# Waste Prevention and Technologies

## Waste Prevention and Technologies in the Context of the EU Waste Framework Directive: Lost in Translation?

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***Abstract***

***The EU is set to transit from linear to circular economy: turning waste into a resource in order to increase resource efficiency and close the loop in a circular economy. This article centres on the Waste Framework Directive and most importantly its newest proposal, the main EU legislation to regulate waste. It argues that there is not sufficient guidance given to the regulatory limits of the definition of waste, especially in the context of the so-called subcategory of "waste v. non-waste" where "waste" was utilised as a fuel. While prevention is a breaking point in the waste hierarchy (as reuse, recycle, recovery and finally disposal are assumed to be waste unless cease to be waste), it seems unfortunate that it is not translated into a well-defined classification of waste and non-waste (i.e. product). It is not clear how prevention operates in the context of the WFD, as before a substance or object becomes waste, it was a product. Therefore, the paper calls to the rethink of categorisation of waste and product in the context of prevention placing further emphasis on the environment and human health as its main condition simultaneously embracing circular economy thinking. The European Commission should provide a European standard for waste derived fuels, which is essential for a proper functioning of European market. Furthermore, the paper also discusses that the WFD (and its newest proposal) fails to properly address technological advancements designed to transfer "waste" to a valued resource without posing any threat to the environment, which could be upgraded to the prevention systems. Against this background, the patented micro-scale Home Energy Recovery Unit, designed to process all unwanted domestic materials to generate energy for the household is used as a case study in this article.***

## I. Introduction

Recent EU legislation and policies on waste aim to stimulate Europe's transition from linear to circular economy to boost global competitiveness, foster sustainable economic growth and generate new jobs. It also sets clear targets for reduction of waste and establishes an ambitious and credible long-term path for waste management and recycling accompanied by concrete measures to address obstacles on the ground and the different situations across the EU Member States.[1] Even though waste management continues to improve in the EU, the Commission staff impact assessment report discovered that the EU's economy currently losses a significant amount of potential secondary raw found in the waste stream. In 2013, total waste generation in the EU amounted to approximately 2.5 billion tons of which 1.6 billion tons were not reused or recycled and therefore lost for the European economy. It is estimated that an additional 600 million tons could be recycled or reused in the EU.[2] Building on this framework, the best and most economical way of dealing with waste is to minimise its production (i.e. turning waste into a resource in order to increase resource efficiency and closing the loop in a circular economy).[3] Therefore, the EU policy and legislation, specifically, the Waste Framework Directive (thereafter WFD)[4] and its newest proposal[5] set the tone for waste prevention. Given

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[1] The European Commission, Review of Waste policy and legislation <http://ec.europa.eu/environment/waste/target_review.htm> accessed 15 December 2016.

[2] Commission Staff Working document Impact Assessment accompanying the document Proposal for a Directive of the European Parliament and of the Council amending Directives 2008/98/EC on waste, 94/62/EC on packaging and packaging waste, 1999/31/EC on the landfill of waste, 2000/53/EC on end-of-life vehicles, 2006/66/EC on batteries and accumulators and waste batteries and accumulators, and 2012/19/EU on waste electrical and electronic equipment, SWD/2014/0207 final.

[3] These objectives, for instance, are also set in the Roadmap to a Resource Efficient Europe, COM(2011) 571.

[4] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives, OJ L 312, 22.11.2008, pp. 3–30.

[5] Proposal for a Directive of the European Parliament and of the Council amending Directive 2008/98/EC on waste, COM/2015/0595 final - 2015/0275 (COD), 2 December 2015. Beforehand, in December 2014, the European Commission decided to withdraw a pending legislative proposal and annex to review recycling and other waste-related targets in the EU Waste Framework Directive 2008/98/EC, the Landfill Directive 1999//31/EC and the Packaging and Packaging Waste Directive 94/62/EC.

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that prevention should be understood as the avoidance of waste generation and it is only one element in the waste hierarchy defined as "non-waste", much rests upon the fundamental notion of "waste" as defined in the Waste Framework Directive. On the one hand, when a substance or object falls outside the definition of waste, this means that waste has not been generated (it has been prevented). On the other hand, when a substance or object falls within the definition, the regulatory scheme of the Directive applies.[6] Despite the "waste" concept's significant role in the regulatory scheme and being subjected to considerable academic commentary[7] and judicial consideration,[8] the definition barely has changed since the mid-1970s.[9] There is no surprise that the Member States and the holders of waste have attempted to narrow the scope of definition of "waste" and to classify their materials as non-waste in order to avoid the extensive regime of legal requirements defined by the Directive and equivalent national legislation.[10] Yet, the Court of Justice of the European Union (thereafter the CJEU) has sought for a wide interpretation of the concept as it may have the effect of circumventing the overall effectiveness of the Directive. The introduction of the new concepts of "by-product" and "end-of-waste" aimed to tighten the scope of "waste", has not improved legal certainty. There is not sufficient guidance given to the regulatory limits of the definition of waste, especially in the context of the so-called subcategory of "waste v. non-waste" where "waste" was utilised as a fuel. It seems that further clarification of the definition or its limits of scope is not on the European Commission's agenda either.[11]

Currently, the Directive refers to use waste as a fuel to generate energy, as an example of recovery operation.[12] The revised Directive upgraded incineration facilities designed to the processing of municipal waste where their energy efficiency is equal to or above the energy efficiency standards to recovery operations.[13] The scholars argue that by promoting energy efficient waste incineration as a recovery operation, the WFD conflicts with other European measures, which aim to reduce carbon dioxide emissions.[14] Yet, there are other more environmentally-friendly technologies that offer more advantages than conventional incineration. Given that the Directive seeks to protect the environment and human health by preventing waste generation and represents waste as a resource, it

[6] Note: any national implementation measures of Member States are excluded from the scope of this article.

[7] See, Ilona Cheyne, "The definition of Waste in EC Law" (2002) 14 *JEL* 1, 61-73; Ilona Cheyne and Michael Purdue, "Fitting definition to purpose: The search for a satisfactory definition of waste" (1995) 7 *JEL* 2, 149–168; Eloise Scotford, "Trash or Treasure: Policy Tensions in EC Waste Regulation" (2007) 19 *JEL* 3, 367–388; Jurgen Fluck, "The term waste in EU Law" (1994) 79 *European Env L Rev* 81; Geert van Calster "The EC Definition of Waste: The Euro Tombesi Bypass and Basel Relief Routes" (1997) *European Business L Rev*, 137–143; Hazel Ann Nash "The Revised Directive on Waste: Resolving Legislative Tensions in Waste Management?" (2009) 21 *JEL* 1; Geert van Calster, *EU Waste Law* (2015), 2nd ed., Oxford University Press; Carlos da Silva Campos, "Waste, Product and By-product in EU Waste Law" (2007) *ELNI Rev* 2, 28–43; Zen A.Makuch and N.Oraee-Mirzamani "Legislative interpretation and guidance on the new Waste Management regime of the European Union" Workspace Imperial College London <https://workspace.imperial.ac.uk/environmentalpolicy/Public/Environmental%20Law/10%20-%20Comparative%20Waste%20Law%20Z%20Mak.pdf> accessed 10 December 2016.

[8] Joined cases C-418/97 *ARCO Chemie Nederland Ltd v Minister van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer* and C-419/97 *Vereniging Dorpsbelang Hees, Stichting Werkgroep Weurt+ and Vereniging Stedelijk Leefmilieu Nijmegen v Directeur van de dienst Milieu en Water van de provincie Gelderland* ECLI:EU:C:2000:318; Case C-9/00 *Palin Granit Oy and Vehmassalon kansanterveystyön kuntayhtymän hallitus*, ECLI:EU:C:2002:232; joined cases C-206/88 and C-207/88 *Criminal proceedings against G. Vessoso and G. Zanetti* ECLI:EU:C:1990:145; case C-457/02 *Criminal proceedings against Antonio Niselli* ECLI:EU:C:2004:707; case C-422/92 *European Communities v Germany* ECLI:EU:C:1995:125; case C-235/02 *Criminal proceedings against Marco Antonio Saetti and Andrea Frediani* ECLI:EU:C:2004:26; joined cases Criminal proceedings against Euro Tombesi and Adino Tombesi (C-304/94), Roberto Santella (C-330/94), Giovanni Muzi and others (C-342/94) and Anselmo Savini (C-224/95) ECLI:EU:C:1997:314; case C-188/07 *Commune de Mesquer v Total France SA and Total International Ltd* ECLI:EU:C:2008:359; case C-114/01 *AvestaPolarit Chrome Oy* ECLI:EU:C:2003:448; case C-129/96 *Inter-Environnement Wallonie ASBL v Région wallonne* ECLI:EU:C:1997:628; *Castle Cement v Environment Agency* [2001] 2 *CMLR* 19.

