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4. Food waste to biogas and biofuel: law and policy

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I. INTRODUCTION

Globally, one in three people do not have access to sufficient quantities of safe food. At the same time, one-third of the food produced for human consumption ends up as waste every year. The co-existence of these extremes suggests a need to recalibrate our food system if it is to meet the nutritional needs of the growing population while operating within planetary boundaries. Transitioning towards a circular way of operating, where resources are utilised to their utmost potential, is one way to address both issues. In the context of food waste, circularity would imply developing novel ways of utilising food that becomes unfit for human consumption. Dependent on the field of study and geographic location, many definitions of food waste exist in current literature.[1] In this chapter we define food waste as proposed by FUSIONS (2012–2016), a European Commission-funded project which is focused on the harmonisation of food waste monitoring: 'Food waste is any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed'.[2] By including biomass from all stages of the supply chain, whether edible or not, this definition provides the possibility of discussing food waste valorisation in the broadest possible way.

[1] Of the various definitions of food waste that are currently in use, many make the distinction between food loss and waste. For instance, the FAO (2011) defines food waste as 'decrease in the quantity or quality of food resulting from decisions and actions by retailers, food service providers and consumers'. Decrease in quantity and quality of food in earlier stages of the supply chain such as agriculture is termed as food loss (https://www.fao.org/3/mb060e/mb060e00.htm). However, in this chapter we will work with the definition proposed by EU FUSIONS which does not distinguish between loss and waste; Jenny Gustavsson, Christel Cederberg, and Ulf Sonesson, 'Global Food Losses and Food Waste' (2011) accessed 30 July 2022.

[2] Jenny Gustavsson and others, 'FUSIONS Definitional Framework for Food Waste' (2014) https://hal.inrae.fr/hal-02800861 accessed 10 November 2021.

Using food waste as feedstock for bioenergy is widely accepted as a way to create value out of surplus or waste food material. The chemical composition of food waste allows for conversion to energy in several ways. Some methods currently employed for this purpose include the transesterification of fats for biodiesel production, the fermentation of carbohydrates for bioethanol or biobutanol production, anaerobic digestion for biogas production, and incineration.[3] For the bioenergy industry, recovering energy from food waste presents a lucrative opportunity because waste is considered a zero cost material and its composition allows for the development of cost-effective and commercially viable methods to produce biofuel and biogas.[4] Bioenergy created from food, which would have otherwise ended up expanding landfills, is lauded for its two-fold contribution towards sustainability. First, it offers partial replacement for conventional energy resources that face the threat of dissipation. Second, using food waste, a biomass that is at the end of its life cycle, instead of food crops for generating bioenergy circumvents the food versus fuel debate.[5] Therefore, from the perspective of energy policy, biofuel and biogas that use food waste as feedstock merit an elevated status. In line with this, policy and legislation surrounding the topic have incentivised the redirection of food waste towards energy recovery in recent years. As a result, businesses in the European Union (EU) have been increasingly investing in infrastructure that enables this kind of valorisation. However, from a food policy perspective, using food material for generating bioenergy may not be seen as an ideal valorisation route; it robs this biomass of the opportunity to be utilised for some of its unique characteristics such as nutritionally or biologically valuable compounds. This chapter will address both food and energy policies and compare their considerations of food waste as feedstock for bioenergy. Section II provides an overview of current laws and policies that govern food waste valorisation in the EU. Section III elaborates on the end-of-waste status in the context of food waste valorisation. Section IV sets out how waste-to-bioenergy is perceived in comparison to other valorisation options by relevant stakeholders and whether its low position in the food waste hierarchy is justified. Section

[3] Thi Phuong Thuy Pham and others, 'Food Waste-to-Energy Conversion Technologies: Current Status and Future Directions' (2015) 38 Waste Management 399; Francesca Girotto, Luca Alibardi, and Raffaello Cossu, 'Food Waste Generation and Industrial Uses: A Review' (2015) 45 Waste Management 32.

[4] Sanjib Kumar Karmee and Carol Sze Ki Lin, 'Valorisation of Food Waste to Biofuel: Current Trends and Technological Challenges' (2014) 2 Sustainable Chemical Processes 22.

[5] See Julia Tomei and Richard Helliwell, 'Food Versus Fuel? Going Beyond Biofuels' (2016) 56 Land Use Policy 320; Eden Tafesework Geletu and Margherita Paola Poto, 'Balancing Agro-Fuels and Food Security on the Tightrope Towards Sustainability' (2019) 14 European Food and Feed Law Review 261.

V explores whether better cooperation between food, feed, and energy private standards could aid food business operators (FBOs) in making the right decision when valorising food biomass. Section VI present concluding remarks.

II. CURRENT STATE OF FOOD WASTE VALORISATION IN THE EU

The 2011 'Roadmap to a Resource Efficient Europe' was the first EU policy document to explicitly mention a food waste reduction goal.[6] The roadmap recommended a 20% reduction in the food chain's resource input by 2020. It suggested that this should be achieved by halving the disposal of edible food, but did not provide further guidance. Since then, several discussions have been had at EU as well as Member State (MS)-levels regarding reducing food waste, first through preventative actions and then via the valorisation of any remaining food materials.[7]

Although relatively new on the policy agenda, food waste has rapidly become an environmental issue requiring urgent attention. In 2017, the Commission adopted the 'Resource Efficiency: Reducing Food Waste, Improving Food Safety' resolution which reiterates previous EU-level discussions on the subject.[8] It invited MSs to measure food waste levels using a common methodology, officially adopt a food waste hierarchy based on Article 4 of the Waste Framework Directive 2008/98 (WFD) and provide clarification regarding the implications of various pieces of domestic legislation on food waste.[9] Most notably, the resolution called on MSs to examine the possibility of setting up binding, Union-wide food waste reduction targets by December 2020.[10] This is the first ever mention of legally binding targets with regard to food waste.

In May 2020, the Farm to Fork Strategy indicated that the Commission would propose legally binding targets for food waste reduction based on data

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6 European Commission, 'Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Roadmap to a Resource Efficient Europe' COM (2011) 571 final.

