste prevention programmes (see WFD Art. 30 (2a)) within their waste prevention programmes (which themselves could either be integrated in the national waste management plans or into other appropriate environmental programmes). The 2023 ETC mapping highlights that 24 countries (here including Flanders and Brussels) integrated food waste prevention within their waste prevention programmes (or waste management plan). Another four Member States (here including Flanders) confirmed the existence of a standalone food waste prevention programme.

Beyond that, 17 out of 26 countries Member States have additionally adopted national strategies or action plans or pacts – the naming varies – in order to further strengthen their food waste focus. Among this group, two countries (Germany, and Spain) are in the process of revising these documents. One country (Belgium[12]) is drafting an individual food waste prevention strategy, action plans or pacts (Figure 3.2).

[12] Belgium, having only food waste strategies for Brussels and Flanders, but not for Wallonia is developing a strategy for the whole country.

Figure 3.2 Illustration of the findings from ETC mapping on food waste strategy / act / action plan, targets, SDG 12.3. commitments, and reference to the food use hierarchy



Notes: Figures do not include Cyprus. For detailed information for each country see table A.1 in annex 1.
Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023 and Member State feedback.

In 2018, the Council assessed that many Member States had already made significant progress in implementing the waste hierarchy and the food use hierarchy (Presidency of the Council of the EU, 2018). By 2020, according to the Council Secretariat, most Member States had integrated the waste hierarchy into their national legislative or non-legislative measures. This often included Member States providing support to help economic operators and other stakeholders put the waste hierarchy into practice (Council of the European Union, 2020).

The literature states that in 2020, seven countries (France, Germany, Italy, Luxembourg, the Netherlands, Romania and Flanders) referred to the food use hierarchy in legal documents (EC et al., 2020). The ETC mapping shows that as of 2023 this number increased to a total of 12 countries (the countries previously mentioned plus Austria, Czechia, Greece, Hungary, Latvia, and Sweden).

In 2020, all EU-27 Member States confirmed their support for achieving SDG 12.3., although not all Member States had yet defined specific national reduction targets, often because these were to be set as part of processes not yet completed (Council of the European Union, 2020). The 2023 ETC mapping shows that 16 countries mention SDG 12.3 in their Hub, and with 22 a majority of the countries report a food waste reduction target. Furthermore, Hungary mentioned the intention to commit to SDG 12.3 in the future when developing a food waste target.

3.3.2. Developing monitoring systems and methodologies

The EU delegated decision (EU) 2019/1597 (EC, 2019) mandates Member States to report data on food waste on annual basis, providing a range of possible data collection methods. The decision requires measuring food waste in each value chain in a detailed manner at least once every four years – methods primarily include direct measurements or approximations of food waste such as weight or volume measurements, scanning/counting, waste compositional analysis, and diaries. Member States have the flexibility to choose from these defined methods for various stages of the value chain, as outlined in Annex 3 of the decision (EU) 2019/1597. In years where direct measurements are not conducted, alternative methods such as mass balance or coefficients can also be employed. Annex 4 offers an additional list of methods that Member States can use if the previously mentioned in-depth methods are not suitable for specific value chain stages in each reference year (EC, 2019).

According to Eurostat, all EU-27 Member States but Romania have reported food waste data as required by the delegated decision (EU) 2019/1597 for the year 2020. According to the ETC mapping, at least 23 Member States are collecting food waste data for the whole value chain. In the hub and questionnaires two countries, Romania and Belgium (Wallonia and Brussels), present data from only parts of the value chain. Romania has data from those parts of the value chain that either give or accept donations, while Belgium (Brussels and Wallonia) only provides food waste data from households. No information was found for Malta and Cyprus.

In response to EU reporting requirements, countries develop their monitoring systems and methodologies. Some countries use several methods outlined in Annex III of decision 2019/1597. For example, Slovenia combines waste compositional analysis with household diaries to measure household food waste levels. Finland chose to combine three methods for household waste measurement: compositional analysis, diary-based studies, and surveys. France mentions mobilizing its statistical services to create survey questionnaires, develop expertise in technical coefficients, and conduct in-depth analyses for non-regular statistical surveys. In 2020, Greece employed online diaries over seven days to assess household food waste levels. In the retail sector, Greece conducted a dedicated study using a combination of counting-scanning and coefficient methods. Greece also collected food waste statistics in 2020 from the processing-manufacturing stage, animal production, and aquaculture.

In theory, the wide range of possible methodological choices and the requirement to measure food waste for each stage of the food supply chain only every four years could contribute to differences in food waste per capita among Member States. For instance, relying solely on diaries to measure household food waste could result in an underestimate compared to waste compositional studies, according to some research (Quested et al., 2020). The ETC mapping also shows that some countries measure food waste in the value chain more frequently than every four years. For example, Sweden measures food waste in households annually (although some factors are not updated each year) and biannually for other stages of the value chain. The ETC mapping, however, was not designed to empirically investigate the potential impact of methodological choices on these disparities. Therefore, conducting further research in this area would be beneficial in understanding how methodological choices can affect the statistics and allow further guidance to countries to facilitate their reporting.

The ETC mapping reveals that some countries are actively engaged in collecting data or developing methods for statistics that are voluntary, such as data on edible parts of food waste and donation of surplus food. For instance, in 2018 Sweden established a national method for measurement of food waste in public meal restaurants and in 2019 conducted the first national survey to assess edible parts of food waste in municipal pre-schools, schools, and elderly homes. Slovenia is also involved in an EU-funded project to develop a methodology for distinguishing between edible and inedible parts of food waste

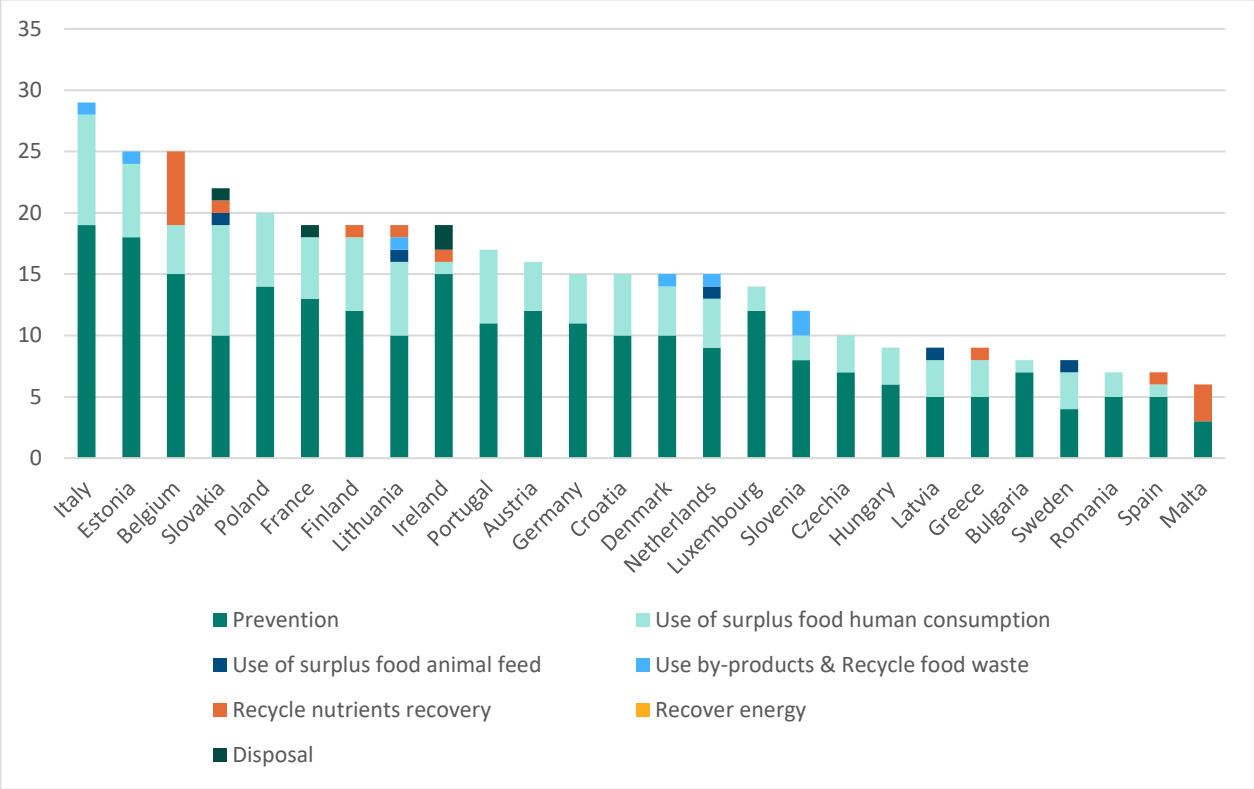
within households. And in Romania both receiving and donating operators are obliged to submit annual reports containing information on the quantity of donated food (for receiving operators) and the quantity and value of food (for donating operators).

None of the countries in the ETC mapping provide information on how much food waste is prevented at the different stages of the food supply chain, or amounts recovered through donation or sent to animal feed.

3.4. Taking actions in accordance with the food use hierarchy

Efforts to fight food waste are evident in all countries looked at, with a total of 332 actions having been listed in the ETC mapping.[13] The reviewed numbers of actions by country range between 29 (Italy) to 6 (Malta). For an overview all countries see Figure 3.3.

Figure 3.3 Total number of reported actions by each Member State and by level of the food use hierarchy



Note: Figure does not include Cyprus. Since an action can target several levels in the hierarchy the total number exceeds the total of 332 reviewed actions.
Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023.

By sorting the actions according to the levels of the food use hierarchy, the ETC mapping enables an understanding of the respective prioritisation of destination of the food. While the countries implemented actions in accordance with different levels of the food use hierarchy and in different prevalence allowing for MS-level customisation, 66% of the total reported actions were designed to help achieve prevention of surplus food. This includes for example, raising public awareness and providing information, primarily via education to students or staff and public information campaigns. In addition, many actions were taken to foster use of surplus food for human consumption (26%), mainly by promoting food donation. Fewer

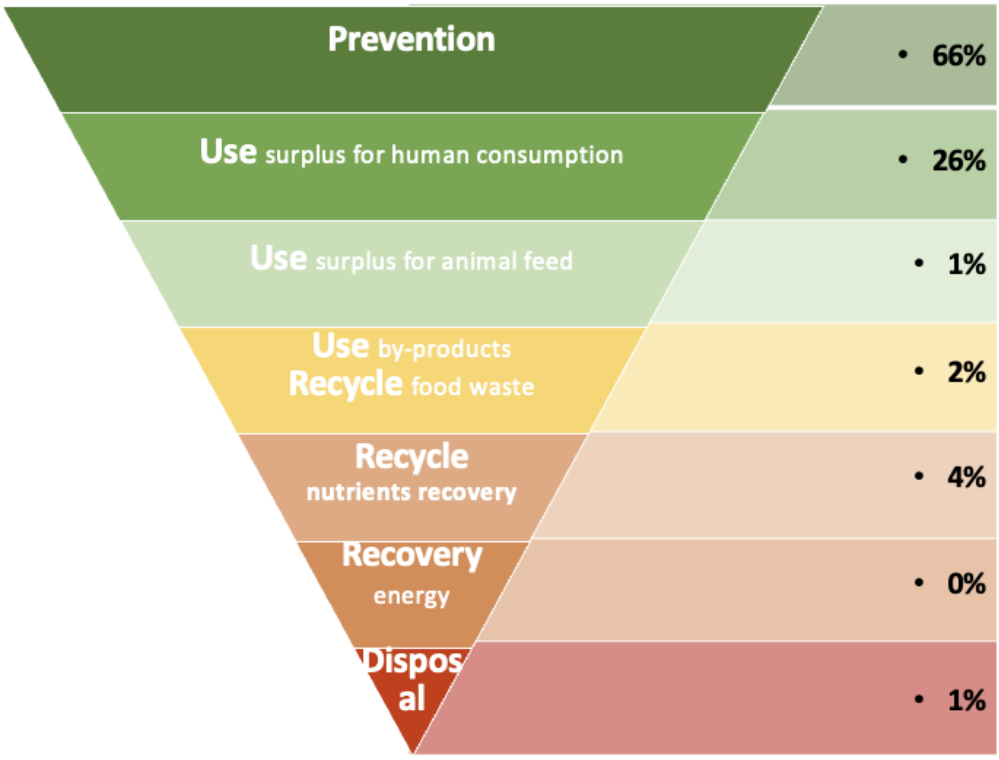
[13] Actions can be quite broad not focusing on one single level of the food use hierarchy but rather targeting several different levels. Therefore, double counting of actions occurred when analysing which level of the food use hierarchy has been targeted.

actions have been found in the five lower levels of the food use hierarchyFigure 3.4), although more actions are likely taking place than those that have been reported.

A 2019 survey conducted with members of the EU Platform on Food Losses and Food Waste (FLW) came to a similar result. From 91 submitted actions and 8 additional actions collected from a review (Caldeira et al., 2019)

- 32 actions were aimed at redistributing surplus food fit for human consumption.
- 21 actions were aimed to promote a behavioural shift amongst consumers.
- 21 actions targeted improvement of supply chain efficiency, by modifying either the processes, the products, or the packaging to promote food waste reduction.
- 15 actions were aimed at food waste prevention governance through crosscutting actions such as voluntary agreements, national food waste prevention programs, and regulatory frameworks.
- Only 2 actions were aimed at valorising surplus food in value added products such as animal feed.

Figure 3.4 Illustration of the 332 reported actions carried out in the Member States, according to the (adapted) food use hierarchy



Note: Figure does not include Cyprus.
Source: Adapted from (Sanchez Lopez et al., 2020). Wording slightly amended and percentages added by ETC according to its mapping in 2023.[14]

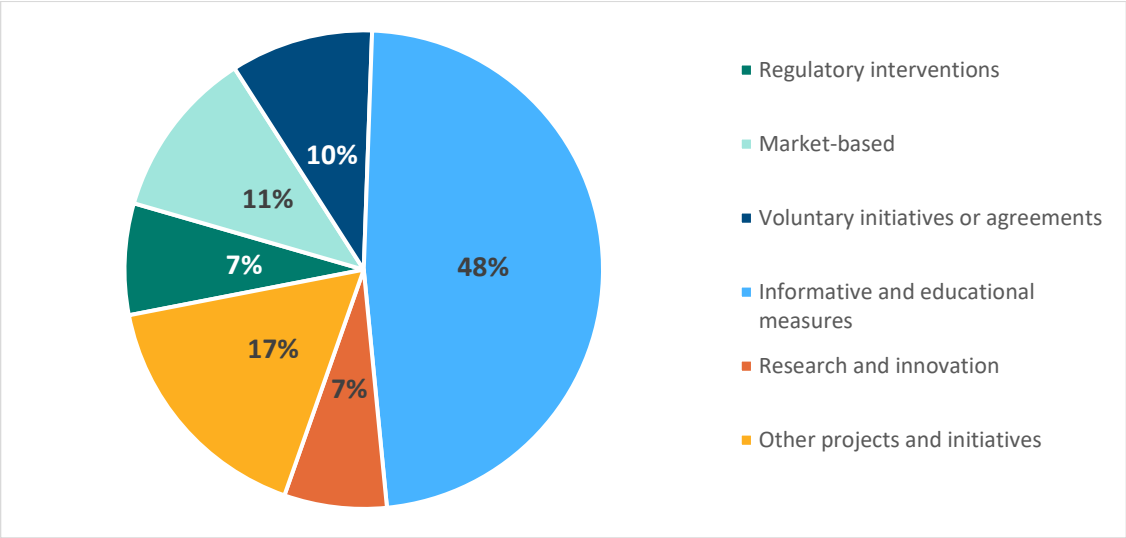
3.4.1. Most common categories of food waste actions

According to the ETC mapping, in general the most common type of actions are soft policy measures, predominantly "informational and educational", but also "voluntary initiatives and agreements", "research and innovation", and "other projects" (see Figure 3.5). "Informational & educational measures" dominate at the level of prevention and recycling (see Figure 3.6).

[14] Note that an action can target multiple levels in the hierarchy, which is why the numbers within each level of hierarchy do not add up to the total identified number of 332 actions.

