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**Extended Producer Responsibility and its Role in
Facilitating a Circular Economy in the European Union:
An Analysis of Four Directives**

By

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A thesis submitted to the University of Birmingham for the
degree of

DOCTOR OF PHILOSOPHY

Birmingham Law School
College of Arts and Law
University of Birmingham
August 2023

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Abstract

Most economies are built on the linear 'take-make-use-throw' model of consumption, which has led to rising rates of production, consumption and waste. If not managed appropriately, high levels of waste represent both an environmental hazard and a loss of resources. Given this, the European Union (EU) has targeted the most ubiquitous and environmentally hazardous waste by Directives. Spanning waste batteries, vehicles, electrical and electronic equipment, and packaging, each of the Directives contain notions of Extended Producer Responsibility (EPR). This requires producers to maintain physical or financial responsibility over products throughout their life-cycle, although in practice, is often only implemented at a products end-of-life. In recent years however, impetus has been placed on the transition from a linear consumption model to one which is circular by design, termed the Circular Economy. This aims to prevent waste, keep products, components and materials at their highest utility value at all times and protect the environment. This study assesses whether existing EPR regulatory frameworks within the EU support circularity and found that the current regime does not do so.

Acknowledgements

My sincere thanks go to my supervisors, Prof. Aleksandra Čavoški, Dr. Walters Nsoh and Prof. Robert Lee, for your unwavering support and guidance throughout this journey. Likewise, I would like to thank my funders, the Faraday Institution, who allowed me to engage in this thesis. They stepped away from their traditional model of doctoral researchers, based in the sciences, to allow me as a legal researcher to pursue my passion for environmental protection.

However, it is my family who are owed the biggest of thanks as they are the people who have propelled me forward when this journey was often proving too difficult. Their love, support and belief have motivated me daily, and I owe this thesis to them. Lorna, my fiancé, has played a special role: she has listened to me rant and rave about the Circular Economy and Extended Producer Responsibility for five years. She believed I would complete this journey, and I'll forever be grateful for that and her unyielding love, support and encouragement. Likewise, thanks go to my Mum, Stepdad (as proofreading extraordinaire) and sister for always creating an environment where I could flourish, even when others thought I could not. Last but not least, Lorna's family (Trina, Malc, Pat and Georgia), from holidays to pubs, BBQs, cricket and football, you have provided me with a perfect excuse to escape the pressures of this journey, thank you; though, perhaps you are the reason this thesis has taken five years to complete

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Directives:

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Council Directive 1991/157/EEC of 18 March 1991 on batteries and accumulators containing certain dangerous substances [1991] OJ L 78

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Council Directive 2006/66/EC of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC [2006] OJ L 266

Council Directive 2008/98/EC of 19 November 2008 on waste and repealing certain Directives [2008] OJ L 312

Council Directive 2011/65/EU of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment [2011] OJ L 174/88

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Delegated acts:

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Agreements:

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The EU-UK Trade and Cooperation Agreement [2021] OJ L 149

Other:

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Acts of Parliament:

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Environmental Protection Act 1990

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Chapter 1: Introduction

Increasing economic activity is a core ambition of most governments.¹ However, economic growth is often associated with increased production and consumption of goods.² This is of growing concern, given that most economies are linear and operate on a 'take, make, use and throw' basis, resulting in the global observation of high resource depletion and waste generation.³ The production of goods has tripled over the last 50 years, leading to unsustainable levels of natural resources and material usage.⁴ Current estimates suggest that global consumption is occurring at a rate of '30% larger than nature's capacity to regenerate'.⁵ Likewise, waste generation is continuing to grow at alarming levels.⁶ In the European Union (EU), waste generation grew by 54% between 1980 to 2005 and now equals an average of 5.2 tonnes per inhabitant per year.⁷

¹ Ebru Topcu, Buket Altinoz and Alper Aslan, 'Global Evidence from the Link between Economic Growth, Natural Resources, Energy Consumption, and Gross Capital Formation' (2020) 66 Resources Policy 101622.

² Qingbin Song, Jinhui Li and Xianlai Zeng, 'Minimizing the Increasing Solid Waste through Zero Waste Strategy' (2015) 104 Journal of Cleaner Production 199; Eurostat, 'Ensure Sustainable Consumption and Production Patterns' (*Eurostat*, May 2021) <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=SDG_12_-_Responsible_consumption_and_production#Responsible_consumption_and_production_in_the_EU:_overview_and_key_trends> accessed 14 February 2022; European Commission, 'Waste Prevention and Management' (*European Commission*, 2021) <https://ec.europa.eu/environment/green-growth/waste-prevention-and-management/index_en.htm>; Richard Gardiner and Petr Hajek, 'Municipal Waste Generation, R&D Intensity, and Economic Growth Nexus – A Case of EU Regions' (2020) 114 Waste Management 124.