7 Some notable discussions and documents that focused on food waste to varying degrees include the 2012 Resolution on How to Avoid Food Wastage, the 2013 Consultation on Communication on Sustainable Food, the 2013 (7th) Environmental Action Programme, the 2014 Circular Economy Package, and the 2015 Closing the Loop Action Plan.

8 European Parliament, 'Resolution on Initiative on Resource Efficiency: Reducing Food Waste, Improving Food Safety' (2017) 2016/2223 (INI).

9 Directive 2008/98/EC on waste and repealing certain Directives [2008] OJ L3 12/3 ('Waste Framework Directive', 'WFD').

10 ibid.

expected from MSs in 2022.[11] While the intention to set up legally binding targets shows political will to reduce and better utilise food waste, tangible actions in the direction are yet to be seen across all MSs. Currently, no legislation or policy document at the EU level provides concrete guidance regarding food waste valorisation.[12] However, the Commission's Sustainable Food System Framework Initiative,[13] which at the time of writing is pending public consultation, has the potential to change this. The impact assessment for this proposed regulation mentions improved food loss and waste management as well as better recovery and redistribution of surplus food as one of its likely impacts.[14] When adopted in 2023, it is probable that it will be among the first food-focused regulations to address the reduction and valorisation of food waste.[15]

Of the numerous legal and policy areas that affect food waste valorisation, waste law is perhaps the most significant. Food law comes a close second but excludes food that is no longer considered fit for human consumption.[16] Instead, it focuses on consumer interest, human health, and effective functioning of the internal market.[17] It is therefore the WFD that regulates food waste and its valorisation. It lays down definitions and best practices related to waste management and includes environmental protection, human health, and resource efficiency in its scope. The current version of the WFD was adopted in November 2008.

In May 2018, the WFD was amended through the adoption of Directive 2018/851.[18] With this amending directive, food waste was recognised as a special category within biodegradable waste. This is a noteworthy change because the 2008 Directive simply considered food waste as part of bio-waste,

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[11] European Commission, 'A Farm to Fork Strategy for a Fair, Healthy and Environmentally-Friendly Food System' COM (2020) 381.

[12] ibid.

[13] European Commission, 'Sustainable EU Food System – New Initiative' https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13174-Sustainable-EU-food-system-new-initiative_en accessed 14 February 2022.

[14] European Commission, 'Inception Impact Assessment for the Sustainable Food System Framework Initiative' (2021) Ref. Ares (2021) 5902055 https://ec.europa.eu/info/law/better-regulation/ accessed 14 February 2022.

[15] ibid.

[16] Regulation (EC) 178/2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety [2002] OJ L31/1 ('GFL').

[17] It is, however, important to note that the EU General Food Law does demarcate the line between 'edible' and 'inedible'. Thus, it decides when certain material will no longer be classified as food but as waste.

[18] Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste [2018] OJ L 150/109.

detaching it from its value as a basic human need and natural resource different from other biomass.[19] By contrast, the amending directive includes a separate definition for food waste, derived from the EU General Food Law's (GFL) definition of food.[20] For the first time since 1975, when the first WFD was adopted, a link between legislation on food and waste has been established. However, it is interesting to note that the GFL defines food as 'any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans'.[21] Therefore, the WFD's definition only considers the wastage of food that humans can be reasonably expected to ingest as food waste. In contrast to this, the EU FUSIONS definition considers wasted inedible parts of food to be food waste as well. By excluding inedible parts such as pits, peels, and trimmings from the definition, the current WFD deprives a significant volume of food waste from being considered as such. Therefore, despite the WFD adopting a definition for food waste, food processing by-products may end up being categorised as bio-waste instead of food waste.

Article 9 of Directive 2018/851 guides MSs to take measures to reduce food waste at all stages of the supply chain in line with the (non-binding) United Nations' Sustainable Development Goal 12. Article 9(h) also states that donation and redistribution should be prioritised over use in animal feed or reprocessing into non-food products. This change is highly relevant with regard to food waste valorisation because never before in the history of EU waste law has the waste hierarchy been modified to accommodate the unique characteristics of food waste. Additionally, in May 2019, a Commission delegated decision (2019/1597) supplementing the WFD was adopted. This decision establishes a common methodology and minimum quality requirements for the uniform measurement of levels of food waste in MS.[22] Considering that data on the measurement of food waste is an important step towards its valorisation, the delegated decision is a step in the right direction if binding targets are to be set in the coming years.

In the context of valorising food waste as feedstock for bioenergy, legislation on renewable energy is relevant as well. In December 2018, Directive 2018/2001 (RED II) replaced the existing Directive 2009/28 on the promotion of the use of energy from renewable sources (RED I). When considering

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[19] Carrie Bradshaw, 'Waste Law and the Value of Food' (2018) 30 Journal of Environmental Law 311.

[20] GFL (n 16).

[21] ibid art 2.

[22] Delegated Decision (EU) 2019/1597 supplementing Directive 2008/98/EC as regards a common methodology and minimum quality requirements for the uniform measurement of levels of food waste [2019] OJ L248/77.

bioenergy that uses waste as feedstock, RED II relies on the principles of the WFD by referring to 2008/98 wherever relevant. In comparison, RED I considered waste biomass independently, without referring to legislation on waste management. This connection between legislation on renewable energy and waste management has the potential to improve the way in which MSs valorise their food waste. RED II directs MSs to consider the principles of the circular economy and the waste hierarchy when developing support schemes for renewable energy.[23] Additionally, with regard to meeting renewable energy targets for the transportation sector, RED I (art 21(2)) considered the contribution made by biofuels produced from waste to be twice that of other biofuels. RED II introduces an important nuance to this. Annex IX (part A(d)) of RED II listing feedstocks for the production of biofuels that can be considered twice for their energy content specifies that only biomass which is 'not fit for use in the food or feed chain' can be counted as such.[24] This is a significant addition with the potential to prevent material fit for higher levels of valorisation from being redirected for energy production. Another salient feature of RED II is that it explicitly states that waste prevention and recycling should be given priority over being used as feedstock for biofuel and that MSs should avoid creating support schemes leading to the inefficient use of waste that is recyclable.[25] The transposition to RED II was to be achieved by MSs by June 2021 and therefore, at the time of writing,[26] there is no data available to indicate whether RED II has made a significant difference to the way in which food waste is utilised as feedstock for bioenergy.