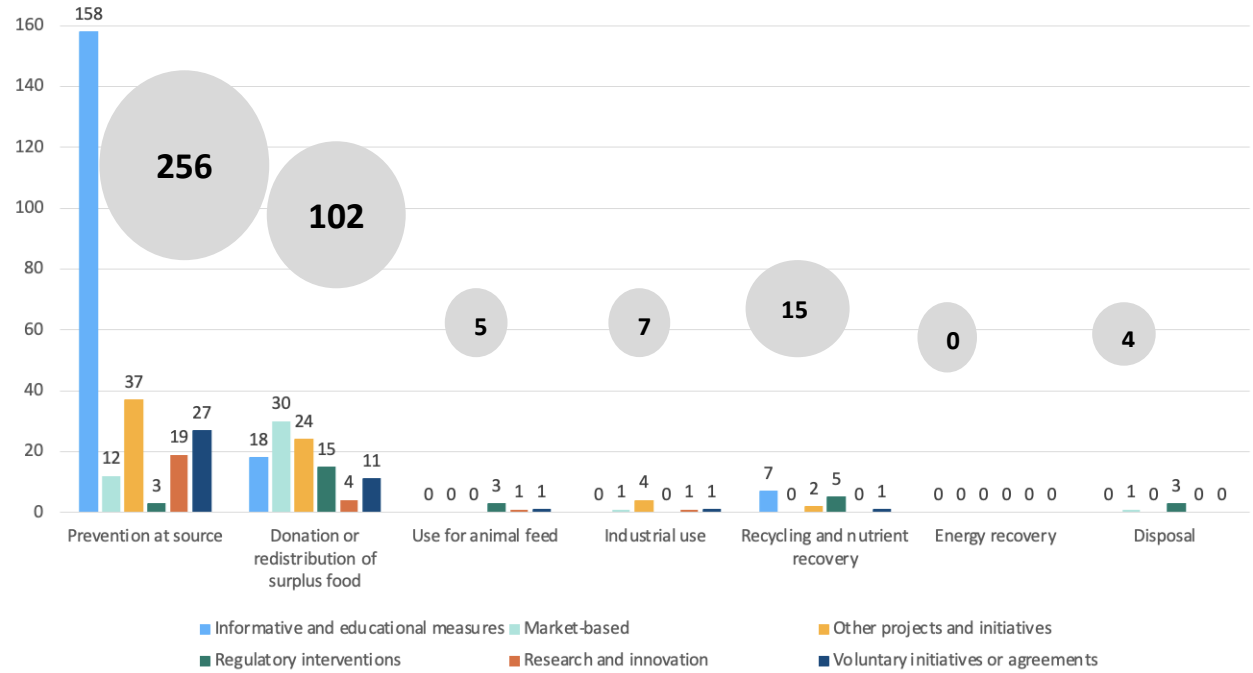
The most common targeted value chain stage (excluding undefined) is households, followed by measures that address various value chain stages (see Figure 3.7).

Figure 3.5 Illustration of the different actions by type of policy measure



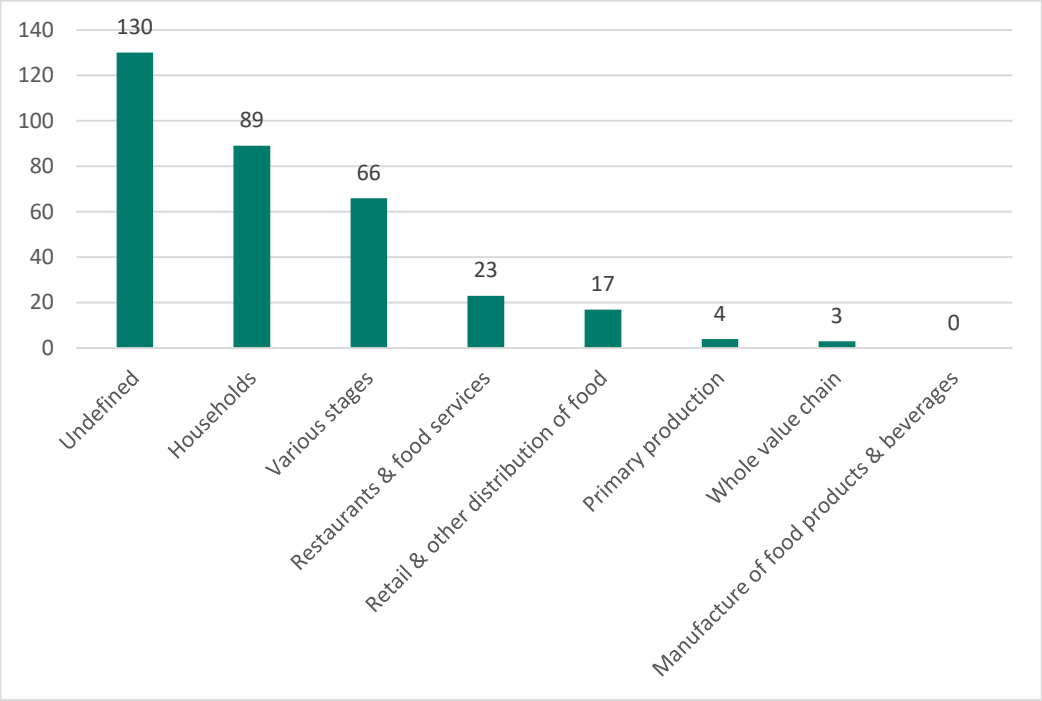
Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023.

Figure 3.6 Number of actions by type and by level of the (adapted) food use hierarchy



Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023.

Figure 3.7 Most common targeted stages of the value chain



Note: For the value chain stage **"**Manufacturing" of food products & beverages there were no single actions found but instead several ones covering "Various stages".
Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023.

3.4.2. Influence of policy on actions taken

All countries focus on reporting actions within the prevention level of the hierarchy. However, according to the information accessible to the ETC no conclusive connection can be drawn from the countries' reference to SDG Target 12.3 or their mentioning of the food use hierarchy on their tendency to prioritise actions in accordance with the hierarchy.

- Both countries that have and do not have a reference to the SDG 12.3 reported most of their actions in the prevention level (69% and 67% respectively). (Note, there is however a difference when looking at the food waste management option of recycling for nutrient recovery, for which 10 out of 15 actions belong to countries with no reference to the SDG Target 12.3.)
- There is no noticeable distinction concerning a country's reference to the hierarchy and their prevention actions. Both Austria, which refers to the hierarchy, and Bulgaria, which does not mention the hierarchy, reported 88% of their actions within the prevention level. The same holds for Malta and Sweden, which both reported 50% of their actions within the prevention level. Malta does not explicitly mention the hierarchy, whereas Sweden makes a reference to it.

Similarly, the existence of a specific food waste strategy / action plan / pact also does not seem to make a notable difference with regards to the number or type of food waste actions.

- Countries with a separated food waste strategy or alike and many actions include for example Italy (29 actions), Estonia (25), Slovakia (22), Poland (20) and France (19). Countries with many actions but no separated food waste strategy etc. include Belgium (25), Lithuania (19), and Finland (19).
- Actions classified as regulatory interventions are taken equally by countries both with and without a separated food waste strategy or alike. Of the 14 countries that mention regulatory interventions; 7 have a separated food waste strategy and 7 do not have such a strategy or alike.

While the range of actions being implemented across the EU-27 Member States is clear, no information or data on the effectiveness of these actions have (yet) been identified during the ETC Mapping. However, Poland indicated upcoming analytical work and stakeholder feedback to assess the functioning of the Act on counteracting food wastage, and also an interesting evaluation took place of the French Garot Law implementation (EY, 2019).

3.5. Do EU-27 Member States create synergies with the policy areas of climate change and biodiversity?

- Some EU-27 Member States are already integrating or linking measures and strategies around food waste, biodiversity, and climate change, but not enough information was yet available for a detailed analysis by the ETC CE.
- There is significant potential in combining and integrating efforts to tackle both climate change and food waste simultaneously, as e.g., reducing volume of food waste also reduces GHG emissions.
- Key to achieving synergies in these policy areas will be to find the most effective ways to conduct those integrations of measures and linkages between policies and strategies. For example, Member States could be supported within the frame of EU actions with Eionet knowledge sharing opportunities, to align monitoring and evaluation of measures between policy silos, considering the wider, more holistic impacts of food loss and waste on a systemic level.

3.5.1. Food waste prevention in climate change strategies

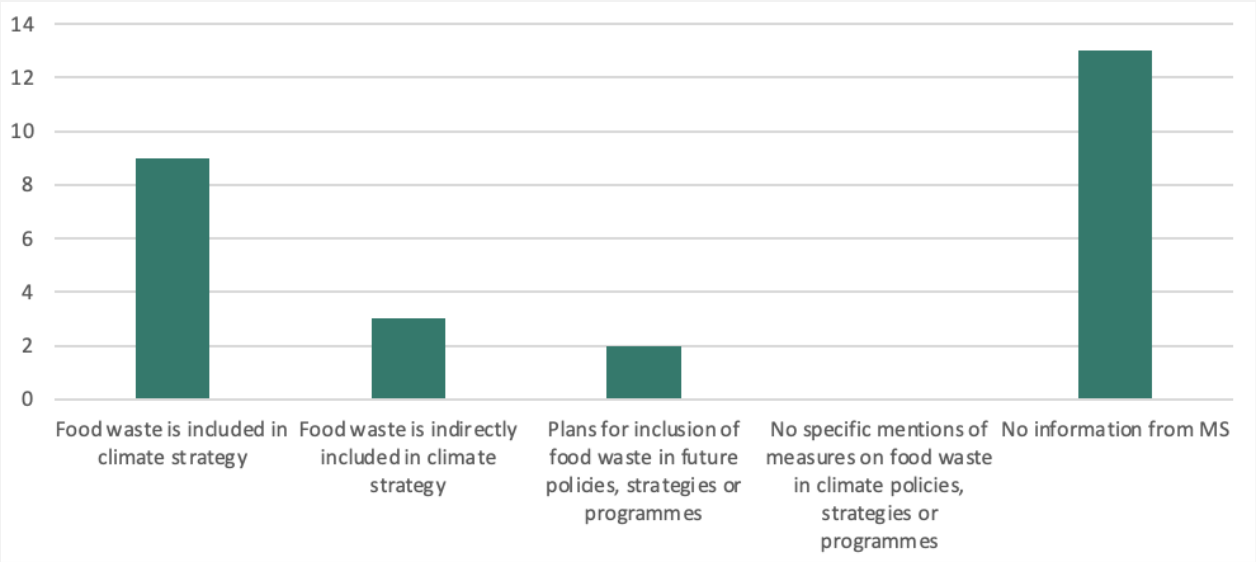
As previously discussed, the significant linkages between food waste and climate change are evident, and highlighted not only by the EU, but also by organisations such as the United Nations, the World Bank, and the OECD (UN, n.d.; Johns Hopkins Centere for A Livable Future, n.d.; The World Bank, 2022). These linkages introduce two challenges: the effects of food waste on climate change (e.g. release of GHG from the production of food that is being wasted, and the emissions from management of food waste); and the impact of climate change on food waste (e.g. if changes in climate affect the quality of food or cause waste through loss of crops due to extreme weather events). However, food waste reduction has potential to contribute to climate change mitigation (e.g., lower GHG emissions from less waste); and climate change mitigation has potential to reduce food waste (e.g., greater stability of agricultural conditions would decrease the needed level of production).

As of 2018, all EU Member States are required to establish a National Energy and Climate Plan and submit progress reports every two years (EC, 2020). These plans should set out how each country intends to address the five elements of the energy union including decarbonisation, energy efficiency, energy security, internal energy market, and research, innovation and competitiveness. In 2019, the EU FLW Platform proposed to the Commission the incorporation of food loss and waste reductions into the Nationally Determined Contributions (NDCs) (EU Platform on Food Losses and Food Waste, 2019a).[15] In 2022, WRAP found that 21 countries had integrated food waste reduction directly as a component of their NDCs (wrap, 2022).

According to the ETC mapping, nine EU Member States have included food waste in their national-level climate plans. Additionally, three countries have partially included it. Two countries reported no mentions or measures related to food waste in their national climate strategies (see Figure 3.8).

[15] Nationally Determined Contributions refer to the climate action plans (to cut emissions and adapt to climate impacts) required every five years of signatory countries of the Paris Climate Agreement (UN, n.d.).

Figure 3.8 Food waste in climate policies, strategies or programmes, from the ETC mapping



Source: Author's compilation based on information retrieved from the Hub, Eionet questionnaires in 2023 and MS feedback.

Additional research conducted on the status quo across European countries – including the EEA database on greenhouse gas policies and measures in Europe (EEA database on greenhouse gas policies and measures in Europe — European Environment Agency, forthcoming) – revealed various interpretations of what falls within the categories of climate and food. For example, it is unclear whether there is a consensus on biomass policy, which was specifically highlighted as a food waste measure by some countries, and conversely, not considered part of linking climate and food waste by another. Many of the mentioned measures focused quite heavily on topics such as agriculture, land use and change, and energy.

Box 3.1. Linking and integrating climate and food waste policies and strategies – examples from Member States

Malta's Low Carbon Development Strategy integrates the waste prevention programme from the Waste Management Plan for 2021-2030 (Government of Malta, 2021). Within this, there are several measures, such as research into consumer knowledge and attitudes in relation to food waste reduction; identification of sources of food waste at primary production level; development of report methodology for monitoring of food waste; and support for the utilisation of digital channels for food sharing and re-distribution initiatives.

Within the **Belgian** policy structure, food waste is a regional competence. The regional food waste policy is referred to in the national Energy and Climate Plan 2021-2030.

In **Italy**, food security and sustainability feature across a range of policies. All policies related to environmental sustainability and circular economy are coordinated with each other, even when separate, rather than in one single plan.

In the **Austrian** National Energy and Climate Plan 2019 (BMK, n.d.) food waste prevention is included in the measure "Reduce emissions from waste treatment", and specifically mentions awareness raising campaigns and the establishment of networks to minimise food waste. Also the Austrian Circular Economy Strategy addresses food waste.

The **Irish Government's** Climate Action Plan 2021 and Ireland's Waste Action Plan for a Circular Economy include as a commitment to develop of a National Food Waste Prevention Roadmap.

Source: Author's compilation based on information retrieved in the questionnaire in 2023 to and individual feedback from Member States.

Several countries are starting to explore how they can bring the topics of food waste reduction and climate change mitigation together more effectively, often as part of a more systemic approach to the triple challenges of climate change, biodiversity loss and pollution (see Box 3.1. for examples). Apart from governments, numerous research organisations and non-governmental organizations (NGOs) continue to advance the field by providing findings and recommendations (EC, 2022c) on the links between food waste and climate (e.g. WRAP - with "Love Food Hate Waste" (Love Food Hate Waste, WRAP, forthcoming) - or WWF (World Wildlife Fund, forthcoming)).

It is yet to be seen, what the full implications of combining and integrating actions on climate and food waste will be. Key to this development is the support for Member States to effectively link between and across strategies, as some are already practicing, and to align monitoring and evaluation of measures between silos, considering the wider, more holistic impacts.

3.5.2. Food waste prevention in biodiversity strategies

Unlike in the context of climate change, there is no requirement for a specific format of national biodiversity strategy or plan in EU countries. This means that the incorporation and implementation of both international agreements and national priorities takes on various structures across Member States. While some have national biodiversity strategies containing specific objectives (sometimes explicitly related to food), others have incorporated biodiversity requirements into a variety of pieces of national legislation. Additionally, the links with food waste prevention may seem indirect.

On a global level, 2022 saw the adoption of the Kunming-Montreal Global Biodiversity Framework as the conclusion to the 15th Conference of Parties to the United Nations Convention on Biological Diversity (Convention on Biological Diversity, 2022b). The Framework, aiming for "a world living in harmony with nature", includes 23 targets for 2030 and four goals for 2050, and by adopting it, all parties have committed to setting national targets to that end (Convention on Biological Diversity, 2022a). The European contribution to this global framework is set by the EU Biodiversity Strategy for 2023 (EC, 2021b). Food waste, however, does not explicitly feature in its key objectives. This could be one reason why the topic has not been thus far present in the majority of Member States' strategies.

The EU Biodiversity Strategy is supported by several pieces of legislation, such as birds, habitats, nature restoration, invasive alien species, pollinators, urban green spaces (EC, 2023b). While these, again, show many indirect links with food production especially, there is little emphasis on the direct links (both in terms of challenges and opportunities) specifically between food waste reduction and biological diversity. Correspondingly, related national legislation may not see food waste as a key component.

From the ETC mapping process, it was found that for the vast majority of EU Member States, there was no direct, explicit mention of food waste found in their national biodiversity strategy (or equivalent).[16] Exceptions found include Spain, Slovakia and Flanders. In the case of Spain, the measures and actions envisaged to be developed as a result of the State Strategic Plan for Natural Heritage and Biodiversity included the implementation of legal measures to reduce food waste (Ministerio para la Transición Ecológica y el Reto Demográfico, n.d.). Slovakia plans to include food waste prevention in the future National Biodiversity Strategy and Action Plan towards 2030. In the Flemish Action Plan Circular Food Loss and Biomass Residues 2021-2025) Flanders responds to the challenge of the biodiversity targets (OVAM, 2021). In some other Member States, food was mentioned in biodiversity strategies, but only in the context of agricultural systems, nutrition or consumption, rather than in relation to food waste

[16] In the ETC mapping process, national biodiversity strategies (or equivalent plans or policies) were searched for key term "food waste" in English and/or the official national language, as appropriate to the document.

This finding from the ETC mapping highlights that further research is required to understand whether the lack of inclusion of food waste in biodiversity strategies is due to: the topic being considered to be fully addressed in other strategies, policies and plans, or through indirect mentions of other food system topics; a conclusion that the two topics are not sufficiently connected to require explicit links in such documents; a lack of exploration of the possible overlaps between the topics; or other reasons.