³ Gardiner and Hajek (n 2).

⁴ Jurgis Kazimieras Staniškis, 'Sustainable Consumption and Production: How to Make It Possible' (2012) 14 Clean Technologies and Environmental Policy 1015.

⁵ *ibid.*

⁶ European Commission, 'Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Identifying Member States at Risk of Not Meeting the 2025 Preparing for Re-Use and Recycling Target for Municipal Waste, the 2025 Recycling Target for Packaging Waste and the 2035 Municipal Waste Landfilling Reduction Target' COM (2023) 304 final.

⁷ Magnus Sjöström and Göran Östblom, 'Decoupling Waste Generation from Economic Growth — A CGE Analysis of the Swedish Case' (2010) 69 Ecological Economics 1545; Eurostat, 'Waste Statistics' (*Eurostat*, April 2021) <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics> accessed 15 February 2022.

Rising resource extraction and waste generation rates contribute to the degradation of the natural environment, and its effects can include high levels of water, soil and air contamination, which can contribute to climate change.⁸ The emissions of greenhouse gases have increased rapidly over past decades, causing experts to warn of changing hydrological cycles, warmer land, air and oceans, and extreme weather.⁹ Indeed, it has been argued that ‘45% of global emissions can only be tackled by changing how we make and consume products’.¹⁰ Similarly, ecosystems are also suffering due to the earth’s consumption patterns.¹¹ Within the EU, only 23% of *flora* and *fauna* species and 16% of habitats are now considered ‘in good health’.¹²

Despite advances in the end-of-life management of products, waste is still disposed of by environmentally damaging and resource-inefficient means, such as landfill and incineration.¹³ Consequently, countries need to ‘redress the balance in favour of the natural world’ by ‘maximising the value of the resources we use, minimise the waste we create, cut emissions, and help create a cleaner, greener, healthier planet’.¹⁴ In recent years, European waste law has sought to evolve from the sanitary management of waste towards resource

⁸ Gardiner and Hajek (n 2); Adama Onyanta, ‘Cities, Municipal Solid Waste Management, and Climate Change: Perspectives from the South’ (2016) 10 *Geography Compass* 499; Ayhan Demirbas, ‘Waste Management, Waste Resource Facilities and Waste Conversion Processes’ (2011) 52 *Energy Conversion and Management* 1280.

⁹ Jyoti Ahuja, Louis Dawson and Robert Lee, ‘A Circular Economy for Electric Vehicle Batteries: Driving the Change’ (2020) 12 *Journal of Property, Planning and Environmental Law* 235.

¹⁰ Waste and Resources Action Programme, ‘WRAP and the Circular Economy’ (WRAP, 2022) <<https://wrap.org.uk/taking-action/climate-change/circular-economy>>.

¹¹ Onyanta (n 8); Demirbas (n 8).

¹² World Wildlife Fund, ‘Biodiversity’ (*World Wildlife Fund*, 2020) <https://www.wwf.eu/what_we_do/biodiversity/> accessed 15 February 2022.

¹³ Eurostat, ‘Waste Statistics’ (n 7).

¹⁴ HM Government, ‘Our Waste, Our Resources: A Strategy for England’ (HM Government 2018) 4 (Ministerial Foreword).

efficiency and prevention.¹⁵ For example, the EU's Waste Framework Directive established a common framework for waste management by forwarding a hierarchy that ranks it in priority order.¹⁶ However, the EU have sought to go further by aspiring to transition from the current linear, 'take, make, use and throw' economy to one that is circular by design.¹⁷ *The Ellen MacArthur Foundation* contends that the Circular Economy is 'an economy that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility value at all times'.¹⁸ Given this, the goals of the Circular Economy is to prevent waste, keep products, components and materials at their highest utility value and regenerate nature.¹⁹ Thus, a Circular Economy strives to decouple 'economic activity from the consumption of finite resources' and is supported by a 'transition to renewable energy and materials'.²⁰

The EU has managed the highest polluting, ubiquitous or hard-to-collect products for over two decades by adopting legislation containing the Extended Producer Responsibility (EPR) principle, which aims to extend a producer's responsibility for their products to its whole life

¹⁵ European Commission, 'Ex-Post Evaluation of Five Waste Stream Directives' COM (2014) 397 final 3.

¹⁶ Council Directive 2008/98/EC of 19 November 2008 on waste and repealing certain Directive [2008] OJ L 312 (The Waste Framework Directive)(as amended) Art. 4 (1).