In line with the rapid developments in this area, a proposal to amend RED II was published by the Commission in July 2021.[27] When addressing food as feedstock for biofuel, the proposal focuses on food and feed crops. Changes likely to impact how food waste is used for energy recovery are numbered. One among these is a proposal to remove biomass from the list of renewable

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[23] Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources [2018] OJ L328/82 ('RED II') para 21.

[24] An exception is applicable in the case of used cooking oil and animal fats classified as categories 1 and 2 in accordance with Regulation (EC) 1069/2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) 1774/2002 ('Animal by-products Regulation'). Section III will discuss this further.

[25] RED II (n 23) para. 21.

[26] Chapter written in November 2021.

[27] European Commission, 'Proposal for a Directive Amending Directive (EU) 2018/2001 of the European Parliament and of the Council, Regulation (EU) 2018/1999 of the European Parliament and of the Council and Directive 98/70/EC of the European Parliament and of the Council as Regards the Promotion of Energy from Renewable Sources and Repealing Council Directive (EU) 2015/652' COM (2021) 557.

resources. Ninety-nine per cent of the 38,786 participants involved in the creation of the proposal voted to limit the use of biomass for energy recovery to locally available waste and residues.[28] If approved, this change would make waste streams exceedingly important as feedstock for biofuels while allowing biomass such as food and feed crops, along with the land required for their production, to be available for their primary purpose of ensuring food security.

Overall, recent changes to waste and renewable energy law have improved the interconnectedness between the two areas and recognised food waste biomass as different from other biomass. Contingent on the interpretation and implementation by MSs, these changes have the potential to make sure that food waste is used as feedstock for bioenergy only if higher priority valorisation options such as donation, use in animal feed, or extraction of valuable biological compounds, are not feasible. In addition, both legislations prioritise other valorisation routes for food waste over being utilised as bioenergy feedstock. This is likely to reduce the incidence of competing policy goals at MS level.

III. END-OF-WASTE CRITERIA AND FOOD WASTE

To transition to a circular economy, materials that are classified as waste at the end of their life cycle must be transformed in a way that enables their reintroduction into the economy. In the 2008 update of the WFD, legal provisions for conferring end-of-waste (EoW) status to such transformed material were introduced.[29] The directive states *inter alia* that waste materials that had undergone specific recycling or recovery processes could be classified as EoW if market demand for them existed and if their use would have no adverse environmental or health impacts.[30] Despite the EU Joint Research Centre developing EoW criteria for several materials, currently EU-level criteria exist only for three kinds of waste; iron scrap, copper scrap, and glass cullet.[31] For most other materials, MSs are responsible for deciding when a certain waste material ceases to be waste.[32] Discussions on EoW do not often overlap those concerning the valorisation of food waste. However, a 2019 decision of the European Court of Justice (ECJ) had a significant impact on the valorisation of waste vegetable oil as biofuel.

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[28] ibid.

[29] WFD (n 9).

[30] ibid art 6.

[31] N Johansson and C Forsgren, 'Is This the End of End-of-Waste? Uncovering the Space between Waste and Products' (2020) 155 Resources, Conservation and Recycling 104656.

[32] ibid.

In 2016, Prato Nevoso Termo Energy Srl ('Prato Nevoso'), an Italian power plant operator, wished to replace methane that was used in its operations with a bioliquid obtained by chemically treating used cooking oil and its residues. The producer of this product had the permit to market it as an EoW product within the ambit of the relevant Italian law. The EoW status was granted in relation to its use for biodiesel production. Since used vegetable oil was not part of a national list indicating the categories of biomass fuels that could be used in operations producing atmospheric emissions, a provincial court denied Prato Nevoso the authorisation to use it as an EoW product. This decision was challenged by Prato Nevoso on the basis of its violation of Article 6 of the WFD setting rules on EoW as well as Article 13 of the RED I that obliges MSs to streamline administrative procedures concerning the use of renewable energy. The ECJ was therefore asked by the involved parties for a preliminary ruling.

The ECJ referred to its decision in the *Tallinna Vesi* case wherein it was found that Article 6 of the WFD does not, in principle, allow the waste holder to demand the recognition of EoW status by a competent authority or court of the MS.[33] Furthermore, the ECJ confirmed that MSs have a wide margin of discretion with regard to establishing appropriate procedural arrangements as well as the substantive examination of compliance with the conditions for EoW status.[34] The Court's judgement established that since the used vegetable oil was not included in the list of authorised fuels, the bioliquid in question must be regarded as waste and not as a fuel.[35]

This decision of the ECJ highlights that in the EU food waste valorisation by way of energy recovery is dependent on MSs' interpretation and application of relevant legislation. Despite waste material such as used vegetable oil, husks, cobs, nut shells, and residues from processing, such as crude glycerine and bagasse, having low greenhouse gas emission values as per RED II, whether they can be used as EoW products is, in many cases, left to the discretion of competent authorities and courts of individual MSs.[36]

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[33] Case C-212/18 *Prato Nevoso Termo Energy Srl v Provincia di Cuneo and ARPA Piemonte* EU:C:2019:898 [2019], para 31; Case C-60/18 *AS Tallinna Vesi v Keskkonnaamet* EU:C:2019:264 [2019].

[34] ibid para 36.

[35] ibid para 41.

[36] These materials, among others, are listed as having low emissions in Annex V of Directive (EU) 2018/2001 (RED II) which lays down the rules for calculating the greenhouse gas impact of biofuels, bioliquids, and their fossil fuel comparators.