Taking a step back from food waste, there is a greater presence of food systems on a more holistic level in biodiversity strategies. From the ETC mapping and questionnaire, for four Member States, (Austria, Ireland, Italy and Spain) food was reported to already be included as a part of their national biodiversity strategy. For an additional three MSs, food was indirectly included (Germany, Greece and Romania) – for example where agriculture and/or primary production formed part of the strategy. Desk research showed that for another eight countries there was some evidence of the inclusion of food in a national level biodiversity strategy. However, since this second stage of ETC research was completed without direct input from Member State representatives, it is considered less accurate. Overall, many of the strategies appeared to include food on a more strategic or background level, for example, naming food to support populations as a key reason for relying on healthy biodiversity. For those which mentioned food in more detail, it often was in the context of food production systems, and their impact on biodiversity, through the pressures created. It is perhaps the case that some Member States have a perception of food waste as a part of the more holistic food and agricultural production systems, and/or as considered primarily under citizen consumption initiatives.

4. Food waste prevention and reduction approaches – in theory and in EU-27 Member States' practice

This chapter provides an overview of literature findings related to specific approaches within the food use hierarchy. This includes respective suggestions on how policy-makers can raise the ambition level, set the regulatory framework and orchestrate efforts for food waste action implementation. Those findings are set side by side with the ETC mapping overview and individual examples of actions taken by Member States in accordance with the six distinct policy measures, as outlined in the methodology section Box 1.1..

4.1. Prevention of surplus food and avoidance of food waste

- All countries implement actions for prevention of surplus food and avoidance of food waste.
- With 62%, the most common type of action was "Informative and educational measures", as found by the ETC mapping.
- Following this reports' definition (see Box 1.2.) 1% of all prevention actions are "Regulatory interventions" indicating that countries rather focus on "soft" policy measures, such as informative and educational (62%), voluntary initiatives or agreements (11%) or initiating/supporting specific research (7%) or other projects (14%).

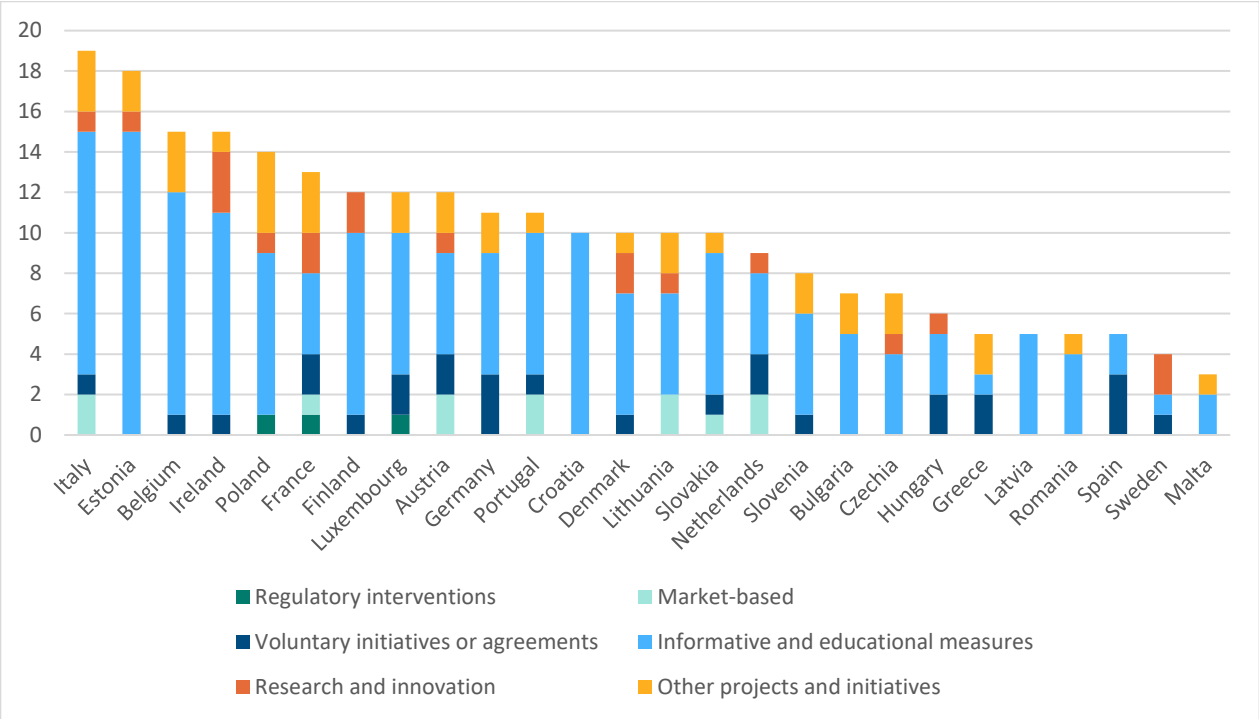
The main guiding principle for tackling food waste is to encourage avoidance of surplus food and then avoid food waste in primary production, processing & manufacturing, retail & other distribution of food as well as restaurants & food services, and to support consumers in respective behavioural change. Preventing surplus food from arising in the first-place results in reduced resources to implement reduction strategies downstream, as there will be, for example, less need for human resources to redistribute surplus food, or for investment in recycling and valorisation technologies (Sanchez Lopez et al., 2020).

4.1.1. Mapping overview

The ETC mapping shows that all countries report several actions related to avoidance of food waste and surplus prevention – ergo the highest level of the food use hierarchy – (see examples in Figure 4.1), ranging from 19 to 3 actions reported. No country only uses one type of policy measure (see Box 1.2), but various: France provided information on all six types. Italy uses all except "Regulatory interventions".

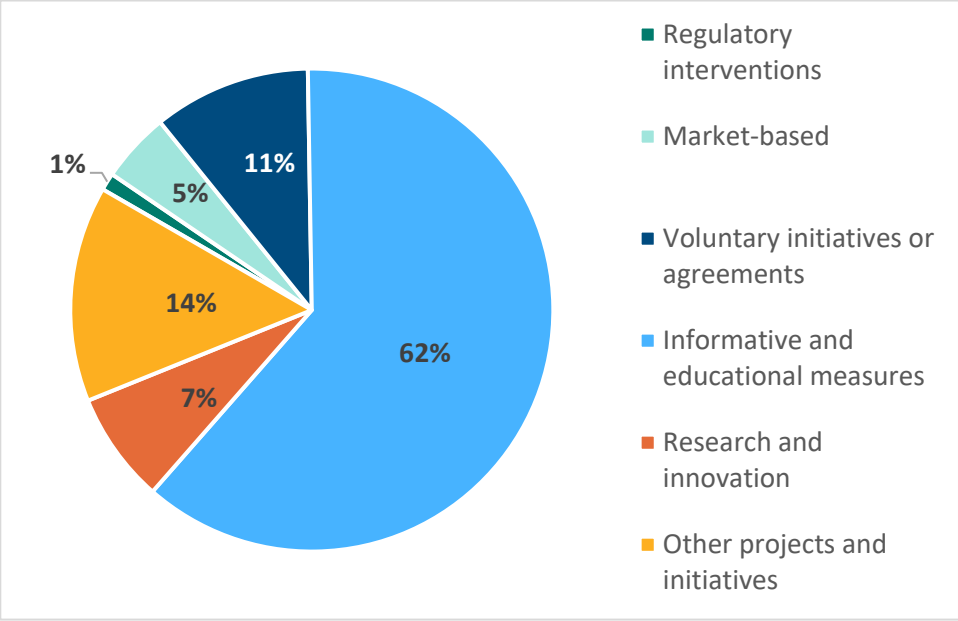
With 62%, the most common type of action was "Informative and educational measures", as found by the ETC mappings (Figure 4.2). This represents 86% of all "informative and educational measures" reviewed by the ETC mapping. Still, three other policy measures are predominantly used at the "prevention" level of the food use hierarchy: 76% of all considered "Research and innovation" actions, 66% of all "Voluntary initiatives or agreements" and 55% of all "Other projects and initiatives" deal with surplus prevention & food waste avoidance.

Figure 4.1 Illustration showing number and type of actions per country within the prevention of surplus food and avoidance of food waste level of the food use hierarchy



Note: Figure does not include Cyprus.
Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023.

Figure 4.2 Illustration showing share of types of reported actions within the prevention of surplus food level and avoidance of food waste of the food use hierarchy



Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023.

4.1.2. High activity: “Information and educational measures”

With 62% of all actions, most of the surplus prevention and food waste avoidance activity takes place in the form of “Informative and educational measures”. Each country makes use of this policy measure. 51% of these actions are directed towards “Households,” 31% were undefined with regards to their target group.

Generally, information and education campaigns are used to address awareness and abilities of e.g. citizens, students, pupils, restaurant clients). According to literature, important success factors include building actions on a behavioural theory and considering segmentation of the target audience (according to e.g., high wasters, and those interested in changing behaviour). Action enhancing individuals’ knowledge and practical skills in food management (such as planning food shopping and usage, cooking precisely, and using leftovers) are likely to have a positive impact according to some studies. On the other hand, campaigns that solely provide information about the negative consequences of food waste do not appear to be influential (Wunder et al., 2018, 2019a). Instead, campaigns aimed at shaping social norms seem to be more promising as these leverage individuals' tendency to conform to the behaviour of those around them (such as relatives and friends). By providing information about the behaviour or attitudes of others in the population, it is possible to shape preventive behaviour. Additionally, policy makers should opt for positive messages in their campaigns rather than negative ones, as research has demonstrated that messages blaming consumers for waste often have unintended negative consequences (Geffen L. et al., 2017; Wunder S., 2019b). However, the studies are based on four countries (Germany, Hungary, Spain, and the Netherlands), and it is important to always consider the context of other countries.

“Informative and educational” examples from the ETC mapping include nationwide campaigns (Luxembourg, Germany and the Netherlands), engaging social media initiatives (Latvia) or websites informing consumers (Slovenia, Germany), challenges for consumers on imperfect fruit and vegetables still tasting good (Slovakia). In the ETC mapping, it was challenging to ascertain whether social norms or positive messages are employed in the “informational and educational” actions of countries, as specific details were not provided in the Hub. Additionally, the mapping did not identify whether countries assessed the effectiveness of these campaigns.

4.1.3. Medium activity: “Other projects & initiatives”, “voluntary agreements” and “research & innovation”

To support surplus prevention and food waste avoidance, countries also make use of “Other projects and initiatives” (14%), “Voluntary initiatives or agreements” (11%) and “Research and innovation“ (7%).

Examples for “Other projects” from the mapping include hosting a National Platform for the prevention of FLW for communication, information and experience exchange amongst stakeholders (e.g. Slovakia), awards to raise attention on innovative ideas and creative food waste reduction solutions (Greece, Germany), food waste measuring requirement as prerequisite to obtain a 'Good Food canteen label' (Brussels, Belgium); a consumer-friendly doggy bag offered at affiliated restaurants and food services (Austria).

Voluntary agreements (VA) can be implemented either by supporting existing legislative targets or by establishing new targets or other obligations within the agreement itself. Literature describes important conditions for the targets, funding, set-up, stakeholder involvement and to develop VAs aligned with national policy (Burgos S. et al., 2019; REFRESH, 2019). ETC mapping collected examples from Denmark, Spain, Ireland and Germany – an upcoming DG SANTE report on VAs identified in the EU additional examples from Austria, Hungary, Finland, France, Luxemburg, the Netherlands, Portugal, Sweden.

The “Research and innovation” examples gathered through the mapping range from scoping studies on the application of circular economy in the field of agriculture and food industries (Lithuania) or an investigation of potential unfair trading practices in the fruit and vegetable sector (Sweden), to the use of

artificial intelligence tools to prevent crop diseases and pests (Sweden) and the identification of regulatory actions as well as gaps. An important recommendation from literature included to consider the consequences of unfair trading practices (UTP) on food waste generation (EU Platform on Food Losses and Food Waste, 2019a). In Sweden, respective discussions with primary producers and food industry about how UTP affect their businesses took place in Sweden and included a 2018 pre-study on trading fruit and vegetables investigating whether unfair trading practices lead to increased food waste in the country.

4.1.4. Low activity: "Market- based measures" and "Regulatory interventions"

According to the ETC mapping, the policy measures "Market based measures" (5%) and "regulatory interventions" (1%) are rarely made use of to support prevention.

Market-based examples found include a loan with lower interest rates when reducing food waste (Netherlands), or financial assistance to implement food waste prevention actions (Austria), financial support to implement technological eco-innovations that lower the negative impact on the environment (Lithuania) or funding of innovative projects to fight against food waste (Italy).

Although the Council of the EU suggested to encourage farmers to develop and implement their own effective programmes to reduce primary production losses by maximising resource utilisation and to then use such engagement as criterion for additional funding under various EU projects and common agriculture policy (CAP) tools (Presidency of the Council of the EU, 2018), information reviewed for the ETC mapping did not reveal such actions. A likely reason might be that such an intervention aims at reducing food losses, not food waste and was therefore out of scope for the information providing Member States. Neither were examples mentioned for the suggestions to offer tax breaks to enable farmers to use their primary products still fit for human consumption or to set waste prevention targets in contractual conditions (e.g., in contract catering for schools, hospitals) (EU Platform on Food Losses and Food Waste, 2019a).

Regulatory actions represent only 1% of all surplus prevention and food waste avoidance actions captured within the "prevention" level, observed in three countries. In Luxembourg, businesses are obliged to prepare waste prevention and management plans. The Garot Law in France now foresees mandatory action plans against food waste for the collective catering and food and drink industry sectors. In Poland, the Act on counteracting food wastage of 19 July 2019 requires from food business operators and their partner organisations to campaign about food management and food waste prevention. Finland's Waste Act obliges actors to keep records of the food waste generated in their operations and its treatment.

4.2. Use of surplus food for human consumption as option for food waste prevention

- The ETC mapping reveals that the majority of the countries (24) take various actions to increase the use of surplus food for human consumption.
- Most actions are "Market-based" (29%) - representing actually 68% of all implemented "Market-based" actions across the whole food use hierarchy levels.
- While "Regulatory interventions" rank (with 15%) on the fourth place of chosen policy measures for use of surplus food for human consumption, these represent at the same time 52% of all "regulatory interventions" implemented across the food use hierarchy levels.

Preventive measures at the source can be inhibited by technical, economic, cultural and organisational barriers. In line with the food use hierarchy, the preferential destination of inevitable surplus is human consumption where safe to do so (Bow-Brouwers et al., 2020).

The European Food Banks Federation (FEBA) estimated 907.208 tonnes of food were redistributed via its members in 2021 (European Food Banks Federation, 2021). These numbers are certainly higher, since not all redistribution is happening via FEBA food banks, but also by non-member food banks or other initiatives across Europe.

A challenge arises from the need to balance food waste reduction with food safety. Food safety and hygiene regulations have been developed to protect human health and ensure a high quality of our food. In some cases, this – or at least the interpretation of the legislation – may cause unnecessary food waste (Wunder et al., 2018).

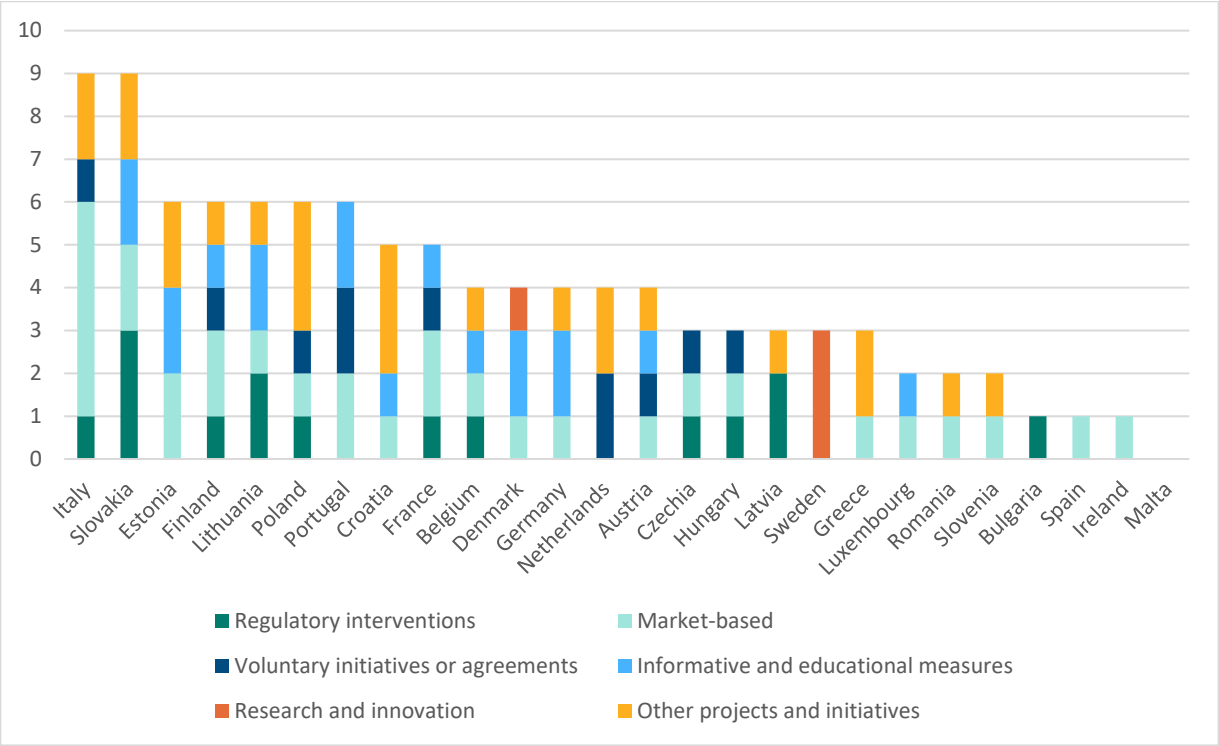
Public support and frameworks for the actors in the field are provided. At the EU level, the European Commission published its "EU guidelines on food donation" in 2017, offering clarification on the applicable provisions of EU legislation concerning food products provided free of charge by the holder (EU Platform on Food Losses and Food Waste, 2019b). Specifications were also made, that the marketing of foods beyond the date of minimum durability (i.e., “best before”) is allowed under EU rules, provided that the foods concerned are still safe and their presentation is not misleading (EU Platform on Food Losses and Food Waste, 2019b). Since 2017 – and not yet reflected in the EU food donation guidelines – revisions of EU legislation with relevance for food redistribution have been adopted: for example the Commission Regulation (EU) 2021/382 from 2021 and Commission Delegated Regulation (EU) 2021/1374 from 2021, the Commission Note providing guidance on food safety management systems for food retail actions, incl. food donations from 2020, and the Regulation (EU) 2021/1374, as well as and food of animal origin and freezing of meat at retail (EC, n.d.).