[9] There have been some minor changes in 1991 Directive 91/156/EEC to eliminate the reference to national law and to replace "dispose" by "discard". The current Directive 2008/98/EC (n. 4) also deleted the reference to Annex I. There are no amendments recommended by the recent proposal to the Directive either (n. 5).

[10] The source of information is national implementing measures rather than directives themselves, as directives are binding only as to the aim to be achieved and therefore shall not be applied at domestic level directly pursuant to Article 288 TFEU.

[11] The Proposal (n. 5).

[12] Other recovery operations referred in the Directive are organic substances which are not used as solvents (including composting and other biological transformation processes), including gasification and pyrolisis using the components as chemicals. See Annex II of WFD (n. 4).

[13] Energy efficiency where their energy efficiency is equal to or above: 0,60 for installations in operation and permitted in accordance with applicable Community legislation before 1 January 2009; 0,65 for installations permitted after 31 December 2008, using the following formula: Energy efficiency = $(Ep - (Ef + Ei))/(0{,}97 \times (Ew + Ef))$. See Annex II of WFD (n. 4).

[14] The Directive 2000/76/EC on the incineration of waste and Directive 2010/75/EU on industrial emissions. See, for instance, Nash (n. 7), at 145.

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does not give adequate attention to modern environmentally – friendly technologies intended to convert unwanted substance to ''fuel''. Even though the recent revision proposal of the WFD places further emphasis on prevention with new measures being added, such as measures to deal with food waste and re-use, they are of ''promotional character by their nature''. Willingness to implement these measures rest within the ambit of the Member States. While prevention is a breaking point in the waste hierarchy (as reuse, recycle, recovery and finally disposal are assumed to be waste unless cease to be waste), it seems unfortunate that it is not translated into a well-defined classification of waste and non-waste (i.e. product). It is not clear how prevention operates in the context of the WFD, as before a substance or object becomes waste, it was a product. Therefore, the paper calls to the rethink of categorisation of waste and product in the context of prevention placing further emphasis on the environment and human health as its main condition simultaneously embracing circular economy thinking. The European Commission should provide a European standard for waste derived fuels, which is essential for a proper functioning of European market.

Furthermore, the paper also argues that the WFD (and its newest proposal) fails to properly address technological advancements designed to transfer ''waste'' to a valued resource without posing any threat to the environment, which could be upgraded to the prevention systems. Against this background, the patented[15] micro-scale Home Energy Recovery Unit (thereafter the HERU), which is a heat pipe based waste treatment unit, and is invented to process all unwanted domestic materials to generate energy for the household is used as a case study in this article. This will be effective if individuals are willing to contribute to protection of the environment. While the WFD has an emphasis on extended producer responsibility, consumer responsibility is lacking. There are some encouragements for consumers, such as initiatives for clean purchases or an obligatory payment by consumers for a given element of packaging that would otherwise be provided free of charge,[16] much more could be achieved through changing individuals' perception of what waste is.

Specifically, the article is organised as follows. Subsequent to this introduction (section 1), section 2 sets forth the development of waste regulation in the EU. Section 3 then turns to the controversial debates surrounding the definition of ''waste'' as set out in the legislation and a strict interpretation of the concept by the CJEU, detailing cases on the ''waste v. non-waste'' battle, where waste used as a fuel. Section 4 explores a practical solution to reduce unwanted materials by using the HERU as a case study. This section tests the extent to which the HERU technology could avoid the application of WFD requirements. Section 5 encapsulates waste management and waste hierarchy, with further focus being placed on waste prevention and particularly municipal waste management and prevention including the modifications suggested by the newest proposal to the WFD. Section 6 addresses the extent to which new innovative technologies, such as the HERU domestic energy generated boiler, should pave the way to waste prevention mechanisms. Final concluding remarks are drawn in section 7.

## II. Background of Waste Regulation

Initially, waste regulation was largely regarded as a local matter in all Member States, and the Union had no legislation concerned with waste disposal. EU legislators began to pay serious attention to waste in the mid-1970s when a call for the EU action was made. If the European Commission was to achieve its goal of a proper market in waste and recycling, common standards established by the Union action had to be put in place without leaving it to the Member States to interpret as they see fit. It has been acknowledged that without more extensive rules in the sphere of protection of the environment, the Internal market would never be able to function effectively. Therefore, the origin of environmental regulation, including the waste regulation started with the Internal Market justification and the creation of a level playing field for producers of waste.[17] The very first Directive on Waste was Directive 75/442, which defined the concept of waste, set the general waste management principles and called upon Member States to encourage prevention and recycling. The notion of waste also contained reference to national law in its application of the Directive,[18] therefore, hampering any Union harmonisation efforts, which was rectified by the 1991 amendments.[19] The 91/156/EEC Directive also

[15] WO/2015/104400

[16] See Annex IV of WFD (n. 4).

[17] The preamble of the Directive 75/442 provided that ''any disparity between the provisions on waste disposal already applicable or in preparation in the various Member States may create unequal conditions of competition and thus directly affect the functioning of the [Internal] market''. ''Whereas effective and consistent regulations on waste disposal which neither obstruct intra-Community trade nor affect conditions of competition should be applied to movable property which the owner disposes of or is required to dispose of under the provisions of national law in force, with the exception of waste covered by specific Union rules''.

[18] Directive 75/442/EEC defined waste as ''any substance or object which the holder disposes of or is required to dispose of pursuant to the provisions of national law in force''.

[19] The 1991 amendments to the Directive (i.e. Directive 91/156/EEC) were certainly intended, *inter alia*, to harmonise the concept of ''waste''. This was a response to the previous definition which effectively left it to the Member States to define ''waste'' on their territory. For further discussion, see Geert van Calster, ''Case Law: Arco Chemie'' (2001) 7 *Colum. J. Eur. L.* 2, 273.

replaced "dispose" by "discard" adding the "intention" component to the definition. The EU has chosen mainly to use directives to legislate on waste measures, allowing the Member States some latitude in the way they put policies into operation. Yet, the concepts and "targets" set out in directives are legally binding.

The current waste "framework" Directive[20] gained its *lex generalis* status upon its first serious amendment in 1991 when Directive 91/156 replaced the original core Directive on Waste.[21] The *lex generalis* of EU waste legislation means that it applies to all categories of waste unless otherwise provided in specific legislation. The current Directive on Waste aimed to simplify the legal framework by merging and repealing the previous Directives, such as Directive 2006/12, the hazardous waste Directive 91/689 and the waste oils Directive 75/439. The Directive is accompanied by some supporting documents. For instance, Decision 2000/532/EC was issued which established a list of wastes and provided the classification system for wastes, including a distinction between hazardous and non-hazardous wastes with further amendment to the list being made in 2014.[22] The current Directive has a clear emphasis on environmental protection and human health by insinuating the importance of proper waste management, recovery and recycling techniques to reduce pressure on resources and improve their use.

The newest developments encapsulate that the EU further changing the face of waste regulation. In 2015 the EU set out the ultimate aim to transit to a more circular economy, where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimised.[23] Turning waste into a resource is an essential part of increasing resource efficiency and closing the loop in a circular economy. Therefore, to achieve this ambitious circular economy goal, the European Commission issued the revised legislative proposals on waste. Together with other five directives,[24] there is a proposal to amend the WFD, which also responds to the legal obligation to review the waste management targets.[25] While there are some welcoming developments proposed, such as a new definition of municipal waste, new measures to promote prevention, including for food waste and reuse, the concept of waste or its limitations remains unchanged. Regrettably, the Union's ambition to move to a circular economy is mainly maintained in the recitals of the proposal of the WFD and do not translate in the binding provisions of the Directive (save the revised targets for reduction of waste).