IV. COMPETING VALORISATION OPTIONS

In recent years, the waste hierarchy has been adapted by various institutions and scholars to address food waste.[37] In all versions of the adapted hierarchy, prevention is the topmost priority. The least preferred option is disposal without obtaining any value from the biomass. All options listed between the most and least preferred ones are valorisation routes because they seek to derive value out of material that would have otherwise gone unexploited. Figure 4.1 presents a version of the waste hierarchy adapted by REFRESH (2015–2019), a European Commission-funded project focused on food waste reduction.[38] This model places the option of recovering energy from food waste at the bottom of the hierarchy, making it the least preferred valorisation option. However, in practice, the waste-to energy route might be preferred by FBOs over other options. This section will explore if energy recovery competes with higher priority options and whether the low priority designated to it is justified.

The most preferred valorisation option as per the hierarchy is redistribution and reprocessing of safe and edible surplus food for human consumption. Redistribution is traditionally carried out by hunger relief organisations and social enterprises that collect surplus food from retailers and redistribute it to those in need. However, taxation and food-safety-related liability are two critical bottlenecks in this kind of valorisation. Under normal circumstances, value-added tax (VAT) is paid by consumers when they purchase the food product. However, if food is donated, the retailer must pay VAT unless MS-level legislation allows otherwise.[39] Next to this, food safety is an important concern. When retailers or suppliers choose to donate food, they

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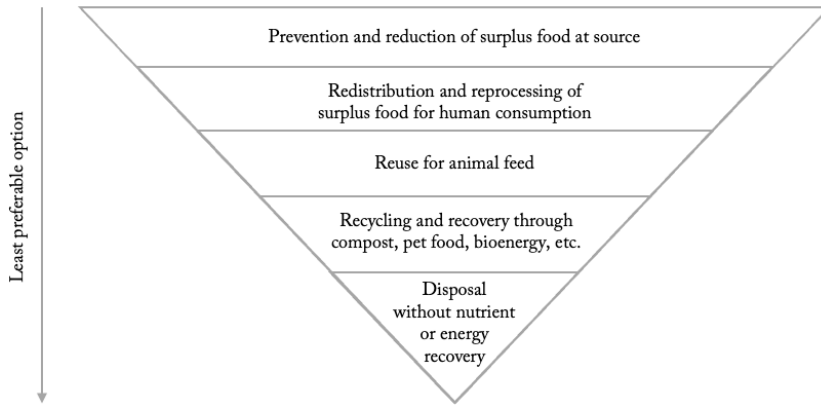
[37] Some examples of the adapted hierarchy include Jochen Moerman, 'Rechtsvergelijkende studie over de investeringssteun met betrekking tot de afv-alstoffen- en recyclageproblematiek: Europa vs. VS' (Universiteit Ghent 2009) https://libstore.ugent.be/fulltxt/RUG01/001/391/554/RUG01-001391554_2010_0001_AC.pdf accessed 14 February 2022; Effie Papargyropoulou and others, 'The Food Waste Hierarchy as a Framework for the Management of Food Surplus and Food Waste' (2014) 76 Journal of Cleaner Production 106; US EPA, 'Food Recovery Hierarchy' (12 August 2015) https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy accessed 14 February 2022; Stephanie Wunder and others, 'REFRESH Deliverable D3.3 – EU Policy Review for Food Waste Prevention and Valorisation' (REFRESH 2018) https://eu-refresh.org/sites/default/files/REFRESH_D3.3_EU%20policy%20screening_18052018_25072018.pdf accessed 14 February 2022. We consider the version developed by Wunder and colleagues since it was created as part of the REFRESH project which is relevant to various sections of the chapter.

[38] Wunder and others (n 37).

[39] Mattias Eriksson, Simone Giovannini, and Ranjan Kumar Ghosh, 'Is There a Need for Greater Integration and Shift in Policy to Tackle Food Waste? Insights from a Review of European Union Legislations' (2020) 2 SN Applied Sciences 1347.



Source: Stephanie Wunder et al., 'REFRESH Deliverable D3.3 – EU Policy Review for Food Waste Prevention and Valorisation' (2018), https://eu-refresh.org/sites/default/files/REFRESH_D3.3_EU%20policy%20screening_18052018_25072018.pdf.

Figure 4.1 The food use hierarchy

often have little or no control over its handling and storage, but the GFL holds FBOs liable if any food safety issues arise. This can have serious legal and reputational consequences for businesses. As a result, discarding surplus food or removing it from the food supply chain becomes cheaper and easier than donating it.[40]

Food or its by-products that are fit for human consumption may also be retained in the food supply chain through reprocessing. Such surplus is usually generated at the manufacturing or processing stage and is easier to valorise compared to surplus from other stages due to its homogeneous nature. Trimmings from fresh produce, whey from the dairy industry, oilseed cakes, and spent grains are examples of by-products that can be valorised in this manner through the extraction of valuable biological components.[41] However, FBOs must deal with food safety risks such as higher pesticide concentration and biological deterioration during storage or transportation.[42] Reprocessing by-products also often requires investment in new technologies and legal accommodations.[43]

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[40] ibid.

[41] Madhura Rao, Aalt Bast, and Alie de Boer, 'Valorized Food Processing By-Products in the EU: Finding the Balance between Safety, Nutrition, and Sustainability' (2021) 13 Sustainability 4428.

[42] ibid.

[43] ibid.

Against this background, if FBOs are offered fiscal incentives to send their waste to energy recovery, it is likely that they will consider it a more inviting choice.[44] For instance, Bowman and colleagues (2020) point out that 19,898 tonnes of food fit for human consumption was redirected to anaerobic digestion by UK's largest food retailer in 2017–18.[45] Some MSs even prioritise waste-to-energy valorisation over redistribution of surplus to improve food security. Sweden, for example, frames food waste as an environmental and economic issue and therefore does not consider the social dimension of food security while making policies that tackle food waste.[46] In 2017, the Commission published guidelines on food donation with the aim of clarifying relevant provisions in EU legislation and promoting a common interpretation of rules across MS and regulatory authorities.[47] Given the non-binding nature of these guidelines, it is up to MSs to amend relevant pieces of legislation and to ensure that donating or reprocessing surplus food for human consumption becomes the most favoured valorisation option.