4.2.1. Mapping overview

The information found in the 2023 ETC mapping shows that most of the countries (24) take various actions to increase donation of food surplus (as “use of surplus food for human consumption”); Italy and Slovakia report the most respective actions (each 9). (Figure 4.3). As mentioned before, very little data for Cyprus and Malta was collected during the ETC mapping, so no action is included here.

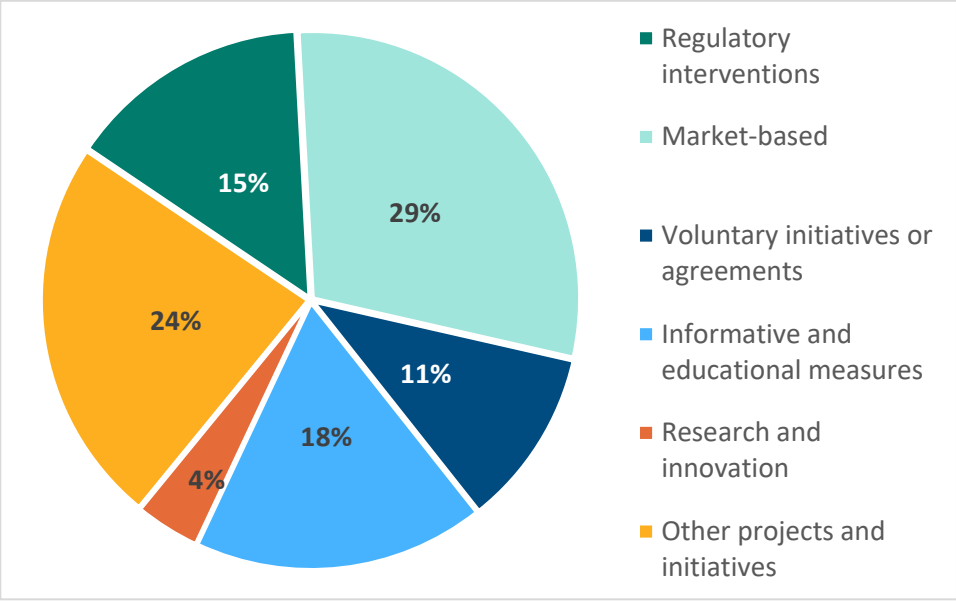
For use of surplus food for human consumption all policy types are used, with “Market-based” at the top, representing 29% of the actions (Figure 4.4). The ETC mapping also reveals that as much as 68% of all “Market-based actions” and 52% of all "Regulatory intervention actions” reviewed are found within that level. Interestingly, for Sweden only one policy type seems to have been used to deal with the use of surplus food was used.

Figure 4.3 Illustration showing number and type of reported actions per country within the use of surplus food for human consumption level of the hierarchy



Note: Figure does not include Cyprus
Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023.

Figure 4.4 Illustration showing share of actions by type of policy measures within the use of surplus food for human consumption level of the hierarchy



Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023.

4.2.2. High activity: "Market based" and "other projects and initiatives"

Most of the actions supporting use of surplus food for human consumption are "market-based" (29%), followed by actions that are classified as "other projects and initiatives" (24%).

Market-based measures suggested in literature to support use of surplus food for human consumption include for example tax deductions (or in some cases tax credits) granted for food donations or the adaptation of fiscal rules. A 60% tax credit in France and a full tax deduction in the Netherlands are considered to be stimulating food donations in these countries. In Italy, a 20% tax deduction was locally implemented in 2018, but is forecast to increase to a 50% rate in 2019 to further promote food redistribution.[68] Further examples from the ETC mapping include Spain (where 35% of the net book value of donated food can be claimed as a corporate tax credit, which can be deducted from the corporate tax on their revenue), but also Germany, Lithuania, Luxemburg, Slovakia. Tax barriers can also be eliminated by reducing Value Added Tax (VAT) for donated food to charitable organisations (Goodwin et al., 2022) - which according to the ETC mapping is practiced in Hungary, Poland, Greece, Denmark and in Belgium; in Croatia and Romania VAT is reduced for donated foods close to the expiration date. Member States also combine food donation with the reduction of waste collection city tax to successfully promote donation of surplus food (EU Platform on Food Losses and Food Waste, 2019a). Other fiscal measures to increase food donation can include deductions or credits that support e.g., offsetting the costs for transportation or storage; no specific example for this was found during the mapping.

Other projects and initiatives to foster the use of surplus food for human consumption included the launch launched of IT system improves the communication between donors and charities (like in Croatia). Another example is the establishment of collection, sorting and distribution systems to charities, social structures and social grocery stores providing food to those in need, as done in Greece by a non-profit company of Thessaloniki Central Market (CMT) as a way to develop strong and reliable mechanisms to limit food waste and support weaker social groups at local level.

4.2.3. Medium activity: "Informative and educational measures" and "Regulatory interventions"

Eighteen percent of the use of surplus food for human consumption actions are "Informative and educational measures". This is well in line with literature recommendations, suggesting supporting food donation and redistribution actions by giving clear guidance. It is considered important to explain the specific legal, administrative or safety requirements well to the actors involved (Wunder et al., 2018). Specifically, national guidelines should clarify e.g., liability and fiscal rules or detail food safety and hygiene provisions in line with the 2017 EU guidelines on food donation (EU Platform on Food Losses and Food Waste, 2019a). It has also been suggested to enhance communication to address the misconception that it is not safe to redistribute food after the "best before" date (EU Platform on Food Losses and Food Waste, 2019b). Respective Member State examples from the ETC mapping include Estonia, France, Germany, Finland and Romania, either publishing guidelines or clarifications on the donation processes.

Regulatory interventions have a share of 15% at this hierarchy level. This represents the highest number of actions classified as regulatory interventions along the whole hierarchy (15 actions compared to 5 or 3 for other hierarchy levels). Two different types of regulations can be found: Belgium (Brussels and Flanders), Czechia, Finland, France, Hungary and Poland mention regulations for companies on different levels of the supply chain that make the donation of surplus food obligatory. Bulgaria, Italy, Latvia, Lithuania and Slovakia focus on legislation regarding food safety and donations.

4.2.4. Low activity: "Voluntary initiatives or agreements" and "Research & innovation"

Less use is made of "Voluntary initiatives or agreements" (11%) or "Research and innovation" (4%) at the level of use of surplus food for human consumption.

"Voluntary initiatives or agreements" have been implemented in 11 cases. In Austria for example, a voluntary agreement has been signed by the large (food) retail companies, obliging them to reduce the amount of avoidable food waste by implementing both mandatory and voluntary measures. Many stores in Finland have agreed to work with charities in the local area to give unsold food to those in need. In Portugal, the retail sector agreed to sell products at risk of being wasted and to inform consumers about date marking via information campaigns. A slightly different approach is a Polish citizen initiative, inspiring people to leave and take food free of charge at community fridges, which are operated by volunteers.

Three of the four "research and innovation" actions are taking place in Sweden, including a project developing redistribution systems of surplus food from wholesalers and stores to schools and restaurants or a Nordic study has identified bottlenecks and barriers linked to food donations.

4.3. Use of surplus food for animal feed as option for food waste prevention

- For use of surplus food for animal feed, 60% of actions can be classified as "regulatory interventions".
- Actions related to this level were only identified in five countries in the ETC mapping. Potentially, the ongoing optimisation of using surplus food no longer intended for human consumption as animal feed - always without compromising feed and food safety – has to be further explored or at least be better communicated to have further measures implemented and showcased.

The EC's Circular Economy Action Plan sets out to increase the use of surplus food from the food chain in livestock feed without compromising feed and food safety. This was further elaborated in the European Parliament report "Initiative on resource efficiency: reducing food waste, improving food safety" (Wunder et al., 2018) noting "the potential for optimization of use of food unavoidably lost or discarded and by-products from the food chain, in particular those of animal origin, in feed production [...]" (European Parliament, 2017).

This illustrates a balanced review of the original feed ban introduced in 2001 as a reaction to the bovine spongiform encephalopathy (BSE)[17] crisis. Since then, progress on feed use has been made with porcine and avian processed animal proteins in fish feed being re-authorised (2013), insect processed animal proteins in fish feed being authorised (2017) and processed animal protein derived from pigs and insects in poultry feed; processed animal protein derived from poultry and insect in pig feed; and gelatine and collagen of ruminant origin in the feed of non-ruminant farmed animals authorised in 2021 (EC, 2021a).

Existing studies illustrate that the valorisation of food waste by use of surplus food for animal feed is a common approach by many sectors. The potential is high: the European Former Foodstuffs Processors Association (EFFPA) estimated that 5 million tonnes of former feedstuff (mostly bakery and confectionary-type goods) are processed every year in Europe into animal feed (EFFPA, 2023).

Research shows clear evidenced climate mitigation benefits of using surplus food as animal feed (Bow-Brouwers et al., 2020). Economic advantages seen include the avoidance of gate fees for recycling or disposal and the potential generation of a financial return (Stenmarck et al., 2016). However, despite economic and environmental incentives, many food business operators and retailers consider applicable EC Regulations, and the way in which national and local authorities implement them, too burdensome to

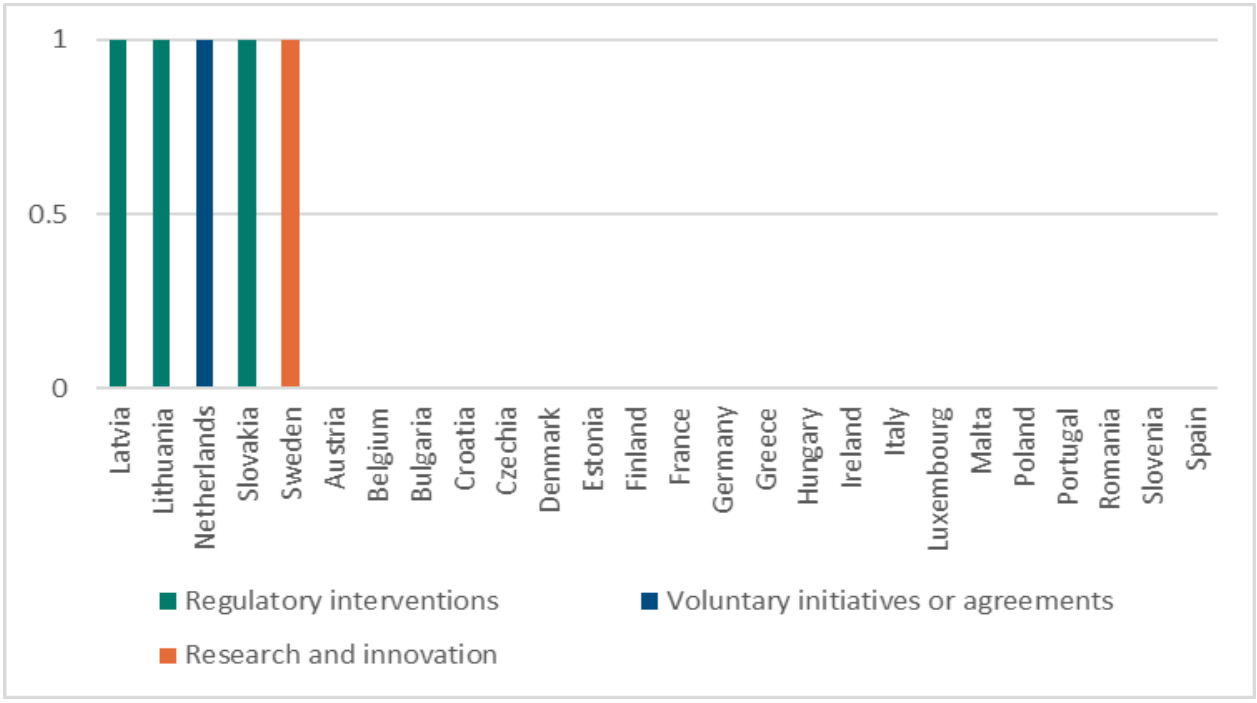
[17] Bovine spongiform encephalopathy (BSE), also known as mad cow disease, causes microscopic holes in the brains of affected animals. This incurable and fatal disease of cattle was first identified in 1986 (EEA, 2016).

justify sending former foodstuff – particularly smaller quantities – to feed (EC, 2018a). Several legal, bureaucratic and logistical barriers claimed by operators were therefore addressed by the Commission notice in 2018 (EC, 2018a), with the objective to assist the national and local competent authorities and the operators in the food chain in applying the relevant Union legislation to further facilitate the feed use of certain food no longer intended for human consumption.

4.3.1. Mapping overview

Compared to the first two levels of the hierarchy, far fewer countries (5) showcase actions for use of surplus food as animal feed according to the ETC mapping (Figure 4.5). Latvia, Lithuania and Slovakia here report regulatory actions: one consists of a ban of food waste going to landfill and the other two regard new rules for using food as animal feed. Netherlands works with "Voluntary initiatives or agreements" in the food industry and Sweden with a research project focusing on use of surplus food as feed (see Figure 4.5).

Figure 4.5 Illustration showing number and type of reported actions per Member State within the use of surplus food for animal feed level of the hierarchy



Note: Figure does not include Cyprus, as not enough information received or available for the ETC mapping
Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023.

4.3.2. High activity: "Regulatory interventions"

60% of the use of surplus food for animal feed actions can be classified as "regulatory interventions" (Figure 4.6). ETC mapping examples for regulatory interventions enable former foodstuff or by-products from the food and beverage industry to be used as animal feed thanks to legislative amendments (Latvia) or more detailed requirements (Lithuania).

Interestingly, literature recommends several regulatory actions, of which none could specifically identified via the ETC mapping. Such suggestions include minimising registration requirements for former foodstuff suppliers, e.g., registration as feed business operators according to the Feed Hygiene Regulation, in cases food is directly delivered to farmers (Bow-Brouwers et al., 2020). Others are to require former foodstuff destined for feed to be labelled as feed and exempt it from additional paperwork related to the waste legislation or to simplify cross-contamination prevention requirements and preventing downgrading of former foodstuffs (Bow-Brouwers et al., 2020).

4.3.3. Medium activity: "Voluntary initiatives or agreements" and "Research & innovation"

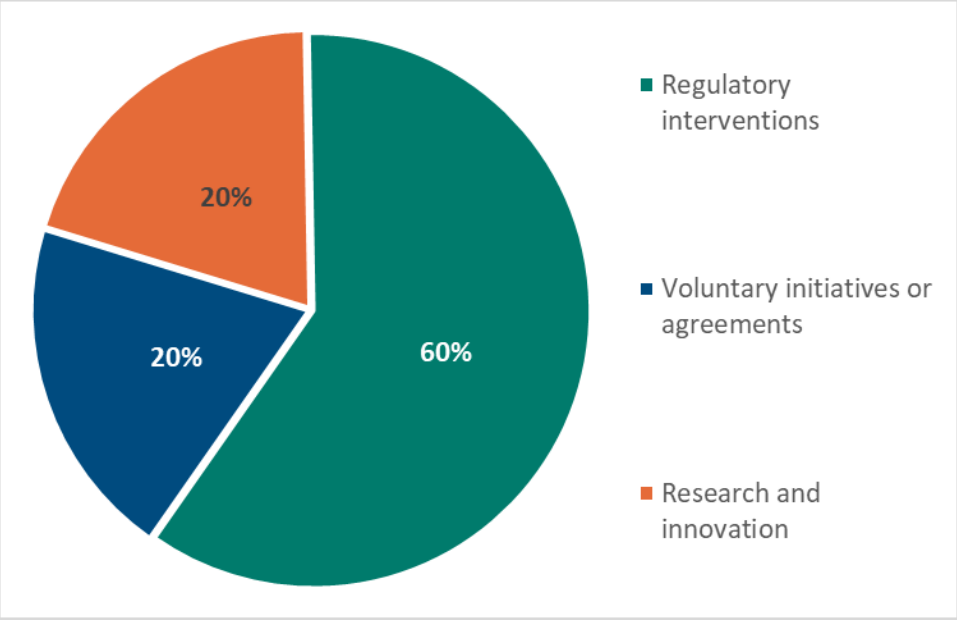
Sweden has carried out research to investigate how to increase the use of surplus food and residues from production as feed. The project report analysis related legislation and discusses barriers and opportunities. With the Dutch Food Waste Free United Foundation voluntary agreement its signatories commit to SDG 12.3, with the government setting the focus on the food use hierarchy, including as a third step using food surplus.