## III. The Definition of Waste: No "One Size Fits All" Approach

### 3.1 The definition of "waste"

Given that the definition of waste is central to control waste processes, it is essential to define its scope. The core definition of waste, which is defined in the WFD has been untouched since the 1975 (save some minor amendments)[26] despite being subject to considerable academic debates[27] and judicial consideration.[28] There are no further changes insinuated in the Commission's newest proposal either with regard to the definition of waste or its boundaries. The WFD states that "waste means any substance or object which the holder discards or intends or is required to discard".[29] As part of its Thematic Strategy on the prevention and recycling of waste of 2005, the Commission committed itself to deal with one of the issues around the waste definition, namely the distinction between waste and by-products. The 2008 WFD has codified some CJEU's guidance[30] on when a substance or object can be exploited rather than discarded by tightening up the concept of waste via the incorporation of the concepts of by-products and of end-of-waste criteria. Even though both concepts "by-product" and "end-of-waste" meant to improve legal certainty, scholars argue that the new categories created further confusion within the market. Given the cumulative conditions attached to each notion, there are challenges involved in understanding and meeting these conditions. Article 5(1) of the Directive provides that "a substance or object, resulting from a production process, the primary aim of which is not the production of that item" may be regarded as not being waste, but a by-product provided the set

[20] WFD (n. 4).
[21] Directive 91/156 was repealed by Directive 2006/12.
[22] See Commission Decision (EU) No 2014/955/EU of 18 December 2014 OJ L 370, 30.12.2014, p. 44–86. Additionally, Commission Regulation (EU) No 1357/2014 was issued on 18 December 2014, which replaced Annex III to Directive 2008/98/EC of the European Parliament and of the Council on waste and repealing certain Directives (OJ L 365, 19.12.2014, p. 89–96) effective from 1 June 2015.
[23] Communication from the European Commission, the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, "Closing the loop – An EU action plan for the Circular Economy", COM(2015) 614 final.
[24] Directive 94/62/EC on packaging and packaging waste, Directive 1999/31/EC on the landfill of waste, Directive 2000/53/EC on end-of-life vehicles, Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators and Directive 2012/19/EU on waste electrical and electronic equipment.
[25] See the Proposal (n. 5), at 1.1.
[26] For instance, these minor modifications include abandoning reference to national law in the 1991 amendments and the current WFD no longer makes a link to Annex I categories.
[27] See, n. 7.
[28] See, n. 8.
[29] Article 3(1) of WFD (n. 4).
[30] See, for instance, Palin Granit (n. 8), Saetti (n. 8) to be discussed in the following sections.

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conditions are satisfied.[31] Along similar lines, Article 6(1) of WFD states that certain specified waste would cease to be waste when it has undergone a recovery, including recycling, operation and complies with the generic requirements prescribed by the Directive and the specific criteria to be defined for each waste stream.

To clarify some of the abstract concepts provided in the Directive, the European Commission adopted a guidance document on the interpretation of the key provisions of Directive 2008/98 (thereafter ''Guidelines'').[32] The Guidelines explain that the terms ''substance'' and ''object'' are not to be understood in the sense of EU chemicals legislation, but as autonomous terms of waste legislation which are to be read broadly, as any substance or object is either waste or non-waste.[33]

While the European Commission adopted the Waste Directive Guidelines on the interpretation of the key provisions of Directive 2008/98, it is merely soft law and does not provide the ultimate interpretation of the Directive's provisions. Therefore, the final interpretation remains with the CJEU. The vague definition of waste provides a leeway for the CJEU's interpretation. Indeed, there is the extensive case law of CJEU on this matter with the concept of waste being applied on a case-by-case basis without any fruitful results in the establishment of a definite definition of waste. The court reaffirmed on several occasions that the concept of waste cannot be interpreted restrictively,[34] as there is a need to consider all the specific factual circumstances involved. Against this background, there are the ''two permissible fates of waste'' prescribed by the WFD.[35] They are the ''subjective'' intentions of the holder of the waste with the emphasis on the ''discard'' test and the ''objective'' analysis of a regulatory system destined to protect the environment – defining ''waste'' through the definition of disposal and recovery.[36] Referring to the latter, Jacobs AG suggested that the definition of ''waste'' should be seemingly built on the terms of ''recovery'' and ''disposal''. Jacobs's approach, also labelled as the *Euro Tombesi* bypass by some scholars,[37] proposes that the notion ''discard'' encompasses both disposal and recovery and therefore, the scope of ''waste'' is depended on what it is meant by ''disposal operation'' and ''recovery operation''. This is because the Directive clearly embraces substances or objects which are disposed of and to those which are recovered.[38] AG Jacobs consulted the OEDC document which employs a similar definition of waste.[39] However, the Advocate General also admits that there are some problems with this approach. Defining ''waste'' as ''something that goes into a recovery operation'' begs a question ''what is a recovery operation?''. If the answer to this question is given as ''something to which waste is subjected'', there is an unbreakable loop. In addition, there are uncertainties regarding the distinction between ''recovery of waste'' and ''the normal processing of raw materials''. For instance, a producer may treat a residue or by-product as a substitute raw material that can be fed directly into his/her normal manufacturing process.[40] The CJEU noted that it was correct to draw a distinction between waste recovery and ''normal industrial treatment of products which are not waste, no matter how difficult that distinction may be''. Yet, it failed to specify ''normal industrial practice''.

Even though it seems that the CJEU limitedly supported Jacob's emphasis on ''recovery'' and ''disposal'' instead of ''discard'' in *Tombesi* and *Inter-Environnement*, the CJEU abandoned this route in the following cases. In a joined case *Arco Chemie and Epon*[41] the Court turned to its subjective interpretation referring to ''discard'', as the focal point of ''waste'': ''what mattered was whether the item in questions was being discarded''. The actual meaning of ''discard'' is subjective given the intention of the holder,[42] where objects and substances are no longer wanted by its holder. However, the time at which the substance becomes ''unwanted'' is not predictable (at least most of the time). Discarding does not merely mean

[31] The four cumulative conditions must be satisfied. They are: a) Further use of the substance or object is certain; b) the substance or object can be used directly without any further processing other than normal industrial practice; c) the substance or object is produced as an integral part of a production process; and finally d) further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts'.

[32] European Commission, Directorate-General Environment, Guidelines on the interpretation of key provisions of Directive 2008/98/EC on waste, June 2012.

[33] See Guidelines (n. 32), at 1.1.2.

[34] *ARCO* (n. 8), paras 36; case C-252/05 *the Queen on the application of Thames Water Utilities Ltd v South East London Division, Bromley Magistrates' Court (District Judge Carr)* ECLI:EU:C:2007:276, para 28; Commune de Mesquer (n. 8), paras 39, 44.

[35] Scotford (n. 7), at 375.

[36] See Opinion of Mr Advocate General Jacobs delivered on 24 October 1996, Euro Tombesi and other (n. 8), ECLI:EU:C:1996:399. Also see van Calster (2015) (n. 7), p. 11–12.

[37] Suggested by van Calster.

[38] See Preamble para 22, WFD (n. 4).

[39] OECD Council Decision C(88)90.

[40] Comments provided by the barristers Satnam Choongh and Martha Grekos 'Finding a Workable Definition of Waste: Is it a Waste of Time?' (2006), JPL, April < http://www.linklaters.com/pdfs/Insights/environment/FindingaWorkableDefinitionofWaste.pdf > accessed 12 December 2016.

[41] *ARCO* (n. 8).

[42] Note: the legal compliance of the act or intention to discard is irrelevant for deciding whether the material is waste or non-waste.

throwing away; discarding also embraces activities and operations such as recycling and recovery that put waste material back to good use – one's "waste" may well be useful to another. If the material recycle or is used as fuel, it might have economic value. For instance, the recycle waste is a genuine "raw material", and thus, the waste market exists with its supply and demand effects.[43] Yet, the CJEU made it clear that distinction between waste and non-waste cannot be based solely on economic considerations. In the past, the CJEU prevented the Member States from narrowing the scope of the definition of waste. For instance, in *Vessoso and Zannetti* the court stated that "[i]t is clear from [the objectives of the WFD as set out in the preamble and Articles 1 and 3] that a substance of which its holder disposes may constitute waste within the meaning of the [Directive] even when it is capable of economic reutilization".[44] Along similar lines, the CJEU precluded the Italian Government's and the German Government's authentic interpretations of the definition of waste by limiting its scope respectively in *Niselli*[45] and in *European Communities v Germany*.[46] Undeniably, even products with an economic value are not excluded from the waste definition, as every substance will have some monetary value somewhere in the world.[47] The CJEU in *Arco Chemie* stated that the concept of waste which depends on the meaning of the term "discard", cannot be interpreted restrictively.[48] The CJEU further noted that even where waste has undergone a complete recovery operation, which has the consequence that the substance in question has acquired the same properties and characteristics as a raw material, that substance may still be regarded as waste if its holder discards it or intends or is required to discard it.[49] The environmental risk is not a "trigger" by itself either: when the holder decides to discard, the material is waste, no matter the level of environmental risk derived from that act or intention.[50]

Labelling "waste" merely according to disposal and recovery operations, especially favouring the subjective interpretation of "disposal", risks for it becoming over-inclusive.[51] It does not embody the essence of waste prevention – "minimising the amount of materials that the holder intends to discard." The current definition assumes that the holder intends to dispose of it, while the fundamental purpose of waste prevention is to avoid waste generation at the source.[52] It seems that the broad concept of "waste" without clear boundaries is disconnected from the fundamental idea of a circular economy through turning waste into a resource.