Reusing food waste for animal feed is the next level of the hierarchy. This practice can address two pressing environmental issues simultaneously: reducing the negative impacts of meat production and reducing food waste. Several food processing by-products such as spent grains, fresh produce trimmings, and oilseed meals are currently successfully valorised as animal feed in the EU.[48] Next to this, surplus food from various stages of the food supply chain, known as former food products, are also redirected to animal feed.[49] By using food waste and surplus to feed livestock, the biomass partially fulfils its original purpose by remaining within the food supply chain. However, not all food surplus and by-products can be valorised in this manner. EU feed regulation heavily restricts the use of animal products in animal feed to prevent the spread of prion diseases. These restrictions are informed by the 1986 bovine

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[44] Clementine O'Connor, Manuela Gheoldus, and Olivier Jan, 'Comparative Study on EU Member States' Legislation and Practices on Food Donation: Final Report' (European Economic and Social Committee 2014) https://www.eesc.europa.eu/sites/default/files/resources/docs/qe-02-13-506-en-c.pdf accessed 9 December 2021.

[45] Martin Bowman, Karen Luyckx, and Christina O'Sullivan, 'Keeping Unavoidable Food Waste in the Food Chain as Animal Feed' in Christian Reynolds and others (eds), *Routledge Handbook of Food Waste* (Routledge 2020).

[46] Nils Johansson, 'Why Is Biogas Production and Not Food Donation the Swedish Political Priority for Food Waste Management?' (2021) 126 Environmental Science & Policy 60.

[47] European Commission, 'Commission Notice – EU Guidelines on Food Donations' (2017) 6872.

[48] Rao, Bast, and de Boer (n 41).

[49] Alice Luciano and others, 'Potentials and Challenges of Former Food Products (Food Leftover) as Alternative Feed Ingredients' (2020) 10 Animals 125.

spongiform encephalopathy (BSE) outbreak which was caused largely by the mismanagement of animal feeding. As a result, animal by-products are often excluded from higher valorisation routes.[50] This not only includes products from meat processing operations but also domestic food waste and leftovers from catering operations that may contain traces of meat or where the absence of meat cannot be verified.

EU regulations in this area are known to be among the most stringent in the world and only a small volume of products that may contain meat and animal by-products are currently used for the purpose of animal feeding despite the high nutritional value they offer.[51] According to results from REFRESH, these restrictions cannot be scientifically justified in the case of non-ruminant livestock that are not susceptible to prion diseases.[52] REFRESH underlined that changes in legislation could allow over 14 million tonnes of surplus food to be safely valorised as non-ruminant feed.[53] Results from the project indicated the need to adjust Regulation 999/2001, which prohibited the feeding of meat to all herbivorous and omnivorous farmed animals.[54] Excluded from animal feeding, conversion to bioenergy becomes the most feasible valorisation route for animal by-products and food waste that has come in contact with animal products.[55] In doing this, animal products are insupportably removed from the food supply chain. However, a recent amendment to Regulation 999/2001 has the potential to change this. In August 2021, Regulation 2021/1372 was adopted.[56] Subject to various hygiene, safety, and traceability conditions, the new

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[50] Rao, Bast, and de Boer (n 41).

[51] D Jędrejek and others, 'Animal By-Products for Feed: Characteristics, European Regulatory Framework, and Potential Impacts on Human and Animal Health and the Environment' (2016) 25 Journal of Animal and Feed Sciences 189.

[52] Jan Broeze and Karen Luyckx, 'REFRESH Deliverable D6.11 – Identification of Food Waste Conversion Barriers' (REFRESH 2019) https://www.eu-refresh.org/sites/default/files/D6.11%20Identification%20of%20food%20waste%20conversion%20barriers_Final.pdf accessed 9 December 2021.

[53] Karen Luyckx and others, 'REFRESH Deliverable D6.7 – Technical Guidelines Animal Feed' (REFRESH 2019) https://eu-refresh.org/sites/default/files/REFRESH%20D6.7%20Technical%20Guidelines%20Animal%20Feed%20Final.pdf accessed 9 December 2021.

[54] Broeze and Luyckx (n 52); Regulation (EU) 2021/1372 amending Annex IV to Regulation (EC) 999/2001 of the European Parliament and of the Council as regards the prohibition to feed non-ruminant farmed animals, other than fur animals, with protein derived from animals [2021] OJ L295/1.

[55] Within this valorisation route as well, many animal products end up being incinerated as opposed to be being sent to anaerobic digestion plants. Regulation 1069/2009 allows only certain kinds of animal products (categories 2 and 3) to be sent to anaerobic digestion plants.

[56] Reg 2021/1372 (n 54).

regulation re-authorises the use of processed animal proteins derived from pigs and insects in poultry feed, processed animal proteins derived from poultry and insect in pig feed, and gelatine and collagen of ruminant origin in the feed of non-ruminant farmed animals.[57] Combined with appropriate market incentives and strict enforcement, this amendment could be a game changer for valorising food waste as animal feed.

When comparing the position of various valorisation options, Marie Mourad's work on competing hierarchies of food waste solutions is especially noteworthy.[58] As illustrated by Figure 4.2, her research indicates that different valorisation routes may be seen as the best fit depending on which lens the issue is viewed through. In the environmental sustainability context, waste-to-energy is seen as more desirable than other options such as food donation or the sale of food products for lower prices. This is due to the success of different valorisation options being evaluated using different criteria. For instance, environmental impact is measured by parameters such as carbon dioxide emissions and effect on soil and water, whereas social impact is measured by the number and kind of calories, and economic impact by savings or profits.[59]

Results from Mourad's work indicate that despite being at the bottom of the hierarchy, companies and municipalities show a strong preference for the waste-to-energy route.[60] A notable advantage of this kind of valorisation is that its positive impact can be easily measured by quantifying waste diverted from landfills.[61] The legislative push to use waste, food or otherwise, to fulfil renewable energy targets has also led to MSs undertaking fiscal measures such as tax incentives to reward businesses that send their waste to energy recovery.[62] Mourad concludes that in terms of social, environmental, and economic values, various valorisation routes constitute competing categories when positioned in a hierarchical manner.[63]

This brings us to the question of whether the ranking of valorisation options through a hierarchy can be justified in the first place. When considered on its own, converting food waste to bioenergy presents much promise in the circular bioeconomy. It allows for biomass to be valorised without the health and safety

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57 ibid.