4.3.4. Low activity: "Market based", "Informative and educational measures" and "other projects and initiatives"

No actions have been reported by the Member States for these types of policy measures.

As inspiration for policy makers interested in introducing potential "market-based" measures, literature suggests to e.g. rework overly strict interpretations of durability dates, to introduce tax incentives for companies that use local food waste for use of surplus food could encourage more actors to take hierarchical more favourable measures (Reynolds et al., 2020). As "informative and educational" actions the provision of specific guidelines for food businesses and farms where there is zero presence of animal by-products, such as a vegan sandwich manufacturer or pea canning factory could be considered (Bow-Brouwers et al., 2020) or the knowledge by food business operators improved about available tools and opportunities to use former foodstuffs and by-products from the food chain for feed production (Vittuari et al., 2016).

Figure 4.6 Illustration showing share of actions by type of policy measures within the use of surplus food for animal feed level of the hierarchy



Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023.

4.4. Revalorisation into high-value products (use of surplus food of by-products, recycling food waste) as option for food waste reduction

- The majority of food valorisation methods, aimed at converting food waste and byproducts into high-value products, are primarily conducted in smaller scale labs. The viability of these methods

on an industrial scale, as well as their economic and environmental assessments, is still being evaluated (Caldeira et al., 2020).
- Six countries have actions related to revalorisation according to the ETC mapping.
- 57% of the revalorisation actions belong to the policy measure type “other projects and initiatives”.

According to the food use hierarchy, if surplus food cannot be prevented or redistributed for human or animal feed, it should undergo revalorisation to produce high-value products. This involves utilising various processes, including biorefinery techniques to transform the food materials or waste into new valuable materials or products, thereby reducing waste disposal and maximising potential. This level of the hierarchy specifically addresses food by-products or recycling food waste for purposes other than nutrient recovery. Typically, these efforts focus on food materials or waste generated during the food manufacturing stage, allowing for greater homogeneity, stable supply for the valorisation processes, large waste or by products streams, and potentially reduced logistics and capital costs (Sanchez Lopez et al., 2020). Revalorization encompasses both waste and by-products; the latter is not falling under waste legislation and therefore needs to be appropriately considered when treated.

There is a wide range of possibilities for targeted valorisation of surplus food or byproducts, encompassing various technologies, extracted products and potential applications. According to Caldeira et al., 2020, the valorisation pathways primarily focus on materials derived from fruit processing, followed by cereals and fish-based food. An example of using by-products from production is utilisation of tomato seeds to make tomato oil, and tomato peel to make carotenoids (natural pigment). (Broeze, J. et al., 2019). Another example is to produce food fibre from chicory[18] extraction residues. However, the scale is critical to produce the chicory fibre at a price that can compete with other dietary fibres (Broeze, J., 2019).

Recycling food waste derived from less homogeneous sources, such as municipal food waste, is more challenging, but some examples exist even in this context. For instance, municipal food waste could be suitable for cultivating insect protein through black soldier fly larvae. These larvae efficiently consume the bio-waste, transforming it into larval biomass and a compost-like residue. While EU food safety regulations as of 2023 do not permit this technology, there is potential for regulatory changes in the coming years (EEA, 2020).

The processes and technologies employed in valorisation pathways are highly diverse and involve a combination of different techniques including biochemical methods (such as enzymatic and acid hydrolysis, fermentation, extraction) and thermo-physical methods (such as supercritical fluid extraction with CO_2, ultrafiltration, ultrasound extraction). The resulting products, such as sugars, polyphenols, polysaccharides, organic acids, enzymes, proteins, and biopolymers etc, have applications across various sectors, including the food, pharmaceutical, cosmetics, biomaterials, and textiles industries (Sanchez Lopez et al., 2020; Caldeira et al., 2020).

According to literature, the majority of valorisation methods are conducted at the lab-scale, and their viability at industrial-scale production is still being assessed. The technological and economic potential of these methods relies on various factors, such as the accessibility and management of food waste streams, the effectiveness of pre-treatment processes, and the feasibility of scaling up the processes to industrial levels. Further research and development are necessary to ascertain the practicality, economic feasibility, and environmental assessment of implementing these methods on a larger scale (Caldeira et al., 2020). Additionally, policymakers should consider the legislative compliance of these new valorisation methods (Bow-Brouwers et al., 2020).

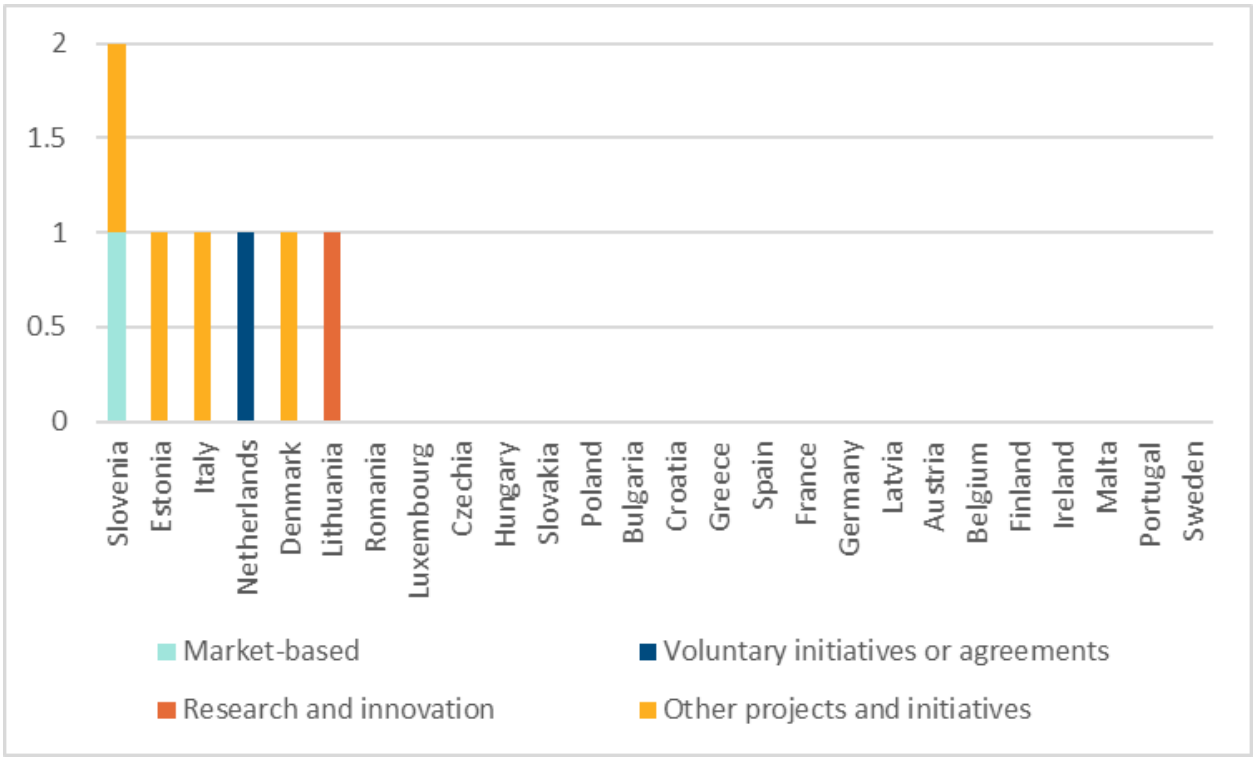
[18] Chicory fibre is a by-product from production of inulin-based food products and today used in agricultural feedstock or in soil fertilisers.

4.4.1. Mapping overview

The ETC mapping reveals that six countries – Slovenia, Estonia, Italy, Netherlands Denmark, and Lithuania – display a total of 7 actions related to revalorisation (Figure 4.7).

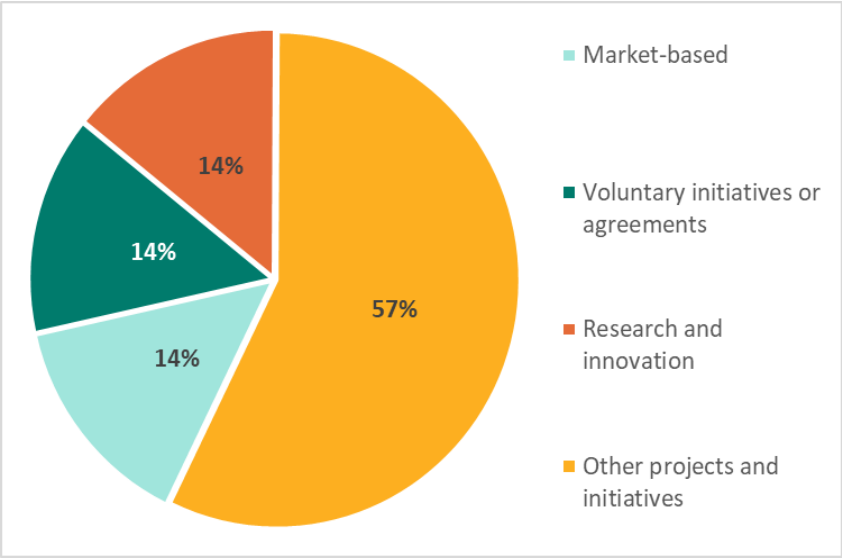
These actions primarily focus on “use of by products” (7 actions) rather than “Recycle food waste” (only 1 action targets both). Many of these actions involve funding or initiating research projects. For example, Estonia's “Resource efficiency in enterprises” program supports projects that transform surplus food or food co-products into new value-added products. Slovenia's “Food not waste: prevention, reduction, and use of waste food” project also involves food waste revalorisation. Lithuania's Ministry of Agriculture has initiated research into the valorisation of food waste into high-value products, among other actions. Denmark's strategy aims to reduce food waste by minimizing barriers to innovative solutions, including utilizing side streams from food and feed production. Slovenia stands out as the only country using market-based actions, such as financing initiatives that valorise food resources and create new market opportunities (Figure 4.7). The limited number of actions focusing on valorisation and the existing actions’ focus on research and development and other projects (see Figure 4.8) partly confirm the findings from the literature that valorisation methods are still in the research stage, and their viability is not yet fully assessed.

Figure 4.7 Illustration showing number and type of reported actions per country within the revalorisation level of the hierarchy



Note: Figure does not include Cyprus, as not enough information received or available for the ETC mapping.
Source: Author’s compilation based on information retrieved from the Hub and Eionet questionnaires in 2023.

Figure 4.8 Illustration showing share of actions by type of policy measures within the revalorisation level of the hierarchy



Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023.

4.5. Recycle for nutrient recovery as option for food waste reduction

- There is a growing emphasis on conventional recycling of food waste in municipal solid waste (MSW) driven by the stringent WFD targets and requirements.
- A total of fifteen recycling actions found in the ETC mapping were either educational campaigns alongside broader waste reduction campaigns or actions primarily related to the WFD requirements on municipal food waste recycling.
- Focusing on food waste separate collection and recycling appears to be a potential solution to achieve recycling targets for MSW. However, it could also present potential challenges for higher levels of the food use hierarchy, such as diverting surplus food from retail to anaerobic digestion with nutrient recovery instead of potential food donation.

Conventional methods for recycling food waste primarily focus on nutrient recovery, primarily through composting (treatment in the presence of oxygen), anaerobic digestion (treatment in the absence of oxygen), or a combination of both. High-quality compost and digestate are essential to enable their use as soil improvers and fertilizers. Application to soils, especially those with low organic matter content, enhances soil water and nutrient retention, facilitates carbon sequestration, and overall improves soil fertility. Source separation is a critical condition to produce the high-quality products and avoid potential risks of contamination (EEA, 2020).

Anaerobic digestion is often considered a more environmentally sound option than composting because it can recover both nutrients and energy. However, realizing these benefits necessitates several conditions: the demand for compost as a soil enhancer, the compositional and quantitative similarity of compost derived from direct composting and digestate, the displacement of fossil fuel-based energy production through biogas recovery, and effective digestion process management. Nevertheless, in regions with low organic matter levels in agricultural soils, composting may still be the environmentally preferred option (EEA, 2020). Moreover, anaerobic digestion can lead to methane leakage if not well managed, and treatment efficiency also depends on waste inputs. For example, composting benefits from a good mix of materials, including structure-improving components such as garden waste. In other words, the environmental benefits depend heavily on local circumstances.

According to the latest statistics from the European Composting Network (ECN) in 2022, composting emerges as the dominant treatment method for biowaste in the EU-27. Out of the total 60 million tons of

treated biowaste in the EU-27, a significant 59% underwent composting, while the remaining was directed towards anaerobic digestion. However, these figures encompass green waste as well. When specifically considering separately collected food waste (e.g., from food and drink processing or even households), anaerobic digestion is more dominant. Notably, substantial variations exist among the Member States (ECN, 2022).

There is a growing emphasis on conventional recycling of food waste in municipal waste. This shift is driven by the stringent and binding recycling targets set by the WFD for municipal waste, which aim to achieve a 55% recycling and preparation for reuse rate by 2025, 60% by 2030, and 65% by 2035. According to an EEA brief (EEA, 2023b), at least eight countries are at risk of not achieving the first target of 55% and have received early warning reports indicating that they may miss these targets.

Food waste constitutes a significant portion of municipal waste, making it a key focus for improvement. The ECN, for instance, estimates that an additional 40 million tonnes of bio-waste, which includes food waste, must be separately collected and processed in composting and anaerobic digestion facilities by 2035. An essential step to meet the WFD's ambitious goal of achieving a 65% recycling and preparing for reuse rate for municipal solid waste (MSW) by 2035 (ECN, 2022). Starting from 2027, this step can be counted as recycling only if composting or digestion is applied to separately collected bio-waste (e.g., and not food waste in mixed waste after mechanical biological treatment (MBT), in accordance with the WFD). Another mandatory obligation imposed by the WFD is for Member States to collect bio-waste separately or ensure recycling at the source by the end of 2023 (EC, 2018c).

4.5.1. Mapping overview

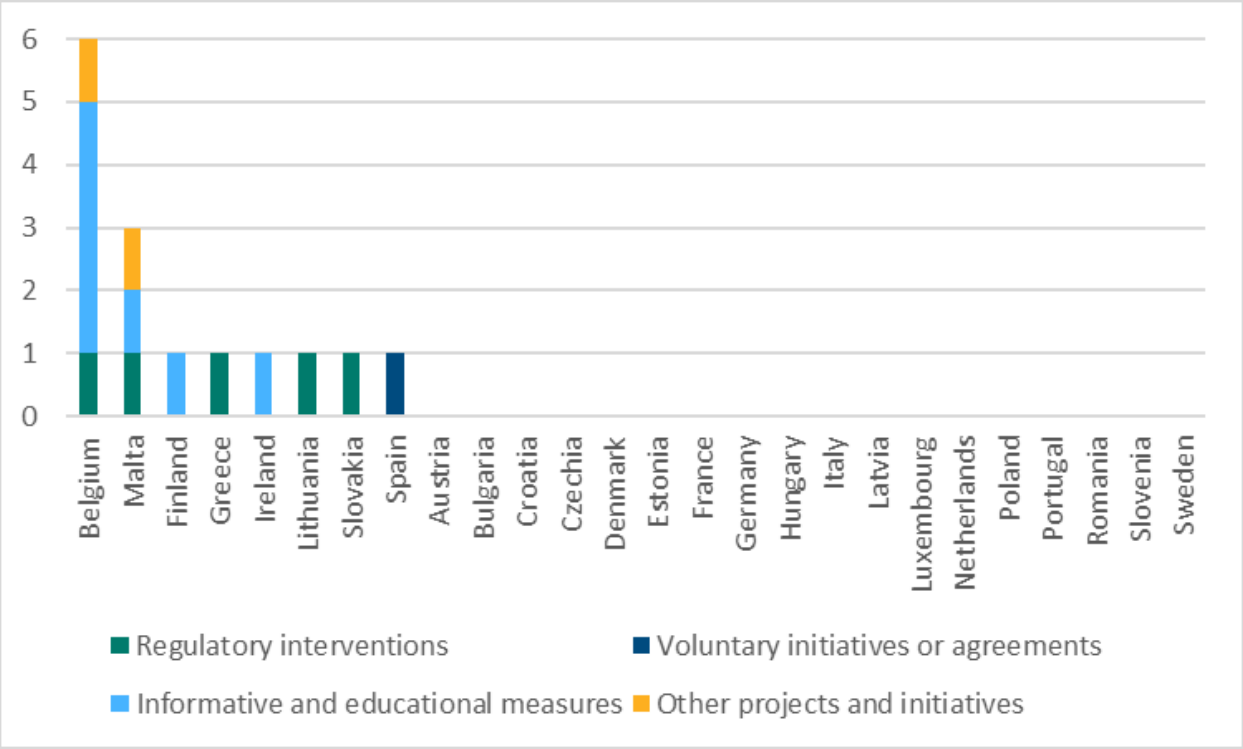
The ETC mapping found a total of fifteen recycling actions by eight countries (Figure 4.9).