¹⁷ European Commission, 'A New Circular Economy Action Plan' COM (2020) 98 final; European Commission, 'Circular Economy Action Plan' (European Commission 2020) <https://ec.europa.eu/environment/pdf/circular-economy/new_circular_economy_action_plan.pdf> accessed 31 August 2021; Circular Online, 'European Commission Adopts New Circular Economy Action Plan' (*Circular Online*, 12 March 2020) <<https://www.circularonline.co.uk/news/european-commission-adopts-new-circular-economy-action-plan/>> accessed 19 March 2020; Ellen MacArthur Foundation, 'The EU's Circular Economy Action Plan' (*Ellen Macarthur Foundation*, 2020) <<https://www.ellenmacarthurfoundation.org/assets/downloads/EU-Case-Study-june2020-EN.pdf>> accessed 26 April 2021; HM Government, 'Our Waste, Our Resources: A Strategy for England' (n 14); Louis Dawson, "Our Waste, Our Resources; a Strategy for England"— Switching to a Circular Economy Through the Use of Extended Producer Responsibility' (2019) 21 *Environmental Law Review* 210.

¹⁸ Ellen MacArthur Foundation, 'What Is a Circular Economy?' (*Ellen MacArthur Foundation*, 2021) <<https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview>> accessed 18 February 2022.

¹⁹ *ibid.*

²⁰ *ibid.*

cycle.²¹ In practice, however, the EPR principle is often only implemented at the end-of-life phase of a products life cycle.²² This is because the EPR principle is not a policy instrument in itself and instead serves as a guiding principle to lawmakers. This means that the principle can be implemented to varying degrees through the selection of numerous policy instruments (EPR policy instruments), which can be set within one or multiple statutes. *The Organisation for Economic Co-Operation and Development (OECD)* notes that EPR policy instruments may include product take-back, economic and market-based measures, performance standards, and information-based measures.²³

1. Research Objective

As an early and prevalent adopter of the EPR principle, the EU's EPR framework targets waste batteries and accumulators, vehicles, packaging, and electrical and electronic equipment. These Directives were created before the widespread adoption of circular strategies and, as such, have since been revised to align with the EU's ambition to transition to a Circular Economy. Now, the *European Commission* contend that these Directives are 'more clearly oriented towards a Circular Economy'.²⁴ Despite this, no academic study has

²¹ European Commission, 'Ex-Post Evaluation of Five Waste Stream Directives' (n 15) 4; Daniel T Kaffine, P O'Reilly and Peter Börkey, 'What Have We Learned About Extended Producer Responsibility in the Past Decade? A Survey of the Recent Epr Economic Literature' (Organisation for Economic Co-Operation and Development 2015) ENV/EPOC/WPRPW(2013)7/FINAL; Katrien Steenmans and Rosalind Malcolm, 'Using Plastic Wastes to Exemplify Justice Dimensions of Extended Producer Responsibility' (2023) 04 *Advances in Environmental and Engineering Research* 024.

²² Steenmans and Malcolm (n 21).

²³ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: A Guidance Manual for Governments* (OECD Publishing 2001) <https://www.oecd-ilibrary.org/environment/extended-producer-responsibility_9789264189867-en> accessed 3 September 2020; Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (OECD Publishing 2016) <<https://www.oecd.org/env/extended-producer-responsibility-9789264256385-en.htm>> accessed 7 June 2023.

²⁴ European Commission, 'Ex-Post Evaluation of Five Waste Stream Directives' (n 15) 5.

comprehensively explored the connection between these Directives and the fulfilment of the EU's circular ambitions, with much of the existing literature instead focusing on the conceptualisation of the Circular Economy or the EPR principle.²⁵ The objective of this study is to assess the extent to which the EU's EPR regulatory frameworks supports the drive towards the Circular Economy in the EU.

2. Research Questions

On account of the above, the following substantive question arises:

Do existing EPR regulatory frameworks within the EU support circularity?

To guide the study further, the following subsidiary questions have been developed:

1. Has the EU's EPR frameworks resulted in the eco-design of products?
2. Has the EU's EPR frameworks increased product collection?
3. Once collected, has the EU's EPR frameworks kept products and their materials at their highest utility value?

3. Research Methods and Methodology

To answer these questions, this research will take a case study approach by comprehensively reviewing the EU's EPR regulatory frameworks to assess whether they

²⁵ *ibid.*

support circularity. For this research, the EU's EPR regulatory frameworks relates to the following:

1. The Waste Packaging Directive (94/62/EC) (as amended);
2. The End-of-Life Vehicles Directive (2000/53/EC) (as amended);
3. The Waste Electrical and Electronic Equipment Directive (2002/96/EC and later recast as 2012/19/EC (as amended)); and,
4. The Batteries Directive (2006/66/EC) (as amended).²⁶