58 M Mourad, 'Recycling, Recovering and Preventing "Food Waste": Competing Solutions for Food Systems Sustainability in the United States and France' (2016) 126 Journal of Cleaner Production 461.

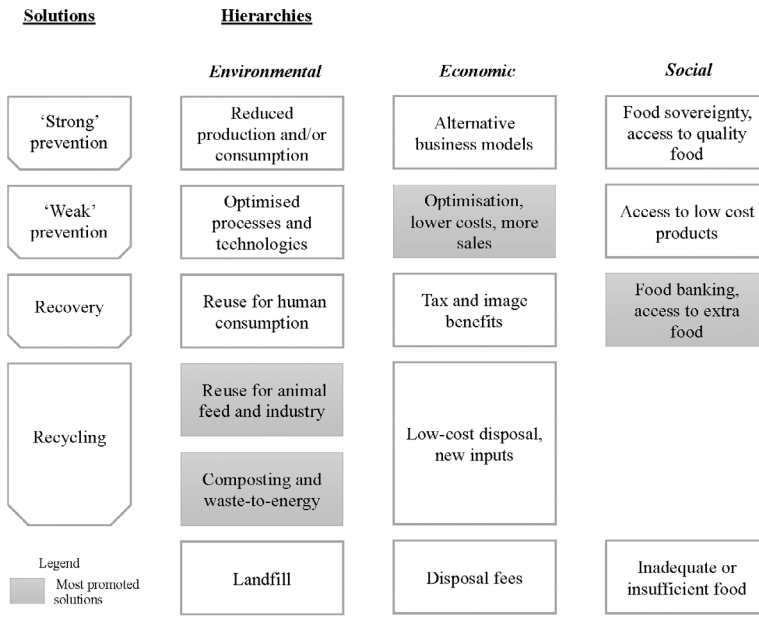
59 ibid.

60 ibid.

61 ibid.

62 ibid; Wunder and others (n 37).

63 Mourad (n 58).



Source: M Mourad, 'Recycling, Recovering and Preventing "Food Waste": Competing Solutions for Food Systems Sustainability in the United States and France' (2016) 126 Journal of Cleaner Production 461.

Figure 4.2 Competing hierarchies of solutions to food waste

risks associated with higher priority valorisation options, while at the same time reducing dependence on fossil fuels and first-generation biofuels. Nadine Arnold, in her work on competition in the food waste hierarchy, discusses this from the perspective of organisation theory.[64] Unique to the situation of food waste valorisation is the likelihood that actors involved in lower-ranking valorisation operations do not have any interest in achieving a 'better' position in the hierarchy.[65] Arnold elaborates that bioenergy producers (Swiss biogas plants in the case of her study) dissociate themselves from the broader field of food waste by creating their own sub-field centred on food waste recovery.[66]

[64] Nadine Arnold, 'Avoiding Competition: The Effects of Rankings in the Food Waste Field' in Stefan Arora-Jonsson and others (eds), *Competition: What It Is and Why It Happens* (Oxford University Press 2021).
[65] ibid.
[66] ibid.

By exercising linguistic nuances, these actors shape the discourse in their sub-field to their advantage.[67] In the Swiss case, terms that signal 'food waste' (*Verschwendung* in German and *gaspillage* in French) are rarely used. Instead, terms like *Abfall* (German) and *déchets* (French), meaning unwanted material, are used. This way, the biogas plants convey the message that they transform unwanted and worthless materials into something of value. Despite bioenergy created from food waste ranking low in the food waste hierarchy, it is viewed favourably when compared to other sources of energy. It can therefore be argued that it is not the actors involved in these various valorisation operations that compete with one another. It is, instead, FBOs that feel the pressure to choose the most sustainable option and justify this choice. In doing this, their social (people), environmental (planet) and economic (profit) priorities may come into conflict with one another.

It is worthwhile at this point to discuss whether the people-planet-profit approach to sustainability, also known as the triple bottom line, is effective when designing policies aimed at optimising food waste valorisation. The concept of the triple bottom line is rooted in the field of management science and was proposed by John Elkington to operationalise corporate social responsibility.[68] Kuhlman and Farrington propose that separating the environmental aspect from the social and economic ones might be a more sensible approach when it comes to assessing the impacts of sustainability policies.[69] They suggest that because the social and economic dimensions of sustainability consider the needs of the present while the environmental dimension considers the needs of the future, they must be viewed separately.[70] Kuhlman and Farrington propose to call the former 'well-being' and the latter 'sustainability'.[71]

Applying this reasoning to food waste, we suggest setting different priorities for the different stages of food biomass. When food is a commodity that is saleable to consumers for its nutritional value, it is of greater consequence for meeting the needs of today. This kind of food must be prevented from turning into waste. At this stage, both strong (systemic change)[72] and weak (process optimisation)[73] prevention strategies must be applied. If prevention fails, the redistribution and donation of such food must be considered and supported by

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67 ibid.

68 John Elkington, 'Towards the Sustainable Corporation: Win-Win-Win Business Strategies for Sustainable Development' (1994) 36 California Management Review 90.

69 Tom Kuhlman and John Farrington, 'What Is Sustainability?' (2010) 2 Sustainability 3436.

70 ibid.

71 ibid.

72 Mourad (n 58).

73 ibid.

relevant legislation. If food processing by-products can be safely reprocessed into new food products, this must be considered after or alongside donation and redistribution. In doing this, however, once food is no longer safe for human consumption, environmental sustainability must become a priority. This is because the way in which this biomass is dealt with will impact the future. Whenever feasible from a safety and nutrition perspective, such food must be reused as animal feed because it offers more environmental benefits as compared to valorisation in the form of energy recovery.[74] If the biomass is unfit for use in animal feed, it must be considered for energy recovery, first through anaerobic digestion and then incineration.[75] Figure 4.3 presents this bifurcated hierarchy.