While generally no prioritisation effect could be seen depending on the official referencing of the food use hierarchy, it can be noted that only 1 out of 15 nutrient recovery actions belong to a country that clearly references the food use hierarchy. Additionally, 10 out of these 15 actions belong to countries with no reference to the SDG 12.3.

The actions primarily pertain to fulfilling the EU's mandate for separate bio-waste collection or ensuring recycling at the source. Four out of five regulatory actions involve the mandatory implementation of separate food waste collection. Belgium stands out with an initiative that goes beyond, as it facilitates compost utilisation by mandating municipalities to organise its distribution. Most actions, however, revolve around informational and educational programs aimed at promoting food waste sorting and home composting. These efforts are typically integrated into broader waste prevention campaigns (Figure 4.10).

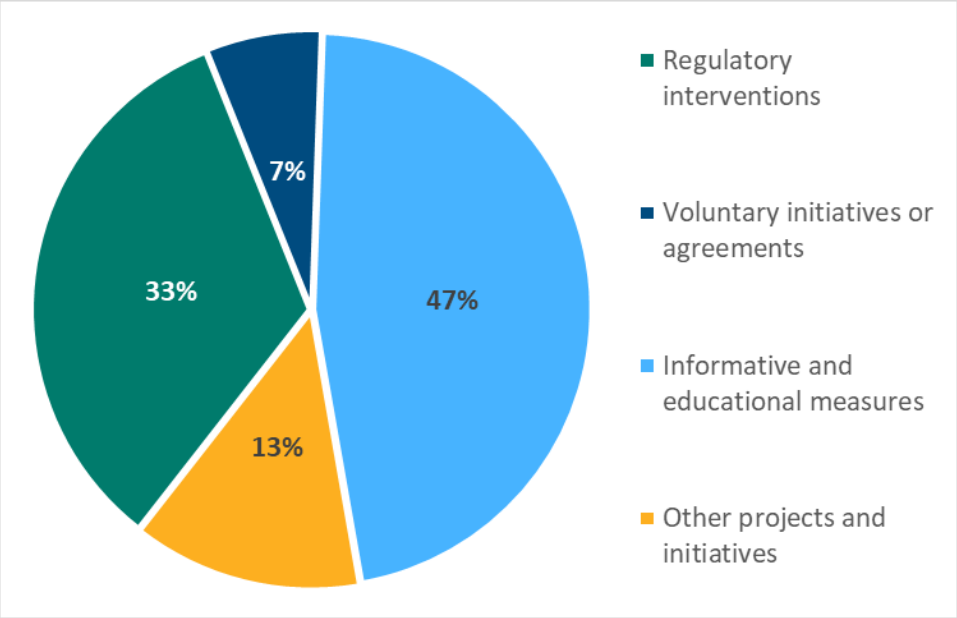
Focusing on separate food waste collection and recycling appears to be a potential solution to achieve recycling targets for MSW. However, the presence of infrastructure for recycling and potential subsidies to increase recycling may also pose challenges for the application of higher levels of the food use hierarchy, such as diverting surplus food from retail to anaerobic digestion with nutrient recovery instead of potential food donation. This is exemplified in the cases of supporting anaerobic digestion facilities or introducing landfilling bans (see the chapter on energy recovery and disposal).

Figure 4.9 Illustration showing number and type of reported actions per country within the recycle nutrient recovery level of the hierarchy



Note: Figure does not include Cyprus, as not enough information received or available for the ETC mapping.
Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023.

Figure 4.10 Illustration showing share of actions by type of policy measures within the recycle nutrient recovery level of the hierarchy



Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023.

4.6. Recovery for energy as option for food waste reduction

- Policy interventions intended to induce energy recovery from renewable waste sources, such as food waste, may hinder the implementation of the food use hierarchy. Similarly, increased market prices for energy might also influence the redirection of food loss from higher levels of food use hierarchy to biogas production.
- The ETC Mapping did not identify country actions related to the recovery for energy.

According to the food use hierarchy, food waste should be directed towards energy recovery only when it is not suitable for nutrient recovery. Conventional methods for energy recovery for food waste include 1) incineration with energy recovery, typically used when food waste is part of the mixed waste stream, and 2) anaerobic digestion, applied to separately collected food waste or the biological portion after mechanical-biological treatment (MBT), often without concurrent nutrient recovery efforts.

In the case of incineration, food waste often contains a relatively high moisture content, which diminishes its value for energy recovery and makes it less desirable as a waste stream for energy recovery.

In anaerobic digestion plants, the primary objective is typically energy recovery, with nutrient recovery not always being the top priority. This is particularly noticeable when anaerobic digestion is applied to the biological portion of waste after MBT of mixed waste. In such cases, the resulting digestate may become contaminated and unsuitable for use as fertilizer (Pahl et al., 2008).

As discussed in the previous chapter 0, anaerobic digestion is often considered a better option than composting when both energy and nutrients are recovered. However, the more environmentally sound choice between composting with nutrient recovery and anaerobic digestion with a sole focus on energy recovery may depend on specific local factors.

From the energy perspective, energy recovery from biodegradable waste, including food, is considered a renewable and carbon-neutral fuel source. However, in some cases, this approach can inadvertently hinder the application of the food use hierarchy, such as extraction of valuable bio products (Reynolds et al., 2020) or redistribution for human consumption (EC et al., 2020). For example, subsidies for anaerobic digestion potentially negatively impact food redistribution. Subsidies in the UK make it more cost-effective to send food for anaerobic digestion than for donation (EC et al., 2020). In the Netherlands, the "Stimulation of Sustainable Energy Production scheme" (SDE+) supports biomass-based energy generation. While SDE+ exclusively compensates the gap between the expenses incurred in a renewable energy project and market price of the energy, there is a perception that it diverts food surpluses towards anaerobic digestion instead of food banks. Moreover, in countries with prior investments in bioenergy plants designed for anaerobic digestion, there may be a higher return on investment when utilizing the existing anaerobic digestion infrastructure. This phenomenon has been observed in Belgium and the UK (EC et al., 2020). Even in situations where a country lacks explicit incentives for anaerobic digestion, the consistent application of the food use hierarchy may face challenges. For instance, in Luxembourg, the surplus food supply exceeds the demand from redistribution organizations or social entrepreneurs. Consequently, a substantial portion of this surplus food cannot be effectively redistributed and is redirected toward biogas recovery instead of being made available for human consumption redistribution (EC et al., 2020). Moreover, increased market prices for energy might also influence the redirection of food loss from animal feed to biogas[19].

4.6.1. Mapping overview

No information on the topic of recovery for energy was identified in the Hub or the questionnaires, hence why no examples are presented.

[19] Statement from participant of Eionet food waste webinar 2023.

4.7. Disposal as option for food waste management

- According to the literature (ETC CM, forthcoming) over the past decade, many countries have made progress in diverting the biodegradable content of municipal waste from landfills and reducing associated emissions. This progress is primarily attributed to binding targets set by the Landfill Directive, primarily enforced via landfill bans, and in some cases by landfill taxes, or a combination of both.
- Some countries introduced regulatory actions prohibiting the destruction of edible food or landfill bans, that to induce food redistribution, as the ETC mapping shows.

According to the food use hierarchy, disposing of food waste in the form of incineration, landfill, or food residue that results in sewage is the least preferred option and should be minimised whenever feasible. In practice, food waste is often disposed of when it is mixed with other waste, especially in cases where separate collection of food waste is not available.

When biodegradable waste, including food waste, ends up in landfills, it poses several environmental issues. This includes resource loss, contamination of groundwater through leachate, and, most notably, the emission of methane — a potent contributor to climate change. In 2021, the waste sector was responsible for 3.18% of the EU's greenhouse gas emissions, with approximately 70% of these emissions originating from methane released by landfills[20] (ETC CM, forthcoming).

Historically, EU policies have aimed to reduce the biodegradable content of landfill waste and mitigate its environmental impact. The Landfill Directive, adopted in 1999 had targets to progressively reduce biodegradable content in landfills. Its last revision in 2018 (EC, 2018d) introduced even more ambitious goals, such as the requirement to reduce landfilling to 10% of municipal solid waste (MSW) generated by 2035, with some exceptions allowing up to 25% of MSW generated by 2035. Furthermore, biodegradable waste collected separately is now prohibited from being sent to landfills.

An upcoming ETC CM on climate change mitigation through waste policies indicates significant progress over time. Emissions from the waste sector of the EU-27 have decreased by 41% since 1990 and are expected to continue declining, potentially reaching a reduction of 68% compared to 1990 levels by 2050 (ETC CM, forthcoming). From 2010 to 2020, the majority of countries significantly reduced their landfilling rate. While several countries appear to have already achieved the 2035 target, many still have ample room for improvement (EEA, 2022).

Effective policies that have demonstrated success in reducing landfilling, among other methods, include implementation of landfill bans and taxes (EEA, 2022). According to the ETC CM report (ETC CM, forthcoming) countries that have achieved substantial per capita reductions in greenhouse gas emissions from the waste sector have primarily done so by decreasing biodegradability of waste sent to landfills and implementing measures to reduce methane emissions. The Landfill Directive played a pivotal role in driving national actions, especially regulatory measures, such as landfill bans, especially targeting specific biodegradable waste streams according to the ETC CHM report (ETC CM, forthcoming). In addition to bans, the use of landfill taxes can also be considered. Their effectiveness depends not only on the level of the tax rate but also on their structure, implementation, and enforcement (EEA, 2023a).

4.7.1. Mapping overview

The ETC mapping in this report shows that two countries use bans even to induce redistribution. Examples include the Slovak Republic introduced a landfill ban on food waste from the retail sector in January 2023. It is anticipated that this law will incentivise retailers to find new ways to distribute food that has reached

[20] This calculation follows the IPCC reporting guidelines, which include emissions from landfills, incineration without energy recovery, and biological treatment, while incineration with energy recovery is attributed to the energy sector and thus excluded.

its best before date, for example by donating to charities or producers of livestock feed. France has a similar law, which prohibits the destruction of edible food from multiple sectors: retail, catering, food and drink industry and wholesalers.

When considering landfilling bans, it might be relevant to evaluate whether the initial goal of redistributing surplus food up the food use hierarchy may once again compete with existing waste treatment options. For example, an empirical study conducted by (Malek et al., 2023), analysing data from 14 European countries, found that landfill bans effectively reduced landfilling rates for MSW while increasing energy recovery and recycling. Although the study specifically focused on MSW and did not investigate the effects of landfill bans on waste generation, another study carried out in Nordic countries (Papineschi et al., 2019) demonstrated that landfill bans targeting organic/biodegradable waste primarily resulted in an increased biodegradable waste recycling rate, with no significant impact on waste generation. This suggests that landfilling bans may have only indirect supportive effect for food waste reduction and it may require additional policy measures, particularly when food waste treatment infrastructure is available.

5. Supporting future food waste prevention: How to choose appropriate actions?

A general understanding exists on how to set up promising interventions for food waste prevention and reduction for rapid and concrete results, known as the "Target-Measure-Act" approach (EC, 2023a). The following steps are suggested: "i) identifying the problem, ii) setting the aim, objectives, and related key performance indicators, iii) defining a plan to reach the objectives, and iv) implementing a monitoring system to measure the baseline situation and to monitor the progress and success of the action." (Caldeira et al., 2019).

While some progress on the knowledge of the effectiveness of individual actions has been made, respective decision making cannot yet rely on an extensive evidence base. As support for decision makers in their fight against food waste, this chapter highlights key factors to consider when assessing the feasibility of food waste prevention and reduction actions and the application of the food use hierarchy. This includes the provision of an overview of the available tools and methodological approaches that can facilitate decision-making in food waste prevention actions.

5.1. Decision support: Identifying the problem and addressing specific drivers of food waste generation

- Food waste prevention and reduction actions can begin even without initial data collection on their efficacy to enable quicker action, represented in the "Target-Measure-Act" approach: Identify the problem area, determine the causes of food waste, and take relevant action.
- Guidelines to support such decision making exist, increasing the probability to successfully choose appropriate and effective measures.

The starting point for decision making is to understand the underlying causes of food waste in order to determine the most effective interventions and inform their design. Interventions are recommended that address the most common drivers of food waste and that are most likely to yield positive outcomes (Candael et al., 2023).

The generation of food waste involves a multifaceted and complex mechanism. Main drivers of food waste include insufficient food management by individuals; inefficiencies and trade-offs in the food supply chain; lack of understanding and certainty regarding the food safety standard implementation; and missing evidence-based, coordinated approaches in Member States (EC, 2023a). Generally speaking, food waste generation is influenced by a range of diverse and often interconnected causes. The reasons can vary among situations, food products, and among individuals involved. Still, there are some insights from literature reviews (such as the FUSIONS project (Canali, M. et al., 2014) or the REFRESH project (Burgos, S. et al., 2017) regarding certain patterns and thus the potential for relevant measures. These insights include:

- It is easier to address technological, organisational, or legislative inefficiencies than those related to specific product characteristics.
- The significance of different drivers highly depends on specific characteristics, such as perishability and the associated food safety risks.
- Different drivers play a role at various stages of the value chain.

While measurements can yield valuable insights, they are not always a prerequisite for finding solutions. In many cases, leveraging expert knowledge and existing data is sufficient. This approach involves collaboration with experts and stakeholders to establish estimates and define problem areas. Measurement becomes essential when identifying these hotspots becomes challenging. Once hotspots

are recognized, the focus shifts to comprehending the root causes of food waste and devising appropriate actions. If necessary, measurements can then be carried out at these hotspots to evaluate the feasibility of interventions (Wageningen U&R, 2022). Some supporting methodologies or tools to facilitate the problem identification process are also presented in Chapter 5.2.

Table A.2 in the Annex also lists possible drivers or main causes for food waste generation within the food value chain. The list is limited to the drivers identified mainly in the FUSION and REFRESH projects[21]. It serves only as an illustration of potential causes of food waste within the value chain and the extent of efforts required to address these potential causes.

5.2. Complex decision making: there is no one solution

- The feasibility and effectiveness of food waste prevention – or food waste management – interventions are context-dependent. They are influenced by factors like waste volume, composition, origin, and position in the value chain, as well as other situational factors. While the food use hierarchy offers initial environmental guidance, making decisions about the food waste management options represented by the lower hierarchy levels (such as revalorisation versus recovery or nutrient recovery versus energy recovery) can be complex and depend on specific circumstances.
- An integrated perspective that considers trade-offs and benefits across environmental, economic and social aspects is essential.

While it is important to gather more information about how effective food waste prevention measures are, the choice between different actions according to the food use hierarchy primarily depends on the specific circumstances and conditions in which they are applied. In other words, what works best in avoiding and reducing food waste and its environmental and economic impact can vary depending on the unique situation or setting.

Therefore, when assessing the feasibility of a food waste prevention measure, the literature recommends considering several key factors, which play significant roles in determining the viability of such interventions. These are described below:

- The potential environmental impact of food waste prevention hinges on both the volume and origin/composition of the waste prevented. Non-animal-based products, such as bread and fresh fruits and vegetables, typically constitute the highest volume of waste (Bow-Brouwers et al., 2020). However, when measured per unit of mass, animal-based products have a greater environmental impact in terms of carbon emissions or biodiversity compared to plant-based products (Crenna et al., 2019; Moberg et al., 2019). Although animal-based products constitute less than 20% of the total food waste by weight, they contribute to more than 50% of the overall environmental impacts when evaluated using a single weighted score. This pattern is consistent across specific impact categories, including climate change, eutrophication, acidification, changes in land use, and biodiversity (Sala et al., 2023).
- Avoiding food waste yields benefits throughout the entire food supply chain, but efforts at the end of the value chain (e.g., households, restaurants, and food retailers) offer the most substantial environmental benefits per ton of waste (Albizzati et al., 2022). Furthermore, most of food waste occurs at the consumption stage (see Chapter 2.1).
- Situational factors significantly influence economic, environmental, and social outcomes of interventions. These factors include transportation distances, market demand, location, product prices, energy and chemical demands, necessary capital and infrastructure, policies, waste legislation,

[21] More recent work on drivers include for example (EC, 2023a) or (Vittuari, M. et al., 2023).

and trade agreements (Jones et al., 2023). Furthermore, it is important to consider the environmental impacts associated with the implementation of prevention measures, such as changes in logistics, transportation, electricity or water usage, and packaging materials (De Laurentiis et al., 2020; Goossens et al., 2019; Caldeira et al., 2019).