### 3.2 Waste as a fuel

For this article, there is a specific interest in the so-called subcategory of the "waste v. non-waste" discussion where "waste" was used as a fuel. One of the leading cases in this subcategory is *Arco Chemie and Epon*,[53] where the court verified some conditions for the distinction of waste and by-product. In this joint case Arco Chemie wished to export "LUWA-bottoms", a by-product of its production process and which was intended to use as a fuel in the cement industry, and in the second judgment involved Epon, a producer of electricity who destined to use as a fuel of wood chips originating in the construction sector. For the establishment whether the use of substances, such as LUWA-bottoms and wood chips as fuels is to be regarded as constituting discarding, it was irrelevant that substance might be recovered in an environmentally responsible manner without substantial treatment (i.e. their use was beneficial to the environment because it enabled natural fuels to be preserved). "An ordinary fuel may be burnt without regard to environmental standards without thereby becoming waste, whereas substances which are discarded may be recovered as fuel in an environmentally responsible manner and without substantial treatment yet still be classified as waste".[54] The court further emphasised that waste within the meaning of the Directive must be determined in the light of all the circumstances including the EU policy on the environment as portrayed by the *effet utile* of Article 191 TFEU and

[43] Campos, (n. 7), at 29.
[44] *Vessoso and Zanetti* (n. 8).
[45] *Niselli* (n. 8). In this case the Italian Degree excluded materials, goods, or substances which were production or consumption residues from the concept of waste provided one of the following conditions were met: i) they could be and were in fact and objectively reused in the same or a similar or different production or consumption cycle, without undergoing any prior treatment and without causing harm to the environment; or ii) they could be and were in fact and objectively reused in the same or a similar or different production or consumption cycle, after undergoing prior treatment, without requiring any of the recovery operations listed in the annex of the waste framework Directive. Degree-Law No 138 of 8 July 2002 Official Journal Italy No 158, as quoted in van Calster (2015) (n. 7).
[46] In this case, the court ruled that merely the fact that a material or substance has the potential to be recycled does not mean that it cannot constitute 'waste' – precluding German legislation to exclude from the definition of waste industrial residues capable of reclamation. *European Communities v Germany* (n. 8).
[47] Germany wished to exclude all waste with an economic value. The Council clearly objected that which led to the changes of the core definition of waste from "to dispose" to "to discard". See, *European Communities v Germany* (n. 8).
[48] *ARCO* (n. 8), para 40.
[49] See *ARCO* (n. 8), para 94.
[50] See Campos (n. 7), at p. 31.
[51] See, Cheyne (n. 7), Nash (n. 7), Scotford (n. 7).
[52] Eva Pongrcz, Veikko J Pohjola, "Re-defining waste, the concept of ownership and the role of waste management" (2004) 40 *Resources, Conservation and Recycling*, pp. 141–153, at 142.
[53] *ARCO* (n. 8).
[54] *ARCO* (n. 8), para 66.

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the objectives of the WFD. Even though the risk of environmental danger is irrelevant in the context of "discarding" as discussed above, it is applicable in deciding whether a substance or object (already classified as "waste") is no longer waste as a result of going through a recovery operation. For instance, in *Castle Cement v Environment Agency*[55] waste was reprocessed to make a fuel (Cemfuel) for use by the cement industry. While relying on the CJEU's reasoning in ARCO, the English judge Stanley Burnton held that the fuel remained waste, as "the production process used for Cemfuel [was] not sufficient to cause its constituent parts to cease to be waste" and they still existed even though in a different form.[56] The act of burning in this case was regarded as a clear act of discarding. Yet, the scholars argue how one could distinguish between the burning of recycled materials and raw materials.[57]

The following cases further illustrate the CJEU's contrasting judgments with various conditions attached for the "waste" v. "non-waste" classification. In the *Saetti* case,[58] the material was the petroleum cokes resulting from the refinery of crude oil in its thermos-electric plant, where the surplus was used as fuel to produce the energy, which then was sold either to other companies or to the grid operator. While the relevant Italian authorities defined the petroleum cokes as a by-product, the CJEU seemed to agree: "[...] petroleum coke which is produced intentionally or in the course of producing other petroleum fuels in an oil refinery and is certain to be used as fuel to meet the energy needs of the refinery and those of other industries does not constitute waste." On the contrary, in *Palin Granit*,[59] where Palin Granit's application involved a plan for management of the leftover stone and the possibility of recovering that stone by using it as gravel or filling material, the court made the distinction between "waste" and a useful industrial by-product. It ruled that the holder of leftover quarried stone which has been stored for an indefinite length of time to await possible use discards or intends to discard that leftover stone fell within the meaning of the definition of "waste" as defined by the Directive due to its uncertainty.[60] The key factor was the reuse of the goods, materials, or raw materials that is not a mere possibility but a certainty[61] without any further processing prior to reuse, and as an integral part of the production process. The certainty argument was also raised in the *Avesta Polarit* case,[62] where the leftover rock and residual sand from ore-dressing operations from the operation of a mine could be classified as a by-product where the holder used it for the necessary backfilling of the mine and provided guarantees in relation to the identification and actual use of the leftover rock for that purpose. Finally, the court followed the same line of arguments when it came to heavy fuel oils in *Commune de Mesquer*,[63] where it held that "[a] substance such as [...] heavy fuel oil sold as a combustible fuel, does not constitute waste within the meaning of Council Directive [...] on waste, [...] where it is exploited or marketed on economically advantageous terms and is capable of actually being used as a fuel without requiring prior processing".

The case law discussed above proves that the Member States and industries are keen not to have such by-products qualify as waste. In particular, Dutch courts interpreting the relevant statutes have held that a substance or object deriving from a manufacturing process which can be used as fuel in an environmentally responsible manner without further processing is not to be regarded as waste.[64] Yet, the CJEU precluded Italian national law and German law to exclude from the definition of waste production or consumption residues capable to be reused without any prior treatment and without causing harm to the environment.[65]

Indeed, the CJEU's approach is rather conflicting,[66] since it retains its assumption that the term "waste" must not be interpreted restrictively. Hence, the rigid requirements must be met for an exemption to apply, which are now codified in the WFD.[67] This ambiguity particularly apparent in these cases, where a substance or object is usable as a substitute for a raw material, such as a fuel.[68] The CJEU's mandate to give a broad construction of "waste" does not seem to reconcile with the WFD's tone to encourage waste prevention as a matter of policy and to minimise waste harmful consequences.

[55] *Castle Cement* (n. 8).
[56] *Castle Cement* (n. 8), para 52.
[57] See, Cheyne (n. 7), at 69. The applicant in this case claimed that the fuel was not waste for the purpose of WFD, as it was the equivalent of a raw material.
[58] *Saetti* (n. 8).
[59] *Palit Granit* (n. 8).
[60] Directive 75/442 at the time.
[61] The Guidance provides some examples of 'certainty of further use', such as i) existence of contracts between the material producer and subsequent user; ii) a financial gain for the material producer; iii) a solid market (sound supply and demand) existing for this further use; iv) evidence that the material fulfils the same specifications as other products on the market. See Guidelines (n. 32), at 1.2.3.
[62] *AvestaPolarit* (n. 8).
[63] *Commune de Mesquer* (n. 8).
[64] Geert van Calster (2001) (n. 19).
[65] See *Niselli* (n. 8) and *European Communities v Germany* (n. 8) respectively.
[66] For instance, in *Inter-Environnement Wallonie* ((n. 8), paras 28–30) the CJEU held that residues and by-products were not in principle excluded from the concept of waste and it was not relevant the substances were to be recovered at the place of production and that those operations formed part of industrial process which did not endanger human health or the environment.
[67] Article 5 of WFD (n. 4).
[68] For further discussion on this subject, see Cheyne (n. 7), pp. 68–69.