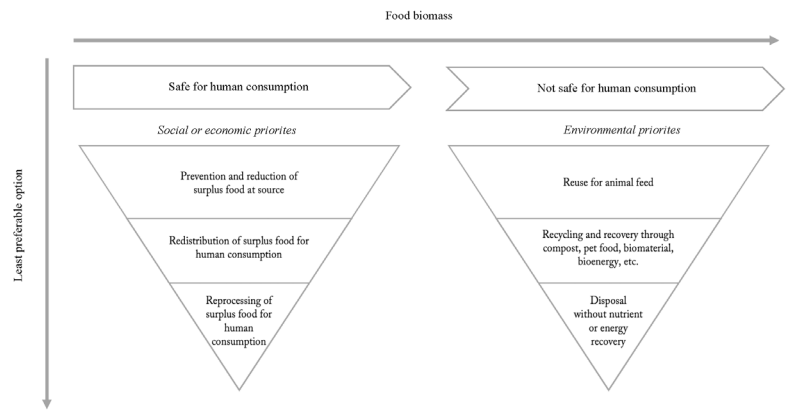

Figure 4.3 The bifurcated food use hierarchy

For this approach to be practicable, FBOs must be provided with pragmatic guidelines. While public law plays an important role in facilitating this, co-regulation by private actors may be able to help businesses deal with the liability and risks that come with food waste valorisation. FBOs have utilised private standards, a means of private co-regulation, as a tool to cope with regulatory uncertainty for over two decades now. In the following section, we

[74] Ramy Salemdeeb and others, 'Environmental and Health Impacts of Using Food Waste as Animal Feed: A Comparative Analysis of Food Waste Management Options' (2017) 140 Journal of Cleaner Production 871.

[75] Papargyropoulou and others (n 37).

will deliberate on whether such standards can help facilitate better food waste valorisation.

V. PRIVATE STANDARDS AND FOOD WASTE

As described above, safety for human consumption is key when choosing the most fitting valorisation option for food surplus and waste. In the EU, food safety is overseen by the GFL.[76] Since its introduction, the GFL has developed around the idea of food safety being the combined responsibility of the State and private actors.[77] Paragraph 30 of the preamble to the GFL explicitly places responsibility on FBOs by stating that they have the primary legal responsibility for ensuring food safety.[78] Regarding the responsibility of businesses, Article 17 states: 'Food and feed business operators at all stages of production, processing and distribution within the businesses under their control shall ensure that foods or feeds satisfy the requirements of food law which are relevant to their activities and shall verify that such requirements are met'.[79]

Given that the exact means to fulfil this responsibility are not specified, FBOs are left in a state of regulatory uncertainty.[80] To cope with ambiguity, FBOs use contracts, hygiene guides, and food safety management systems to specify criteria such as contaminant levels, handling and storage requirements, and quality specifications.[81] Influential actors like supermarket chains, trade organisations, and multinational corporations develop and enforce their own food safety management systems.[82] In addition to compliance with GFL and international law, these systems also cover consumer expectations.[83] Although technically voluntary in nature, food safety management systems (also known

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[76] GFL (n 16).

[77] Madhura Rao, Aalt Bast and Alie de Boer, 'European Private Food Safety Standards in Global Agri-Food Supply Chains: A Systematic Review' (2021) 24 International Food and Agribusiness Management Review 1.

[78] GFL (n 16) para 30.

[79] ibid.

[80] Christophe Charlier and Egizio Valceschini, 'Food Safety, Market Power and Private Standards: An Analysis of the Emerging Strategies of Food Operators' (2010) 1 International Journal on Food System Dynamics 103.

[81] Theo Appelhof and Ronald van den Heuvel, 'Inventory of Private Food Law' in Bernd van der Meulen (ed) *Private Food Law: Governing Food Chains through Contract Law, Self-regulation, Private Standards, Audits and Certification Schemes* (Wageningen Academic Publishers 2011); Bernd van der Meulen, 'The Anatomy of Private Food Law' in Bernd van der Meulen (ed), *Private Food Law: Governing Food Chains through Contract Law, Self-regulation, Private Standards, Audits and Certification Schemes* (Wageningen Academic Publishers 2011).

[82] Rao, Bast and de Boer (n 77); Appelhof and van den Heuvel (n 81).

[83] Appelhof and van den Heuvel (n 81).

as standards or schemes) that are created or favoured by influential actors have become *de facto* mandatory in agri-food supply chains.[84] Standards that were once established with the aim of regulating food safety have expanded their scope to include several contemporary issues such as labour conditions, animal welfare, and environmental impacts of food production.[85] This is often done by adding plug-ins to existing standards or through collaborations between two private standards specialising in different aspects of food production and trade. We posit that food waste prevention and valorisation could also be incorporated into private food safety standards in a similar manner.

It is expected that private standards already influence the state of food loss and waste. On the one hand, through prescriptive and often unduly strict product specifications, private standards can cause perfectly safe food products to be classified as unwanted or unsalable.[86] On the other hand, they can help prevent food waste by improving traceability, aiding in the early identification of food safety issues, and reducing product failure.[87] By taking cognisance of these impacts, standards can be optimised to prevent food waste. Where prevention is not possible, they can help FBOs decide on the most suitable valorisation option. In the case of reuse as animal feed, private standards are already instrumental in helping FBOs adhere to feed safety requirements.[88] This cooperation can be replicated in food-to-energy or feed-to-energy valorisation.

Similar to the food sector, the European bioenergy sector is no stranger to private standards. RED II encourages co-regulation by directing actors to demonstrate compliance with sustainability criteria through Commission-recognised voluntary schemes.[89] In fact, this model of compliance checking has inspired several other sectors of the bioeconomy to develop similar certification schemes.[90] As a result, actors in the bioenergy supply chain, like those in the

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[84] Rao, Bast and de Boer (n 77).

[85] Spencer Henson and John Humphrey, 'Understanding the Complexities of Private Standards in Global Agri-Food Chains as They Impact Developing Countries' (2010) 46 Journal of Development Studies 1628; Rao, Bast and de Boer (n 77).