While the food use hierarchy can provide initial guidance from an environmental standpoint, for food waste management actions for example in practice additional factors require consideration including:

- The **choice between revalorization and recovery** is not straightforward.
    - The properties of food such as their composition of polysaccharides, proteins, lipids, minerals, vitamins, enzymes, phenolic compounds, carotenoids, and water content, along with the presence and extent of contaminants, play a crucial role in determining their suitability for producing high-value bioproducts or for anaerobic digestion (Bow-Brouwers et al., 2020).
    - Furthermore, most methods for food using by-products or recycling food waste are predominantly conducted on a laboratory scale and evaluating their viability and environmental impact at an industrial scale is an ongoing process (Caldeira et al., 2020).
    - Consideration must also be given to (future) legislative compliance regarding new use by-products or food waste recycling options (Bow-Brouwers et al., 2020).
- The **choice between nutrient recovery and energy recovery** is not straightforward.
    - Anaerobic digestion is often considered a more environmentally sound option than composting because it can recover both nutrients and energy. However, realizing these benefits requires specific conditions: compost demand, similar compost and digestate composition, fossil fuel displacement with biogas, and effective process management. In low-organic matter regions, composting may remain the better choice (EEA, 2020).

An integrated perspective that considers trade-offs and benefits of different pathways, including environmental, economic, and social aspects, is crucial (Bow-Brouwers et al., 2020). To cater to diverse needs, several tools that can aid in decision-making are presented in Table 5.1..

Combining essential interventions appears promising for achieving impact at scale, as demonstrated by the European Consumer Food Waste Forum (ECFWF). The evaluation also suggests that combining messages or interventions on practical food waste management skills with knowledge of financial savings, healthy eating, and local food practices can equip households with comprehensive food management skills and motivation to change (Swannell et al., 2023).

Decision-makers should be supported to make **decisions locally and on a case-by-case and context-specific manner** (Bow-Brouwers et al., 2020). Scientific insights are needed to assist in tailoring and implementing interventions to specific contexts (e.g. complex, market- and culture-specific drivers of food waste generation) (Candael et al., 2023).

The following table provides examples of the available tools and methodological approaches that can potentially support decision-making in food waste prevention actions.

Table 5.1 Examples of tools and methodological approaches to support decision making for food waste prevention and reduction actions at national, regional and local policy level.

Tools	About
Calculator for impacts of food waste prevention actions (Garcia Herrero, L. et al., 2023; De Laurentiis et al., 2020)	**Description** An Excel-based LCA tool designed for practitioners to evaluate the net **environmental** savings and **economic** benefits **of food waste prevention actions**. The tool can assist in recognizing potential trade-offs that may arise during intervention implementation. These trade-offs occur when the environmental and economic impacts of an intervention outweigh the benefits of reducing food waste. Identifying such trade-offs with and using the calculator can enhance intervention design and enable comparisons between different intervention approaches. The tools have recently been updated with further improvements, including simplification with generic items (general food) and new food products, additional nutritional features, positive messages, and the inclusion of questions and answers (Q&A) to clarify the benefits and limits of this tool.
Accessibility - Free of charge. - Methodological approach accessible here. - Tool available for download here.	**Target Audience** - Local, regional, or national decision makers. - Food business operators and other actors within the food supply chain. - NGOs. **Assessment** - Relatively simple and free-of-charge tool. - The tool is built on a solid scientific foundation, with the methodological approach presented in a peer-reviewed article. - Customizable for specific initiatives, value chain stages, Member States, or product/waste categories. - Valuable for understanding and communicating waste prevention benefits. - One of the few freely available decision-support tools for food waste prevention. - Requires some understanding of LCA for accurate interpretation. - The guide lacks clarity in addressing uncertainties and limitations. - Limited availability of data sources (e.g., concerning waste treatment), which can be challenging for handling uncertainties.
Consumption footprint Platform (EPLCA)	**Description** An **LCA-based** framework for monitoring the EU's environmental footprint from **production** and **consumption**. Its primary objective is to track the overall environmental impact trends, comparing them against planetary boundaries. Available at both the EU and Member State levels. Additionally, it assesses the environmental impacts of food consumption using 16 impact categories, including biodiversity. The indicators have diverse applications that can enhance policymaking, ranging from identifying environmental hotspots to monitoring and evaluating policy options and scenarios. Used to assess food waste reduction targets in the WFD proposal.
Accessibility - Free of charge. - Methodological approach accessible here. - Tool available here.	**Target Audience** National and EU policy makers, researchers and other interested parties.
FORKLIFT (FOod side flow Recovery LIFe cycle Tool) (REFRESH, 2018)	**Description** A decision support system aimed at enhancing stakeholders' understanding of the **environmental impacts** and **costs** (based on the LCA and LCC) associated with specific **valorisation** routes. It allows users to assess and compare various options, make parameter adjustments, and incorporate custom-generated data. By using the tool producers can choose the route higher on food use hierarchy and with the lowest cost and environmental impact.
Accessibility - Free of charge. - Tool available here. - Methodological approach accessible here.	**Target Audience** Policy makers, researchers, professionals, businesses, and other interested parties. **Assessment** - user-friendly - revealing hotspots of the different valorisation options and providing indications of the effects of certain choices. - Should not be used as a precise tool for investment decisions nor for external communication of impacts and costs.

Tools	About
FoodWasteEXplorer (REFRESH, 2020)	**Description** An easily accessible online database featuring **compositional data** on food waste, including nutrients, bio actives, toxicants, and other relevant information related to specific food streams. It enables users to explore improved waste management strategies and potential market applications, such as animal feed, textile fibres, bioplastics, or biofuels. With over 25,000 datapoints, users can apply filters to retrieve specific data subsets by food name, food groups, and common food descriptions.
Accessibility - Free of charge. - Tool available here.	**Target Audience** Industry, SMEs, researchers, government agencies and the general public.
An evaluation framework for consumer food waste prevention interventions	**Description** This framework is designed to assess the most effective and efficient consumer food waste prevention interventions. It has been developed by the European Consumer Food Waste Forum (ECFWF) based on the framework originally developed by (Caldeira et al., 2019). The enhanced version is detailed in the report by (Garcia Herrero, L. et al., 2023), with a specific focus on consumer food waste. A section deals with the systemic effects to encourage users to start thinking about trade-offs and co-benefits and apply a more integrated perspective together with a behavioural science lens. Additional tools developed by the ECFWF deal with segmentations of consumers to tailor and with experiments to evaluate respective interventions (Bruns, H., Nohlen, H., 2023).
Accessibility - Framework available (Garcia Herrero, L. et al., 2023).	**Target Audience** Policy makers, practioners implementing and evaluating consumer food waste interventions.

Source: Author's compilation based on above mentioned resources.

5.3. Recent progress in understanding the effectiveness of measures

- Real action to prevent and reduce food waste is taking place on the ground. However, analysing the effectiveness of these actions is still a challenge for authorities and other actors in the field. Especially prevention efforts are by their nature difficult to assess.
- While overall knowledge about the most effective actions is still lacking, progress on understanding the effectiveness of measures has been made and information is becoming increasingly available.

Strategies aimed at addressing food waste should be guided by the food use hierarchy – and there are various types of food waste prevention actions that may be successful in preventing food waste at different stages of the food supply chain. A clear understanding of their effectiveness is still generally lacking. As an example, a JRC study from 2019, was able to review 91 interventions across the supply chain, but a robust evaluation was not possible at the time due to insufficient reported data (Caldeira et al., 2019). However, progress has since been made.

Thanks to improved monitoring practices, effectiveness information is becoming increasingly available. At best, the data include information on food quantities, costs, barriers, and opportunities for scaling and transferring interventions. Key Performance Indicators (KPIs) help to track the progress and achievement of each action's goals and to help balance environmental benefits with implementation costs and avoid significant trade-offs (Caldeira et al., 2019).

An example of the progress made is the evaluation of 74 interventions targeting consumer food waste prevention published in 2023 by the European Consumer Food Waste Forum (ECFWF) – a pilot project by the European Parliament. Forty-eight of the interventions provided satisfactory and clear information on the effectiveness and 18 enough, but not clear information. To exemplify the findings, of the 35

interventions evaluated by the ECFWF under the "Nudging" category, 21 provided satisfactory and clear information on the effectiveness, 12 provided enough but not clear information, and 2 had incomplete or non-applicable information (Swannell et al., 2023). To further support more and better insights, the ECFWF prepared recommendations on how to set up and evaluate actions targeting private households (Candael et al., 2023).[22]

Development can also be observed in primary production and manufacturing. The German Thünen-Institut, for example, developed a sustainability assessment (Goossens et al., 2019) and is applying it more and more widely. It's 2023 study evaluated demonstration projects implemented by farms and companies in Germany – 10 in primary production and 12 in manufacturing. The measures were assessed according to economic, ecological, and social factors. Efficiency was calculated, expressing the savings, such as reduced food waste quantities per Euro invested, to allow inter-comparison of the measures. While the transferability of many of these evaluated measures was rated as high – meaning that the approaches could generally be well-used by other actors – the results were not considered transferable on a 1:1 basis. Reasons included economic, ecological, and social impacts being dependent on various factors, such as the initial situation or the legal framework in the respective food system (Lehn et al., 2023).

As already stated in the previous chapters, during the ETC mapping no specific information on conducted evaluations of the implemented actions or other information about their impacts was (yet) found. More knowledge sharing about the recent efforts will be key.[23]

[22] For more information about and all relevant documents of the European Consumer Food Waste Forum see this website: https://knowledge4policy.ec.europa.eu/projects-activities/european-consumer-food-waste-forum_en#context

[23] Existing examples include an evaluation the French Garot Law implementation (EY, 2019) or the development and evaluation of a rice & paste measuring cup (Van Dooren et al., 2020).

6. Conclusions and recommendations

6.1. What did the ETC mapping show?

This report identifies different food waste prevention actions in the European Union. Food waste actions and policy measures as of 2023 were reviewed based on information received via Eionet questionnaires, waste prevention country profiles, and self-reporting to the EU FLW prevention hub. The actions were then categorised and mapped according to the guidance provided by the (adapted) “food use hierarchy”, which enabled drawing the insights described below on the actions towards food waste prevention within the EU-27 Member Countries at the time.

According to the ETC mapping, most (15) of the EU-27 Member States have a dedicated food waste strategy, action plan or pact in place or under development (2) – this in addition to the legally required (food) waste prevention programmes. Furthermore, nearly all the Member States that provided information (22 out of 25) have set a food waste reduction target and 16 countries clearly state that they are committed to SDG 12.3. In line with the Commission delegated decision (EU) 2019/1597, food waste is collected according to the different stages in the value chain in all but one of the countries. The Member States are making significant progress to develop their monitoring systems and methodologies, often in response to EU reporting requirements, national monitoring needs, or specific projects. Some are actively involved even in collecting data or creating methods for statistics that are voluntary for reporting under the delegated act. This includes specific data on edible parts of food waste and donations for human consumption.

The 332 concrete country actions identified demonstrate the efforts being made to prevent and reduce food waste in Member States. Overall, the ETC mapping also shows the EU-27 Member States prioritising actions, with 93% aiming at highest levels of the hierarchy: specifically, 66% of these actions primarily focus on prevention of food surplus and avoidance of food becoming waste, 26% target use of surplus food for human consumption and 1% comprises the use of surplus food for animal feed. The remaining shares of actions are directed towards the lower levels of the food use hierarchy, i.e. actions aimed at food waste reduction and management.

For the top level of the food use hierarchy – prevention and avoidance of surplus food – countries predominantly focus on “soft” policy measures: 86% of all reported “informative and educational measures”, 76% of all “research and innovation” actions, 66% of all “voluntary initiatives or agreements” and 55% of all “other projects and initiatives” deal with prevention of surplus food and food waste avoidance

At the level of “use of surplus food for human consumption”, however, 68% of all “market-based actions” (such as tax relief when donating food or money to food banks) and 52% of all "regulatory intervention actions” have been found during the ETC mapping.

In the Member State pages on the Hub and in the questionnaires, no country mentioned any results of evaluations assessing the effectiveness of their reported actions. This confirms a continuing challenge for decision makers of not yet being able to rely on any extensive evidence base. However, the available literature reveals some progress in the knowledge of the effectiveness of individual actions.

Some Member States are already integrating or linking actions and strategies around food waste, biodiversity, and climate change, but not enough information is yet available for a detailed analysis by the ETC CE. In the case of climate change, eight countries had mentioned food waste in national climate strategies, whereas in the case of biodiversity, only one country was found to have a mention of food waste in a biodiversity strategy at the time at national level. More research is required to understand why

the majority of countries are not yet making food waste related cross-policy inks, and how this could be supported if it is found to be beneficial.

It is important to note that there is some uncertainty regarding the presented results, since the ETC mapping relies on self-reporting and answers provided to the questionnaire by the EU-27 Member States, as well as actions listed in the Hub and the analysis has not been independently verified by the countries themselves.

6.2. Reflections - Consideration of the interconnectedness of actions at different levels of the food use hierarchy

While this ETC CE report aimed to provide primarily insights on how prioritisation of food waste actions towards the upper levels of the "food use hierarchy" is taking place, obviously efficient food waste management will always be necessary. Against this background, it is essential to recognise the interconnectedness or sometimes even conflicts of actions at different (lower) hierarchy levels, e.g. in light of other requirements faced by Member States. Below are a few reflections regarding this topic:

- **Municipal waste recycling targets:** There is a growing emphasis on conventional food waste recycling within municipal waste streams. This shift is driven by the ambitious recycling targets set by the WFD, aiming for recycling and preparing for reuse rates of 55% by 2025, 60 % by 2030, and 65% by 2035 for municipal solid waste. Notably, at least eight EU-27 Member States are already facing challenges in meeting these targets by 2025 (EEA, 2023b). Given that food waste constitutes a substantial portion of municipal waste, it could become a pivotal area for municipal food waste separation and recycling efforts. However, this transition could present challenges for higher levels of the food use hierarchy, such as diverting surplus food from retail to anaerobic digestion with nutrient recovery, instead of potential food donation. Similarly, actions taken to decrease landfilling, such as landfill bans, often induce energy recovery or recycling, rather than food waste reduction. It must be noted that the better strategy is to prevent waste in the first place.
- **Energy recovery from food waste:** Another notable trend is the growing emphasis on renewable and carbon-neutral fuel sources, including energy recovery from food waste. This approach may inadvertently hinder the prioritisation of actions in accordance with the food use hierarchy, impacting the extraction of valuable bio-products or redistribution surplus for human consumption. Subsidies for renewable energy and prior investments in waste-to-energy plants may direct surplus food toward biogas production instead of higher food use levels (Feedback, 2020). In addition, increased energy market prices can influence the redirection of food material from animal feed to biogas.
- **Food waste treatment (recycling, energy recovery):** It is crucial to acknowledge that even with a primary focus on prevention, there will always be a need for some form of food waste treatment, especially for inedible portions of food waste. Additionally, certain food waste may need treatment for safety reasons. A practical approach involves prioritising prevention and completely avoiding landfilling. Recycling and biogas production should be reserved exclusively for products that cannot be used for food, feed or by-products, while other unavoidable food waste should be directed towards higher levels of the food use hierarchy, if possible.

6.3. Reflections

6.3.1. Support for Member States in creating policy linkages and synergies

The topics of climate change, biodiversity, and food waste can be seen as interconnected. At the moment, in many cases they are still operating in silos – with countries implementing strategies according to international agreements, but often not cross-linking between the plans. Some EU-27 Member States have started to work in this more interconnected way. Support is needed to enable further countries to follow their lead.

In the case of climate change and food waste, the EU could support Member States in the integration of food waste actions, as part of their required National Energy and Climate Plans, for example through guidance on where best to integrate such actions, in addition to the links with biodiversity (EC, 2022a). Additionally, the ETC could play a role in supporting a common understanding of which topics relate and

link between different agendas (e.g. where does biomass fit between climate and food waste agendas), in turn strengthening consistency of entries in the EEA database on integrated national climate and energy policies and measures in Europe (EEA, n.d.).

For the linking of biodiversity and food waste policy, this is slightly more challenging to address from the EU level, since most Member States have based their national biodiversity strategies on the United Nations Convention on Biological Diversity (UN Environment Programme, n.d.). Here, the Eionet network could support its members to share best practices in the integration of food waste actions into such policies, strategies and plans.

6.3.2. Continuous work on evaluation and monitoring and share the knowledge

Analysing the impact of the many actions to prevent and reduce food waste remains a challenge. Similarly, overall knowledge on the effectiveness of food waste prevention programmes and strategies seems to not yet be available, complicating also the assessment of potential cross-cutting benefits when integrating climate, biodiversity and food waste strategies. Still, progress is slowly being made and information is becoming increasingly available. This important trend must be further supported – authorities and other actors in the field should consider the inclusion of evaluation and monitoring whenever feasible. It is also important to align such efforts across policy areas as much as possible. Equally important would be to share the knowledge gained to enable learning from each other.