## IV. Recovery of "Waste" – the HERU

The regulatory requirements of the WFD do not apply if a substance or object is not waste, but a "product". In economic terms waste is a product. Yet, the CJEU clearly expressed the distinction between waste and product cannot be based on economic considerations as discussed in the previous sections. The definition of "waste" has been also tightened through concepts of "by-product" and "end-of-waste" status. Pertinently, preferred options are to prove that a material is a "product" or "by-product", as an "end-of-waste" status assumes a substance or object to be "waste" until it undergoes a recovery (including recycling) operation in compliance with the aims of the WFD (i.e. minimising the possible waste-related risks to health and the environment) and receives a non-waste status.[69]

Pursuant to the CJEU, when materials are recycled the holder of those objects or substances has already acknowledged that they have been classified as wastes and almost all processes of recovery waste materials fall into the ambit of "discarding". "By-products" on the other hand fall outside of the regulatory framework of the Directive. Yet, the broad criteria attached to Article 5 WFD can contribute to further uncertainties, especially in relation to the interpretation of "further processing" and "normal industrial practice". These notions do not have any legal definition in EU waste law. The CJEU case law suggests that if a substance or object has been processed through a conventional waste treatment, it would then be seen as a waste.[70] The HERU in this context, which is Home Energy Recovery Unit, designed to fit seamlessly into domestic properties to process all domestic unwanted materials into clean energy for the household only, would have difficulties meeting the "normal industrial practice". The same would apply to any new innovative technology.

Unravelling it further, a by-product definition is not needed for the establishment of whether a material is waste or non-waste (otherwise product). Therefore, the question is raised the extent to which unwanted materials intended for use as a fuel either to produce hot water, or to run electricity generating unit in the household, such as HERU falls outside the scope of the definition of "waste" as defined the WFD. Building on the subjective interpretation of "waste", the main focus is on "discard". The word "discard" refers to acts and intentions of the waste holder. Society cannot afford to tolerate absolute freedom of "just get rid of things". "Discarding" should be compliant with legal requirements. In the past, the CJEU took into account different aspects in its distinction between "waste" and "non-waste". Even though the mere fact that the substance has economic value is not a sole determinant that it is not a waste.[71] Nonetheless, a financial value of a material can play a role. In several cases discussed in section 3.3, the court stated that "[i]f, in addition to the mere possibility of reusing the substance, there is also a financial advantage to the holder in doing so, the likelihood of reuse is high".[72] In the HERU context, individuals will have a financial incentive not to dispose of their unwanted domestic materials, but place them for further use, in this case to process these materials into clean energy to generate hot water or provide other options for energy conversions for their household. Therefore, individuals can reduce their bills by generating their own energy. The HERU technology would normally process a relatively small weight of materials at once, approximately 7 kilos; it would involve a regular use of the HERU boiler (i.e. it is estimated that in the two person household, all unwanted materials would have to be treated about every 3 days). Additionally, it is important to provide further incentive to influence individuals' actions, so that they do not "wish just to get rid of" materials and contribute to protection of environment, reduction of waste generation. For instance, a theory on community values calls for individuals not to be self-centred and care about the society as whole. The emphasis is on providing the opportunities for individuals to participate in the decision making and developing the community concept of "good". Individuals are expected to act as reflective consumers and consider the impact of their conception decision have on the environment.[73] Drawing public awareness to waste

[69] Waste streams must have undergone a recovery operation, and comply with a set of specific criteria. These criteria are to be defined for each specific waste stream, but the general conditions that a waste material has to follow are defined by Article 6 of the WFD (n. 4), which are: a) the substance or object is commonly used for specific purposes; b) a market or demand exists for such a substance or object; c) the substance or object fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products; and d) the use of the substance or object will not lead to overall adverse environmental or human health impacts.

[70] Normal industrial practice in this context can include all steps which a producer would take for a product, such as the material being filtered, washed, or dried; or adding materials necessary for further use; or carrying out quality control. However, treatments usually considered as a recovery operation cannot, in principle, be considered as normal industrial practice in this sense. See Guidelines (n. 32), 1.2.4.

[71] *Tombesi and Zanetti* (n. 8).

[72] See, *Palin Granit* (n. 8), paras 36–37, *Saetti* (n. 8), paras 35–36. However, the mere fact that the substance has economic value is not a sole determinant that it is not a waste (per *Tombesi and Zanetti* (n. 8)).

[73] The studies on consumer behaviour and consumers' environmental responsibility fall outside the scope of this paper. For a general discussion on this topic, see Iain Ramsay, *Consumer Law and Policy: Text and materials on regulating consumer markets* (2012), Hart.

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prevention is an essential step in encouraging behavioural change. Therefore, the HERU could change individuals' perception about "waste".

Even though the environmental risk is not relevant in the context of "discard" (when the holder decides to discard, a substance or object is waste, no matter the level of environmental risk derived from that act),[74] however, an environmental threat is applicable to the question when a recovery operation is complete. A material is regarded "waste" when a further treatment is required to assure the WFD objectives, such as the public health and environmental protection are met. In the HERU context, there is no need for any further treatment. The HERU unit was tested under the ETC (the Experimental Techniques Centre of Brunel University London) standard operating procedures 5, 14 and 16 (i.e. subject to UKAS accreditation) and no hazard materials were found. Specifically, chemical and mineralogical composition of the three samples was investigated: 1) char deriving from pyrolised mixed waste; 2) oil deriving from pyrolised mixed waste; and finally 3) ash deriving from the combustion of the char. The specimens were analysed using X-Ray Fluorescence (XRF), Fourier Transform infra-red spectroscopy (FTIR) and X-Ray diffraction. The results revealed that none of the elements determined using XRF was toxic as element. The higher concentration of iron and zinc did not indicate a hazard and the hexatetracontane, which was present in the char but fully disappeared in the ash, did not have records for hazard either. The FTIR of the oil also indicated a non-toxic composition.

On the objective interpretation, the term "discard" in the definition of waste has its consignment to a recovery operation apart from disposal of waste. Any waste treatment can be either a recovery operation or a disposal operation; the CJEU has expressed that no operation can be classified as disposal and recovery at the same time.[75] Pongracz argues that the individual perception of "waste" and their intention to dispose is useless for a legal definition.[76] Along similar lines, Campos further states that the distinction between waste and product cannot be solved by the "holder approach". Instead, the classification should result from the material itself and its effect on environment and public health.[77] This complexity was addressed by Advocate-General Jacobs in *Tombesi*, where he noted that "the distinction between the recovery of waste and normal processing of raw materials is somewhat fragile". Unfortunately, this distinction is not recognised either in the current WFD or the recent proposal leaving the tension the regulatory and preventive purposes of the Directive. Indeed, further clarity is required as innovative technologies, such as the HERU would fail to meet the requirement of "normal processing of raw materials" and therefore, would fall into the category of recovery of waste. This is counterproductive given the HERU's preventive nature.

Since classification of an operation has significant consequences not just for adherence to the waste hierarchy, but also for every waste management decision, further discussion is necessary on waste management and more specifically on waste prevention.

## V. Waste Management

Waste management was highlighted as a priority already in the first EU Environmental Action Plan, adopted in 1972. Since that date, it has continued as a priority area for EU action with a number of important Commission policy dossiers having been published to determine and evaluate the direction of EU waste law. Most recently under the current 7th Environmental Action Programme (thereafter EAP) there is a continuous promotion of recycling with a special focus on turning waste into a resource, also addressing a number of wider EU policies and programmes including the Resource Efficiency Roadmap and the Raw Materials Initiative.[78]

The scholars have criticised EU waste management policy and its consistency due to the lack of clarity on the extent to which waste management strategies, policies and measures are to be established at EU or at national level.[79] This is because the Member States generally prefer to keep responsibility for management options, i.e. investments into cleaner technology at national level, as the waste management infrastructure, including waste collection and treatment, recycling and recovery installations is set up and monitored by the Member States. Yet, pursuant to article 28 of WFD the Member States are obliged to produce waste management plans. These plans should allow evaluating the existing situation, defining the objectives that need to be met, formulating appropriate strategies, and identifying the necessary implementation means, *inter alia* including

[74] See Campos (n. 7), at p. 31.

[75] Case C-6/00 *Abfall Service AG (ASA) v Bundesminister für Umwelt, Jugend und Familie* ECLI:EU:C:2002:121, para 63.

[76] Eva Pongracz, "Re-defining the concepts of waste and waste management. Evolving the Theory of Waste Management" (2002), the University of Oulu, < http://jultika.oulu.fi/files/isbn9514268210.pdf > accessed 19 December 2016: "Waste is a value concept, culturally construed and subjective to the individual, be it the observer or disposer. Consequently, if we associate waste with humans, we shall not ever be able to define waste objectively" (at p. 69).

[77] Campos (n. 7), at 33.

[78] Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 'Living well, within the limits of our planet'.

[79] See, for instance Ludwig Kramer, *EU Environmental Law* (2012), 7th ed., Sweet & Maxwell, Chapter 10, at 333.