[86] Rao, Bast and de Boer (n 77).

[87] ibid.

[88] See for example standards such as GMP+, Qualimat, and FAMI-QS that work with several food producers to set requirements regarding food products which can be valorised through reuse in animal feed.

[89] Stefan Majer and others, 'Gaps and Research Demand for Sustainability Certification and Standardisation in a Sustainable Bio-Based Economy in the EU' (2018) 10 Sustainability 2455.

[90] Kirsten Selbmann and Lydia Pforte, 'Evaluation of Ecological Criteria of Biofuel Certification in Germany' (2016) 8 Sustainability 936.

food and feed supply chains, work according to the chain of custody principle.[91] Connecting food and feed safety standards with bioenergy standards could aid FBOs in directing biomass that can no longer be used for food and feed purposes to energy recovery. In line with public legislation on waste, renewable energy, and food moving towards improved interconnectedness, private standards must follow suit to allow for these changes to be practicable for market actors. For the circular bioeconomy model to succeed, it is critical that the traceability of biomass is ensured in not only individual supply chains but also when biomass is transferred from one supply chain to another. Majer and colleagues propose the development of meta-standards based on the mutual recognition of different certification frameworks that play a role in the bioeconomy.[92] They also point out that most standards, whether food, feed, or energy, do not consider the end-of-life (EoL) scenario for biomass.[93] It is likely that standards, even those focused on sustainability-related issues, are designed for linear, cradle-to-grave or cradle-to-gate operations. Therefore, EoL scenarios are either not given much importance or included as an afterthought. Instead, if standards are designed keeping in mind that many supply chains, especially those dealing with biomass, are likely to move to a circular, cradle-to-cradle way of operating in the future, EoL scenarios would become significantly more important.

Private regulation, especially in the United States, seems to already be moving in this direction. Cradle to Cradle Certified® is a US-based scheme that certifies the 'circularity' of materials, products, and systems. The Upcycled Certified Program, which is also US-based, certifies the environmental credentials of food products made from by-products. It is, however, important that such standards develop in tandem with other standards that regulate this area. Like it is in the case of public policy, cooperation instead of competition is the need of the hour in the private regulation space if biomass is to be utilised in a manner that is fair and environmentally sustainable.

This brings us back to Mourad's distinction between strong and weak measures to prevent food waste. As defined in her work, a weak food waste prevention strategy is one that 'relies on the belief that improved processes and technologies without a fundamental change in business models are enough to significantly prevent and almost eradicate waste'.[94] This approach is criticised because it relies primarily on companies' voluntary commitment

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[91] Seita Romppanen, 'The EU's Biofuels: Certified as Sustainable' (2012) 3 Renewable Energy Law and Policy Review 173.

[92] Majer and others (n 89).

[93] ibid.

[94] Mourad (n 58).

to reducing waste.[95] However, considering the urgent need to address the issue of food waste, the role of private actors can no longer be seen as voluntary or optional. In contrast to weak prevention is strong prevention, which proposes reducing food waste through comprehensive, systemic changes such as the implementation of short food supply chain models and avoiding overproduction.[96] Modifying private standards, without changing the way in which businesses that implement them operate, would be classified as weak prevention. However, even weak prevention strategies have the potential to drive systemic change in the long run. Increased cooperation among food, feed, and bioenergy private standards can help drive this change by translating the new interconnectedness in public law on these topics into a language that businesses are well versed in.

VI. CONCLUSION

This chapter discusses the valorisation of food as energy in the EU. It is evident that the pressure to meet global and regional sustainability goals is driving EU legislators to consider food waste as a multidimensional issue that is impacted by a broad range of policy areas. The legal patchwork that oversaw food waste valorisation is gradually being replaced by pieces of legislation that are better aligned with one another. However, the food waste hierarchy model that forms the backbone of all legislative changes concerning food waste might cause various valorisation options to compete with one another. Despite energy recovery being ranked the lowest among valorisation options, it may end up being seen more favourably by FBOs since it helps keep food out of landfills while avoiding the safety risks and costs associated with reuse as food or feed.

To prevent such competition, we propose that valorisation options for food be based on its safety for human consumption. By prioritising economic and social well-being when food is fit for human consumption and environmental sustainability when it is not, conflicts between FBOs' economic, social, and environmental priorities may be largely avoided. At the same time, businesses are likely to require additional support in their decision-making process when it comes to choosing the most suitable option for their food surplus or waste. In both the food and energy sector, public law affords private actors the opportunity to self-regulate some aspects of decision-making and compliance. Private regulation measures such as voluntary standards may offer a bridge that allows the sustainable and fair valorisation of food waste. In line with the legislation on these subjects, private standards on food, feed, and energy must cooperate

[95] ibid.
[96] ibid.

better to enable transitioning to a future where biomass at the end of its life in one supply chain is safely utilised in another.

LEGISLATION

Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources [2018] OJ L328/82 ('RED II')
Directive 2008/98/EC on waste and repealing certain Directives [2008] OJ L312/3 ('Waste Framework Directive', 'WFD')
Directive (EU) 2018/851 amending Directive 2008/98/EC on waste [2018] OJ L150/109 ('GFL')
Regulation (EU) 2021/1372 amending Annex IV to Regulation (EC) 999/2001 as regards the prohibition to feed non-ruminant farmed animals, other than fur animals, with protein derived from animals [2021] OJ L295/1
Regulation (EC) 999/2001 laying down rules for the prevention, control and eradication of certain transmissible spongiform encephalopathies [2001] OJ L147/1
Delegated Decision (EU) 2019/1597 supplementing Directive 2008/98/EC as regards a common methodology and minimum quality requirements for the uniform measurement of levels of food waste [2019] OJ L248/77

CASES

AS Tallinna Vesi v Keskkonnaamet (Case C-60/18) EU:C:2019:264 [2019]
Prato Nevoso Termo Energy Srl v Provincia di Cuneo and ARPA Piemonte (Case C-212/18) EU:C:2019:898 [2019]