6.3.3. Strengthened Hub as a reliable EU-wide source of food waste prevention and reduction actions

To complement information received via questionnaires to Eionet members and waste prevention country profiles, the ETC mapping extracted information for each of the Member States from the online EU FLW Prevention Hub. Against this background, the authors can confirm that the Hub is an important information source across the European Union with the objective of being a 'one-stop-shop for stakeholders active in the area of food loss and waste prevention and reduction'. It displays information according to the important three-step approach 'target, measure, act'. Nevertheless, this voluntary tool for information sharing amongst practitioners could further be strengthened by showcasing ambitious and effective interpretations and implementations of prevention actions in line with the food use hierarchy. To achieve this, both the European Commission, as the host of the Hub, and Member States, as input providers, can enhance transparency in referencing the food use hierarchy. The European Commission could do this by incorporating clear references to the hierarchy in its templates and guidance for the EU Member States section of the hub. Member States can contribute by voluntarily sharing their important food waste reduction and prevention actions.

To accelerate knowledge sharing on the effectiveness of individual actions but also on (food) waste prevention programmes as such, a section or reference box highlighting respective evaluation and monitoring efforts (beyond the requirements from the delegated act) could be promising.

Another immediate and simple improvement suggestion for the Hub is to include the date of the last Member State's update either at the bottom or the top of the individual country pages for easier interpretation of the presented data.

A recommendation to countries could also be to align internally on what data is shared via which channels so that data sent to the Hub and e.g. via Eionet questionnaires are more aligned, updates facilitate and processes made more efficient.

6.3.4. EU considerations for clearer communication about the 'food use hierarchy' and its interpretation of 'food waste prevention'

The legal basis for food waste prevention is the Waste Framework Directive. WFD Article 9(1)(g) reiterates the obligation to prevent and reduce in litra (g) food waste along the value chain (to achieve the SDG 12.3) and other prevention actions in litra (h) to "encourage food donation and other redistribution for human consumption, prioritizing human use over animal feed and the reprocessing into non-food products". Since, an evolution from the 'waste hierarchy' to 'food waste hierarchy' to 'food use hierarchy' took place as illustrated in Table 3.1 to acknowledge the specifics of food (e.g. in comparison with textiles or construction and demolition waste) and to provide and illustrate respective guidance.

On the one side, this guidance was earlier considered a need (European Parliament, 2017) and not so long ago again requested by some Member States (Council of the European Union, 2020).

On the other side, there seem to be different interpretations across EU-27 Member States on which actions are included in the term 'prevention'.

- Discussions during an Eionet webinar revealed that some authorities understand 'food donations' to be part of 'prevention', while others would not. For example, a country uses 'prevention' as long as it is used for food or feed. However, in another country, if food is not suitable for human consumption it is considered waste and cannot be used as animal feed. One participant stated that "when people talk about prevention, many talk about 'management' e.g. composting, but this is still 'wasting' according to the definitions in the WFD"[24].
- Additionally, Member States, particularly in their written information on the Hub, put the emphasis differently depending on their individual understanding of prevention.

[24] Statements from participant of Eionet food waste webinar 2023.

List of abbreviations

The following table sets out the main abbreviations used in this report. Some are sector-specific, and as such include links to their source. Others were created specifically for use with common terms used in this report.

Abbreviation	Name	Reference
CAP	Common agricultural policy	
ECFWF	European Consumer Food Waste Forum	
EEA	European Environment Agency	www.eea.europa.eu
ETC CE	European Topic Centre on Circular Economy and Resource Use	https://knowledge4policy.ec.europa.eu/projects-activities/european-consumer-food-waste-forum_en
Eionet	European Environment Information and Observation Network	https://www.eionet.europa.eu/
FW	Food waste	
GHG	Greenhouse gases	
Hub	EU Food Loss and Waste Prevention Hub	https://ec.europa.eu/food/safety/food_waste/eu-food-loss-waste-prevention-hub/
JRC	Joint Research Centre	https://commission.europa.eu/about-european-commission/departments-and-executive-agencies/joint-research-centre_en
KPIs	Key Performance Indicators	
MBT	Mechanical biological treatment	
MS(s)	Member State(s)	
MSW	Municipal solid waste	
NDCs	Nationally Determined Contributions	
LCA	Life Cycle Assessment	
SDG	Sustainable Development Goal	https://sdgs.un.org/goals
SDE+	Stimulation of Sustainable Energy Production scheme	
UN	United Nations	https://www.un.org/en/
VA	Voluntary Agreement	
VAT	Value added tax	
WFD	Waste Framework Directive	https://environment.ec.europa.eu/topics/waste-and-recycling/waste-framework-directive_en

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Annex 1

Table A.1 EU-27 Member States' information on food waste strategy, national targets, as well as references to SDG Target 12.3. and to the food use hierarchy

Countries	Food waste strategy /action plan / act or alike in place	National food waste reduction target	SDG 12.3 reference	Food use hierarchy reference
Austria	Yes.	Yes	Yes	Yes
Belgium	No, but under development.	Yes	No	Intend to
Bulgaria	Yes	Yes	Yes	No
Croatia	Yes	Yes	Yes	Intend to
Czechia	No	Yes	Yes	Yes
Denmark	No	Yes	Yes	No
Estonia	Yes.	Yes	Yes	No
Finland	No	Yes	No	No
France	Yes	Yes	Yes	Yes
Germany	Yes, revision ongoing.	Yes	Yes	Yes
Greece	Yes	Yes	Yes	Yes
Hungary	Yes	No	No, but intend to	Yes
Ireland	Yes	Yes	Yes	Yes
Italy	Yes	No	No information	Yes
Latvia	Yes	Yes	No	Yes
Lithuania	No	Yes	Yes	Intend to
Luxembourg	No	Yes	Yes	Yes
Malta	No	No information	No information	No
Netherlands	Yes	Yes	Yes	Yes
Poland	No, but under development.	Yes	No	No
Portugal	Yes	Yes	Yes	No
Romania	No	Yes	Yes	Yes
Slovakia	Yes	Yes	No	No
Slovenia	Yes.	No	No	No
Spain	Yes, revision ongoing.	Yes	No	Intend to
Sweden	Yes	Yes	Yes	Yes

Note: Table does not include Cyprus, as not enough information was received or available for the ETC mapping.
Source: Author's compilation based on information retrieved from the Hub and Eionet questionnaires in 2023s.

Table A.2. Potential identified causes of food waste generation available in literature

Efforts needed to address drivers (based on (Canali, M. et al., 2014)	**Priorities**	**Primary production**	**Manufacturing**	**Retail & other distribution**	**Restaurants & food services**	**Households**	**Whole value chain**
Easier to change 	Technological, organisational inefficiencies along the value chain, including readily changeable consumer behaviours	• Non-use or sub-optimal use of available harvesting, storage and logistics techniques (Canali, M. et al., 2014) • Lack of knowledge of valorisation options (Burgos, S. et al., 2017) • Lack of, or poor communication within the supply chain, e.g., late order cancellations of fresh products (Burgos, S. et al., 2017)-	• Non-use or sub-optimal use of available manufacturing techniques (Canali, M. et al., 2014) • Poor inventory management • Product and/or packaging damage due to organisational or technological inefficiencies (Canali, M. et al., 2014).	• Late order cancellations of fresh products resulting from inefficient information sharing, leading to unharvested food and/or waste in both primary and retail stages of the value chain, if surplus cannot be realised in alternate markets promptly (Burgos, S. et al., 2017) • Minimum order quantity criteria can also contribute to ingredient waste for complex products like sandwiches and bread (Burgos, S. et al., 2017) • Product and packaging damage due to organisational or technological inefficiencies (Canali, M. et al., 2014).	• Inventory management and stock rotation • Poor staff training and awareness (Canali, M. et al., 2014).	• Lack of awareness and general information (easily addressable by awareness raising campaigns) (Geffen L. et al., 2017; Canali, M. et al., 2014). • Poor shopping and management skills (planning shops and meals, maintaining food stock, impulse buying, utilising leftovers etc.) (Geffen L. et al., 2017) (Canali, M. et al., 2014). Ease of changing the related behaviour depends, however, on context (e.g., existing skills, household motivation, opportunities, existing social norms etc.).	• Inefficient supply chain management practices, such as poor or lack of communication, information and data sharing. Most sensitive (and difficult to change) are supply chains of high complexity or highly complex products (Burgos, S. et al., 2017).
	Other priorities than food waste by	• Profitability, costs and benefits, when	• Contracts/agreements (waste resulting from	• Profitability, costs and benefits, e.g. an		• Misinterpretation of **date labels**: Only 1/3 of consumers	• Emphasis on producing renewable energy through

	public and private sector (costs, risks for food safety, animal welfare, etc.)	the product price does not cover the cost of harvest and transport to markets, it can contribute to food waste (Canali, M. et al., 2014).	manufacturers' inability to redirect overproduction in accordance with retailer agreements) (Canali, M. et al., 2014) • High quality criteria such as "Minimum life on receipt" (MLOR) applied at e.g., depots, meaning that the minimum remaining age of a food product must be delivered by the producer or supplier, and it is often rigid and fixed (e.g., two-thirds of the product's age regardless of its shelf life) (Burgos, S. et al., 2017) • "Over-stringent" quality standards not necessarily representing lower food quality, could e.g., lead to 40 % of the food wasted at the meat slicing plant stage for sandwiches (Burgos, S. et al., 2017).	increase in unsold stock due to rising costs (e.g. fuel and energy expenses) or the cost-effectiveness of waste disposal compared to redistributing surplus food for human or animal consumption (Canali, M. et al., 2014) • Precautionary actions with respect to public health risks / food safety / quality and the brand image (Canali, M. et al., 2014) • MLOR (see "manufacture of food")		correctly understand the difference between 'used by' and 'best before' labels (Burgos et all, 2017). Up to 10% of food waste is linked to date marking (European Commission et al., 2018). The ease of change depends on the main reason; it is easy to change if the main cause is lack of knowledge but much more difficult to change if the cause is households prioritising potential health risks.	biogas. As society adopts and promotes new biogas solutions, it may become more acceptable to generate food waste (Canali et all., 2014).
	Non-readily changeable individual behaviours of consumers and the food chain operators (behaviours related to consumer expectations towards food (freshness, accessibility of food independently of geographical location, season, time, etc.)	• Consumer preferences (see "whole value chain") • Retail quality standards: strict cosmetic and other quality standards set by retailers for fruits and vegetables may lead to significant food waste and loss (Canali, M. et al., 2014). These standards are often driven by consumer preferences.	• Consumer preferences (see "whole value chain").	• Consumer preferences (see "whole value chain").	• Consumer preferences (see "whole value chain").	• Consumer preferences (see "whole value chain").	• Consumer preferences (cosmetics, freshness, convenient foods, possibility to access broad quantities and varieties of food independently of geographical location, season, and time) and expectations regarding the appearance of food can lead to more food waste concerns in specific product categories from primary production to the final consumption (Canali et all., 2014)(EC, 2023a; Canali, M. et al., 2014).
	Non-readily changeable social factors and dynamics in	See "whole value chain".	See "whole value chain".	See "whole value chain".	See "whole value chain".	• Perceived low value of food (EC, 2023a). • Perceived **social norms** play a significant role in influencing	• Trend towards healthier diets (e.g. lower salt or sugar content, which can increase perishability and the risk of

	population habits and lifestyles (single-person households, young age of household members, meals out of the home, etc.)					food waste levels. For instance, when consumers perceive that their family members and friends waste food, they are more likely to waste food themselves (Geffen L. et al., 2017). • Socio-demographics (e.g., young couples with small children, single-person households tend to generate more waste, and these may be difficult to change) (Canali, M. et al., 2014) • Lack of opportunity (e.g., a busy lifestyle and frequent unforeseen events have a strong impact on food waste levels). Consumers who frequently experience unexpected changes in their schedules tend to waste more food (EC, 2023a; Burgos, S. et al., 2017).	food waste) (Canali, M. et al., 2014; Moz-Christofoletti and Wollgast, 2021; EC, 2023a)
	Characteristics of products and specific ways of production and consumption (perishability, predictability of supply & demand, etc.)	• Inaccurate forecasting/crop planning due to difficulties in accurately predicting demand, influenced by factors such as weather changes (Burgos, S. et al., 2017).	• Forecast/ordering system (mainly related to characteristics of food products).	• Deterioration of food (primarily linked to the characteristics of food products). • Late order cancellations of fresh products resulting from poor projections (Burgos, S. et al., 2017).	• Consumer expectations prediction and demand forecasting (Canali, M. et al., 2014) • Deterioration of food (primarily linked to the characteristics of food products)(Canali, M. et al., 2014).	• Lack of opportunity, e.g. a physical opportunity to accumulate individual stocks of food (lack of storage or place in the fridge) (Canali, M. et al., 2014). • Unclear labelling of the expiration date may be a significant cause of unnecessary food waste, that requires the change of EU legislation (EC, 2023a) (see also above "misinterpretation of food labelling").	• Unfair Trading Practices (UTPs) referring to practices that deviate significantly from fair commercial conduct within trading relationships, often resulting from an imbalance of power between the parties involved[25]. While it is important to discourage UTPs across all sectors of the EU economy, they have a particularly significant impact on the grocery supply chain, affecting the level of food waste generated by affected businesses. Specifically, UTPs contribute

[25] The European Commission (EC, 2023a) has identified four main categories of UTPs: 1) Unfairly shifting costs or risks from one party to the other; 2) Requesting advantages or benefits without offering reciprocal benefits or services in return; 3) Making unilateral and/or retrospective changes to a contract, unless permitted under fair conditions; 4) Avoiding unfair contract termination or making unjustified threats of termination.

 More difficult to change							to food waste in relation to factors such as inadequate demand forecasting, last-minute order cancellations, and overly strict criteria regarding the minimum shelf life upon receipt (Sinclair Taylor J. et al., 2019).

Note: These drivers are just a subset, and their significance and required actions depend on the context.
Source: Author's compilation based on above mentioned resources.

Annex 2

The following text was included in the e-mails that were sent by the ETC team to the Eionet members in April, for the purpose of gathering country-specific data for the research task. The notes in the boxes give further insights on the process of the analysis undertaken.

Dear Sir/Madam,

I trust this email finds you well.

The European Commission is expected to propose an EU-wide target on food waste reduction as part of a revision of the Waste Framework Directive. The EEA and ETC Circular Economy and Resource Use aim to support European countries in achieving the targets and, if necessary, in revising their food waste prevention programs. A first step in this work is mapping the food waste prevention efforts of EU countries, with the aim to assess and identify areas in which more strategic or greater efforts can be developed.

We are focusing on the following types of policies/strategies/programs:

1) food waste prevention,
2) food waste addressed in climate policies and
3) food waste addressed in biodiversity policies.

As part of the mapping exercise, please can you provide your input to the questions below:

1. **On food waste prevention programmes:**

- Attached is a pre-mapping of food waste prevention efforts of your country (food waste prevention country profile) based mainly on your national waste prevention program. Please can you review the document and respond to the in-line comments/questions?
- Further, please can you let us know if your country has a specific/dedicated food waste prevention program?
    - If YES, is the program standalone or integrated as part of the general waste prevention program or other programme?
    - If not do you foresee doing so, and if not why?
- How does your country coordinate food waste prevention actions taken at different levels, i.e., national, regional and local?

Note: The ETC team only included in their food waste prevention programmes analysis information which had been directly provided by Member States in the questionnaires (in response to this email) and in the Hub. Further external sources were not considered to ensure better comparability across all countries and to avoid language problems.

2. **On food waste mentioned in climate policies:**

- Attached is also a list of climate strategies for EU countries that may relate to food waste. It is an extract from the EEA's database on greenhouse gas policies and measures in Europe, filtered with the search keyword "food" and filtered for adopted, implemented and planned policies only (link here for original reference). The EEA database is fed by policies and measures reported by the countries themselves.
- Please can you review the listed policies for your country and let us know:
    - Does your country integrate food waste in its climate policies/strategies/programmes? Yes/No
        - If yes, does the list reflect those?
        - If not, please can you add relevant references to the list including an attachment (to this email) or link to the reference?

Note: Accompanying the question, countries were provided with an overview of the actions for their country included in the EEA database on greenhouse gas policies and measures in Europe which contained the keyword 'food'. The Member States were able to provide feedback on whether this selection was still an accurate overview of the status of the inclusion of food waste in their national climate policy.

3. Food waste mentioned in biodiversity policies:
    - Please can you share any references of biodiversity policies/strategies/programs that relate to food waste?

Note: The ETC CE team conducted additional desk research. This consisted of a search for national-level biodiversity strategies, and within those documents (if available) a key word search for 'food waste' and then simply for food, when there was found to be little mention of food waste.

Your input would be valuable in our analysis and support eventual efforts to prevent food waste and related impacts in the EU. The results of the mapping will be presented in a Eionet webinar on food waste on June.

06/03/2025 10:05:00

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