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general waste management policies, embracing planned waste management technologies and methods, or policies for waste posing specific management problems.[80] Additionally, the Member States have a legal duty to design and enforce necessary measures enabling waste to be recovered or disposed of without risk to human health and the environment.[81] The Member States must also take appropriate measures to establish an integrated and adequate network of waste disposal installations and of installations for the recovery of mixed municipal waste collected from private households and from producers subject to the principles of proximity and self-sufficiency.[82] Despite the generic nature of these provisions, the CJEU confirmed that the Commission, as the guardian of the Treaties, has a wide remit in reviewing the way in which the Member States operate their waste management facilities.[83]

Most recently, the Commission set clear revised targets for reduction of waste and establishes an ambitious and credible long-term path for waste management and recycling, as part of its Circular Economy Package to stimulate Europe's transition towards a circular economy.[84] These legally binding targets in the EU have been accepted as key drivers to improve waste management practices. Yet, the proposal of the WFD is rather vague and does not provide any tools how circular economy can be achieved. In addition to the previously established waste management principle, such as the "polluter pays principle" and the extended producers responsibility, the proposal also seeks for initiative to change consumer behaviour. Unfortunately, this initiative is not explored further and is assumed to be limited to promotional measures defined in Annex IV of the WFD.

### 5.1 Waste hierarchy

The EU's approach to waste management is based on the "waste hierarchy" which sets the priority order when shaping waste policy and managing waste at the operational level. The practical application of the waste hierarchy is positioned on three fundamental principles: waste prevention, recycling and reuse, and improving final disposal and monitoring.[85] Building on this framework, the best and most economical way of dealing with waste is to minimise its production (i.e. turning waste into a resource in order to increase resource efficiency and closing the loop in a circular economy).[86]

Waste prevention is the first tenet of the hierarchy and represents the most efficient and sustainable use of resources. Re-use is an important part of this tenet, because it keeps products in the consumption sphere for a longer period and thus avoids the creation of waste. Re-use implies that a product is used again for the same purpose for which it was originally conceived.[87] Next in the hierarchy, "preparing for re-use" contributes to the same purpose, but deals with products which have already been discarded by their last owner and are, therefore, formally is "waste" according to the definition provided in Article 3(1) of the WFD.[88]

While an important application of resource efficiency policy, materials recovery for re-input into the manufacture of products is not considered as waste prevention for the purposes of national waste prevention programmes. If waste cannot be prevented, as many of the materials as possible should be recovered, preferably by recycling. Where possible, waste that cannot be recycled or reused should be safely incinerated, recovering the energy released with waste combustion and leaving landfill as the last option for waste disposal. These are in line with the objectives set in other EU programmes, such as Resource Efficiency Roadmap,[89] 7th EAP,[90] which call for full implementation of the waste hierarchy in all Member States, ensuring high quality recycling and the use of recycled waste as a major, reliable source of raw materials for the Union. Specifically, the Roadmap to a resource-efficient Europe recognises the importance of waste as a resource to be fed back into the economy and gives a higher priority to re-use and recycling and incentives for waste prevention and recycling. The 7th EAP "Living

[80] European Commission, Waste Management planning, <http://ec.europa.eu/environment/waste/plans/index.htm> accessed 19 December 2016. See Article 28(2)(e) WFD (n. 4).
[81] See Article 13 WFD (n. 4). Yet, this article does not require the adoption of specific measures or any particular method of waste disposal, therefore, it is not capable of producing direct effect.
[82] Article 16 WFD (n. 4).
[83] See, for instance, case C-420/02 *Commission of the European Communities v Hellenic Republic* ECLI: EU: C: 2004:727, and previously case C-365/97 Commission of the European Communities v Italian Republic (San Rocco) ECLI:EU:C:1999:544, case C-236/92 Comitato di Coordinamento per la Difesa della Cava and others v Regione Lombardia and others ECLI:EU:C:1994:60.
[84] The Circular Economy Package consists of an EU Action Plan for the Circular Economy that establishes a concrete and ambitious programme of action, with measures covering the whole cycle: from production and consumption to waste management and the market for secondary raw materials. The annex to the action plan sets out the timeline when the actions will be completed. For further discussion, see <http://ec.europa.eu/environment/circular-economy/> accessed 5 December 2016.
[85] Preamble, para 6 of WFD (n. 4).
[86] Note: these objectives, for instance, are also set in the Roadmap to a resource-efficient Europe.
[87] Article 3(13) of WFD (n. 4).
[88] Preparing a Waste Prevention Programme, Guidance document, European Commission Directorate-General Environment, October 2012, at p. 9.
[89] The Roadmap to a Resource Efficient Europe COM(2011) 571.
[90] Environment Action Programme (n. 78).

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well, within the limits of our planet" also highlights the importance of waste prevention, indicating that there is considerable potential for improving waste prevention and management in the Union to make better use of resources, open up new markets, create new jobs and reduce dependence on imports of raw materials, while having lower impacts on the environment.[91]

Even though these priorities are clearly set, the waste hierarchy is not without its controversies and identifying the "best environmental option" to deal with waste from a practical point of view is not always clear.[92] Trade-offs need to be assessed in all waste management options, as the balance between benefit and burden will vary depending on sector, place or other issues. For instance, recycling may accrue high environmental costs due to long transportation to a recycling facility.[93] Along similar lines, legislation requiring "qualitative" prevention with regard to end of life vehicles, has been controversial due to the fact that there could be environmentally negative effects if the removal of certain hazardous substances reduces the life of a vehicle, or increases its weight leading to rise of fuel consumption.[94]

### 5.2 Waste prevention

Reducing the amount of waste generated at source is regarded as the highest priority pursuant to the waste hierarchy and it is also in line with wider EU policies as discussed in the previous section. Technically, "prevention" is not a waste management operation because it concerns substances or objects before they become waste.[95] Yet, this breaking point when a substance or object transforms from product to waste (i.e. borderline cases) is not accentuated in the WFD (i.e. everything below prevention is assumed to be waste in the waste hierarchy). Instead, the WFD defines "prevention" as "measures taken before a substance, material or product has become waste, that reduce: (a) the quantity of waste, including through the re-use of products or the extension of the life span of products; (b) the adverse impacts of the generated waste on the environment and human health; or (c) the content of harmful substances in materials and products."[96] This definition embraces both quantitative waste prevention through the reduction of the amounts of waste and qualitative waste prevention via reducing the content of harmful substances in materials and products. These are supportive elements of each other, as even if quantitative prevention has been performed, it does not mean that qualitative prevention on the remaining or non-avoidable waste no longer needed.[97]

Given that the Union misses opportunities to improve resource efficiency and create a more circular economy, further initiative from the WFD is lacking. The main binding provision of the WFD, specifically, article 29 requires the Member States to establish National Waste Prevention programmes and offers in Annex IV a list of 16 measures that could form part of such programmes in order to move up the waste hierarchy.[98] The objective of these programmes is to present a coordinated national approach to waste prevention, delineating targets and policies, and aiming to decouple economic growth from the environmental impacts of waste generation.[99] The handbook[100] to support the Member States when developing Waste Prevention Programmes clarifies the main concepts related to waste prevention, suggesting a framework to develop Waste Prevention Programmes and providing best practices and examples of national and regional programmes employing an effective mix of measures. The Member States are obliged to define their existing prevention measures and evaluate their usefulness in order to break the link between economic growth and the environmental impacts associated with the generation of waste.[101] Even though the prevention measures should be clearly identified, the Member States are free to integrate their prevention programmes either into the waste management plans or into other environmental policy programmes, as appropriate.[102] For instance, the UK government issued the Waste Prevention Programme for England "Prevention is better than cure: the role of waste prevention in moving to a more resource efficient economy" in 2013 with the aim to improve the environment and protect human health by supporting a resource efficient economy, reducing the quantity and impact of waste produced whilst promoting sustainable economic growth.[103]

[91] Environment Action Programme (n. 78). In addition, the 7th Environment Action Programme and the EU Raw Materials Initiative (COM(2008) 699 and COM(2014)297) call to combat unnecessary food waste.

[92] Maria Lee, *EU Environmental Law: Challenges, Change and Decision-making*, (2005) Hart, at 219.

[93] Like the case in Finland, where the major recycling facilities are located in the southern part of the country. See, Pongracz and Pohlola (n. 76), at 148.

[94] Directive 2000/53 on End-of-Life Vehicles (2000) OJ L 269/34. See Alison Lea "The Scrapping of End of Life Vehicles: Is New European Legislation Necessary?" (2000) *Env L Rev* 65.

[95] See, Guidelines (n. 32), at 1.4.2

[96] Article 3(12) of WFD (n. 4).

[97] European Commission, DG Environment, Final Report Analysis of the evolution of waste reduction and the scope of waste prevention, Framework contract ENV.G.4/FRA/2008/0112, <http://ec.europa.eu/environment/waste/prevention/pdf/report_waste.pdf> accessed 20 December 2016.

[98] The deadline to established the National waste prevention programmes was 12 December 2013. Article 29(1) WFD. Commission Decision 2013/727/EU.

[99] Waste Prevention Guidance document (n. 88).

[100] Waste Prevention Guidance document (n. 88).

[101] Article 29(2) WFD (n. 4).

[102] Article 29(1) WFD (n. 4).

[103] The Waste Prevention Programme for England "Prevention is better than cure: the role of waste prevention in moving to a more resource efficient economy" (2013)

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In its recent development, specifically the proposal to the WFD, there is a further focus on waste prevention with new measures to promote prevention being added.[104] Particularly, the proposal sets the Member States to establish the measures, *inter alia*, to encourage the use of products that are resource efficient, durable, reparable and recyclable; to identify and target products that are the main sources of raw materials of a high importance to the economy of the Union and whose supply is associated with a high risk to prevent that those materials become waste; to reduce 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.[105] It is to be seen whether these new changes will be accepted and how they will be implemented at national level. In the past, these measures have been criticised for their non-binding nature and therefore, for their ineffectiveness to reduce waste generation.[106] It seems that the Commission has currently abandoned setting waste prevention targets, which is in a domain of the Member States.[107] Instead, the European Environment Agency aims to publish annual report on the evolution relating to the prevention of waste generation for each Member State and for the Union as a whole, including on decoupling of waste generation from economic growth and on the transition towards a circular economy.[108] It is not clear how these data will be evaluated without a common methodology or indicators to measure the implementation of waste prevention.[109] It seems the WFD and its newest proposal totally ignores any technological advancements, most likely leaving it to national level.

### 5.3 A new focus of the proposal for the Directive – Municipal waste management

The newest proposal to the Waste Framework Directive places a specific focus on municipal waste. First of all, the proposal aims to harmonise the definition of municipal waste, as the concept of municipal waste currently varies across the Member States. This is because municipal waste reflects different waste management operations in the Member States. Therefore, proposal defines ''municipal waste'' as ''(a) mixed waste and separately collected waste from households including: paper and cardboard, glass metals, plastics, bio-waste, wood, textiles, waste electrical and electronic equipment, waste batteries and accumulators; bulky waste, including white goods, mattresses, furniture; garden waste, including leaves, grass clipping; (b)mixed waste and separately collected waste from other sources that is comparable to household waste in nature, composition and quantity; (c) market cleansing waste and waste from street cleaning services, including street sweepings, the content of litter containers, waste from park and garden maintenance.''[110] The definition, however, excludes waste from sewage network and treatment, including sewage sludge and construction and demolition waste. The definition of municipal waste in the proposal is neutral with regard to the public or private status of the operator managing waste.[111]

Secondly, the proposal of the WFD sets the new targets for municipal waste reduction for economically valuable waste materials to be re-used and effectively recycled to channel back into the European economy, and to move towards a circular economy. For instance, a common EU target for recycling of municipal waste by 2030 is 65 per cent, with a binding landfill target to reduce landfill to maximum of 10 per cent of municipal waste by 2030.[112] This is because only a limited share (43 per cent) of the municipal waste generated in the European Union was recycled, with the rest being landfilled (31 per cent) or incinerated (26 per cent).[113] Therefore, the Member States must monitor and assess the implementation of the waste prevention measures by using appropriate qualitative or quantitative indicators and targets, notably on the per capita quantity of municipal waste that is disposed of or subject to energy recovery.[114]

*cont.*
< https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/265022/pb14091-waste-prevention-20131211.pdf > accessed 10 December 2016.

[104] Member States should take measures to promote prevention of food waste in line with the 2030 Agenda for Sustainable Development, adopted by the United Nations General Assembly on 25 September 2015, and in particular its target of halving food waste by 2030. These measures aim to prevent 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. Member States should establish specific food waste prevention measures and should measure progress in food waste reduction. To facilitate exchange of good practice across the EU both between Member States and between food business operators, uniform methodologies for such measurement should be established with reporting on food waste levels taking place on a biennial basis. Proposal (n. 5), at recital 12.

[105] See Article 9(1) of the Proposal (n. 5) for full measures.

[106] On this subject, see Kramer (n. 79), at 348.

[107] Note: according to article 29(3) of WFD the Member States have to determine specific qualitative or quantitative benchmarks for waste prevention measures adopted, in order to monitor and assess their progress.

[108] Proposal (n. 5), article 9(5).

[109] Proposal indicates that the Commission may (rather than shall) adopt implementing acts to implementing acts to establish indicators to measure the overall progress in the implementation of waste prevention measures. At least it is welcoming that the Commission is planning to adopt a common methodology to measure the levels of food waste. Proposal (n. 5), article 9(4).

[110] Proposal (n. 5), Article 1 Amendments, 2(a).

[111] Proposal (n. 5), at recital 6.

[112] Proposal (n. 5) Article 11(2).

[113] Proposal (n. 5), Explanatory memorandum, at 1.1.

[114] Proposal (n. 5), Article 9(2).

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This waste stream is regarded as amongst the most complex ones to manage, as the challenges of municipal waste management result from its highly complex and mixed composition, direct proximity of the generated waste to citizens, and a very high public visibility. Furthermore, its management involves a need for a highly complicated waste management system including an efficient collection scheme, a need to actively engage citizens and businesses, a need for infrastructure adjusted to the specific waste composition, and an elaborate financing system.[115] This complexity can be illustrated by an example in England where the amount of household waste being rejected for recycling has increased by 84 per cent over the past four years.[116] The cost to local authorities of re-sorting so-called contaminated recycle bins is said to be the primary reason the vast majority of the waste is being rejected; with 97 per cent of the rejected waste being incinerated or sent to landfill in 2012–2013 undermining the overall purpose of recycling. Therefore, trade-offs should be assessed in all waste management options. Given the challenges of municipal waste management, the Member States should be encouraged to use life-cycle thinking to weigh up the possible environmental benefits and invest in new technologies.

### 5.4 Waste prevention – new technologies in practice – the HERU

The WFD and the newest proposal[117] discussed in previous sections emphasise that the best option to deal with waste is not to generate it at all and encourage an approach that takes into account the whole life-cycle of products and materials, and focus on reducing the environmental impacts of waste generation and waste management, thereby strengthening the economic value of waste.[118] Upon the European Parliament's approval of the Directive in June 2008, European Commissioner for the Environment at the time Stavros Dimas, expressed that "[the WFD] marks a shift in thinking about waste from an unwanted burden to a valued resource".[119] Building on the framework, that waste has value as a resource, this section compares and contrasts traditional approaches to deal with waste, such as incineration and more environmentally friendly advanced thermal treatments (i.e. gasification and pyrolysis) and their ability to recover energy (in the form of heat, electricity or fuel).

As discussed in section 1, pursuant to the revised WFD a municipal waste incineration plant has been reclassified to a recovery operation, if it generates energy and the plant meets the efficiency thresholds calculated using the "R1" formula.[120] To the recovery operation category are also allocated other technologies, such as pyrolysis and gasification using the components as chemicals ("R3"). However, in comparison with conventional MSW (municipal solid waste) incineration, pyrolysis treatment offers many advantages. Firstly, the quantities of nitrogen oxides ($NO_x$) and sulphur oxides ($SO_2$) produced during the pyrolysis process are much lower than with incineration. Secondly, the final products of pyrolysis are syngas, oils and chars, which can be recovered from the process and used as fuel. Finally, the greenhouse gas emissions from the pyrolysis process are reduced compared to incineration and the quality of the solid residues is enhanced.[121] In fact, the HERU technology is even more advanced than usual pyrolysis system which requires pre-treatment,[122] and which relies on direct heating techniques, such as electric heaters, heating with naked flames or exposure to hot media and involves very high temperature. The innovation of the HERU system is that efficient pyrolysis of waste is possible at low temperatures (below 300C) without the need of any pre-treatment of the waste prior to its

[115] Proposal (n. 5), Recital 4.

[116] BBC News, "Rejected recyclable waste up 84% in England since 2011, data shows" 23 August 2016. A BBC Freedom of Information request found councils were unable to recycle 338,000 tonnes of waste in 2014–2015 (in comparison with 2011–2012, where the figure was about 184,000 tonnes).

[117] WFD (n. 4). The WFD has introduced the concept of life-cycle thinking into waste policies. This approach gives a broader view of all environmental aspects and ensures any action has an overall benefit compared to other options.

[118] Recital 8 of WFD (n. 4).

[119] "Commission welcomes EP vote on revision of waste directive", *Europa*, 17 June 2008, IP/08/950.

[120] WFD, Annex II (n. 4). The R1 formula calculates the energy efficiency of the municipal solid waste incinerator and expresses it as a factor. This is based on the total energy produced by the plant as a proportion of the energy of the fuel (both traditional fuels and waste) which is incinerated in the plant. It can only be considered recovery if the value of this factor is above either 0.60 (permitted before 1 January 2009) or 0.65 for installations permitted after 31 December 2008.

[121] Dezhen Chen, Lijie Yin, Huan Wang, Pinjing He "Reprint of: Pyrolysis technologies for municipal solid waste: a review" (2015) 37 *Waste Manag*, pp. 116–136.

[122] Various procedures are normally required to prepare the waste prior its thermal treatment to ensure that the pyrolysis process will take place throughout the volume. A common practice is to separate the waste according to its moisture content, then dry the material and grind it into small pieces before placing it in the pyrolysis chamber. See Mohammad I. Jahirul, Mohammad G. Rasul, Ashfaque A. Chowdhury, Nanjappa Ashwath, "Biofuels production through biomass pyrolysis- A technological review" (2012) 5 *Energies* 5, 4952–5001; Zheng J, Jin Y-Q, Chi Y, Wen J-M, Jiang X-G, Ni M-J, "Pyrolysis characteristics of organic components of municipal solid waste at high heating rates" (2009) 29 *Waste Manag* 3, 1089–1094; Luo S, Xiao B, Hu Z, Liu S. "Effect of particle size on pyrolysis of single-component municipal solid waste in fixed bed reactor" (2010) 35 *Int J Hydrogen Energy*, 93–97; Abnisa F, Wan Daud WMA, "A review on co-pyrolysis of biomass: An optional technique to obtain a high-grade pyrolysis oil", (2014) 87 *Energy Convers Manag*, 71–85.

loading. The key feature of the unit is that the heat injection into the treated materials operates by providing a controlled working temperature rather than controlled heat fluxes. Further innovative aspects of this concept are that the use of heat pipe technology achieves high uniformity of heat distribution throughout the chamber volume as well as enabling high efficiency of energy recovery, which can further contribute to meeting the energy recovery targets.[123]

The "prevention" definition discussed in section 5.2 involves both quantitative and qualitative waste prevention. While a quantitative element is self-evident, as the HERU is capable to eliminate all unwanted domestic materials (except batteries) in the household, qualitative aspect requires further testing. To recall the qualitative requirement involves the reduction of the adverse impacts of generated waste on the environment and human health. The CJEU has held on several occasions that a substance or object is waste when a further treatment is required to ensure that the WFD objectives of the public health and environmental protection are met. As discussed above, the HERU technology does not require any further treatment. The system was assessed in the three rounds of tests with the same composition and weight of MSW.[124] According to the chemical analysis of the pyrolysis residues, no toxic elements were found in any of the tested materials. The main component of char was calcium, the fluid oil obtained from the initial stages of pyrolysis had a similar composition to that of water, while the dense oil produced during the final stage of the process showed traces of iron and a potential composition match to additive oils. The power consumption of the heat pipe based pyrolysis unit was similar to that of an electric oven, while the carbon emissions of the unit were slightly more than a microwave and lower than many household appliances.

Furthermore, the HERU technology can contribute to meeting the binding targets set by the Directive. For instance, due to the serious environmental impact landfill of waste can cause, the proposal to the Directive sets a new target to reduce landfill to maximum of 10 per cent of municipal waste by 2030.[125] The HERU, which uses a controllable and safe heat pipe technology to heat, decompose and transform the unwanted materials into synthesized gas (which is efficiently cleaned prior to venting to the atmosphere), can contribute to the diversion of biodegradable municipal waste away from landfill. This is because the HERU can effectively deal with waste "at source" (i.e. in households), removing a need for inefficient waste infrastructure (i.e. collecting, transporting, sorting, storing and processing waste). For instance, local authorities in the Member States may accumulate high environmental costs either transporting waste long distances to recycling facilities (i.e. if greenhouse gas emissions from the waste collective vehicles are taken into account) or recycling on a small scale that cannot outweigh the benefits of recycling. The HERU can eliminate these trade-offs. The initial tests of the HERU prototype showed that in order to treat 7 kilos of MSW 5.51 kWh of electricity is required; thus, approximately 0.78 kWh/kg of waste is consumed by the HERU unit. Treating unwanted domestic materials (save batteries) with the HERU technology can reduce the total $CO_2$ emissions production by approximately 60 per cent (58.88 per cent) enabling the Member States to meet the EU legal requirements.[126] Provided that the HERU was perfectly insulated and no heat losses were observed, the power consumption of the chamber would be around 3.5 kWh, leading to the total carbon footprint reduction of the waste management sector reaching up to 72.22 per cent.

Innovative technologies play a crucial role in waste management and can largely contribute to a circular economy model. Out-of-date technologies (i.e. incineration) currently appearing in the WFD do not fit neatly with the circular economy and life-cycle concept and should be rebalanced. The European Commission has to provide a European standard for waste derived fuels and champion further incentives for new technologies in the context of prevention. Therefore, the new innovative technologies, such as the HERU, which are in line with life-cycle thinking,[127] should move up the waste hierarchy to waste prevention.

## VI. Concluding Remarks

The EU recognises that turning waste into a resource is an essential part of increasing resource efficiency and closing the loop in a circular economy; in a circular economy there is no waste. While this is true,

[123] Or even renewable energy target, as defined in Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources, OJ L 140, 5.6.2009, p. 16–62 (i.e. a proposal the Commission published a proposal for a revised Renewable Energy Directive published on 30 November 2016). For instance, energy recovery from waste can play a role in meeting renewable energy objective. Given that these issues raise a different argument, they fall outside the scope of this article.

[124] See Section 4.

[125] Proposal for a Directive of the European Parliament and of the Council amending Directive 1999/31/EC on the landfill of waste COM(2015) 594 final.

[126] Defined in the Directive 2000/76/EC on the incineration of waste and Directive 2010/75/EU on industrial emissions, which establish the air emission limit values.

[127] Article 4(2) WFD allows specific waste streams to be departed from the waste hierarchy where this is justified by life-cycle thinking on the overall impacts on the generation and management of such waste. Yet, it does not prevent life-cycle thinking in the context of waste prevention.

# Waste Prevention and Technologies

there is a considerable distance to travel in achieving its full potential. Even though the WFD and its newest proposal have set a tone for waste prevention and moving up the waste hierarchy, the initiatives and support for strengthening waste resource efficiency have not been fully embraced. It is not clear how prevention operates in the context of the WFD, without further clarification on the classification of ''waste'' and ''non-waste'' (i.e. product). The WFD seems to be unbalanced and tilted towards regulation rather than prevention. Although the final arbiter is the CJEU, its approach leads to even further ambiguity, since it retains its assumption that the term ''waste'' must not be interpreted restrictively.[128] The court further emphasised that waste within the meaning of the Directive must be determined in the light of all the circumstances including the EU policy on the environment and the objectives of the WFD. This purposive test has become the benchmark against which objects and substances have been judged to verify whether they fall within the scope of ''waste''.

The CJEU's mandate to give a broad construction of ''waste'' is lost in translation, as it does not seem to reconcile with the WFD's tone to encourage waste prevention as a matter of policy and to minimise waste harmful consequences. The court's reluctance to reduce the ambit of the Directive accentuates its priority to the regulatory purpose of the WFD over its fundamental intention to prevent waste at all. Labelling waste merely according to disposal and recovery operations, especially by simply referring to Annexes, risks for it becoming over-inclusive. Therefore, the WFD should shed light on a ''non-waste'' status, for instance, through achieving other objectives of the directive, namely waste prevention and increasing resource efficiency by encouraging life circle thinking and closing the loop in a circular economy. The paper used the HERU, the Home Energy Recovery Unit, designed to process all domestic unwanted materials into clean energy to generate hot water or provide other options for energy conversions in the household as its case study. The heat pipe based pyrolysis used in the HERU technology provides a green solution to the disposal of municipal waste streams at-source simultaneously providing a sustainable, renewable solution to power generation. Certainly, these innovative technologies with individuals' waste prevention behaviour encouragement should find a new place in the WFD categorisation, moving up the waste hierarchy ladder to the waste prevention systems.

[128] Article 5 of WFD (n. 4).