To assess the Directives, the thesis takes a product lifecycle approach. Accordingly, the research critiques each of the Directive's design and end-of-life measures, as well as, for example, the implementation of financing and informative responsibilities, other economic instruments, export provisions and enforcement practices. Given that the EU's EPR regulatory frameworks take the legislative form of Directives and, it is, as discussed in Chapter 2, Section 3.5, left to the Member States to incorporate ('transpose') their measures into national law, the thesis will, where it is appropriate to do so, explore the United Kingdom's (UK) transpositions as an exemplar of how the Directives objectives and measures have been implemented.²⁷ This approach, which will further the analysis and critique of the Directives measures, has been adopted because of the authors familiarity with the UK's legal system, and an inability to thoroughly explore other Member State

²⁶ Council Directive 1994/62/EC of 20 December 1994 on packaging and packaging waste [1994] OJ L 365 (The Waste Packaging Directive) (as amended); Council Directive 2000/53/EC of 18 September 2000 on end-of-life vehicles [2000] OJ L 269/9 (The End-of-Life Vehicles Directive) (as amended); Council Directive 2002/96/EC of 27 January 2003 on waste electrical and electronic equipment [2002] OJ L 37/24 (The WEEE Directive) (as amended) (37 24); Council Directive 2012/19/EU of 4 July 2012 on waste electrical and electronic equipment [2012] OJ L 197/38 (The WEEE Directive (Recast)) (as amended); Council Directive 2006/66/EC of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC [2006] OJ L 266 (The Batteries Directive)(as amended).

²⁷ Stuart Bell and others, *Environmental Law* (9th edn, Oxford University Press 2017) 183.

transpositions owing to language barriers. Despite Brexit, the approach remains appropriate given that the UK retained EU law at the point that it left the EU; see Section 5 of this Chapter for a greater discussion on the ramifications of the UK's exit from the EU on this study. Notwithstanding the above, where it is both possible and appropriate to do so, this thesis will not exclude other Member State approaches to implementing the Directives measures, where it aids the study's learning.

Consequently, this thesis comprises doctrinal and comparative modes of study. The 'black letter' or doctrinal aspects will primarily focus on the law as written and, as a result, will consider primary sources of information.²⁸ In the main, these will include statutes, namely, the EU's EPR regulatory frameworks, consisting of the four waste Directives outlined above, and UK transpositions. Analysing the law as it is written is considered essential to this study to interpret, clarify and critique it to answer the research questions.²⁹ In order to do so, the law will need to be accessed before being interpreted and analysed.³⁰ Notably, however, this aspect of the study will not exclude secondary sources of information pertinent to contextualising or demonstrating the law and its outcomes. Doctrinal research has often been criticised for its propensity to lead to analysis from an 'objective viewpoint'.³¹ In acknowledging this, the thesis will adopt a policy approach whereby it frames and synthesises the evidence pragmatically.³² In doing so, it is anticipated that this study will

²⁸ Terry Hutchinson and Nigel Duncan, 'Defining and Describing What We Do: Doctrinal Legal Research' (2012) 17 *Deakin L. Rev.* 83.

²⁹ Mike McConville and Wing Hong (Eric) Chui, *Research Methods for Law* (2nd edn, Edinburgh University Press 2017) 4 <<http://ebookcentral.proquest.com/lib/bham/detail.action?docID=5013854>> accessed 4 March 2022.

³⁰ *ibid* 18.

³¹ *ibid* 36.

³² Paul Cairney and Richard Kwiatkowski, 'How to Communicate Effectively with Policymakers: Combine Insights from Psychology and Policy Studies' (2017) 3 *Palgrave Communications* 37.

likely impact law, policy and academic understanding by offering considered conclusions to the aforementioned research questions.

The comparative aspect of this research will be used, as *Lengrand* noted, to ‘critically illuminate’ legal systems.³³ At the basic level, a comparative study can explore the similarities and differences between multiple laws or legal systems.³⁴ Despite ‘very little systematic writing about the method of comparative study’, this research will compare the four case study Directives to assess whether the EU’s EPR regulatory frameworks supports circularity.³⁵ In doing so, the study will draw lessons from each of the Directives analysed in this thesis, taking account of their particular characteristics and for this reason, the thesis’ chapters each comprise a similar structure to aid comparative opportunities. Such an approach is anticipated to provide greater scrutiny of the Directives and ensure sound conclusions on the research question.³⁶

Despite gaining traction in recent years, the Circular Economy and the EPR principle, remain under-researched within the legal discipline. Whilst some academics have researched the EU’s EPR Directives individually, no such study has explored the extent to which the EU’s EPR frameworks promotes circularity.³⁷ Indeed, the author of this study has contributed to the body of research assessing individual Directives, namely the Batteries Directive, and

³³ Pierre Legrand, ‘Comparative Legal Studies and Commitment to Theory’ (1995) 58 *The Modern Law Review* 262.

³⁴ Edward J Eberle, ‘The Method and Role of Comparative Law’ (2009) 8 *Washington University global studies law review* 451.

³⁵ Konrad Zweigert, Hein Kotz and Susan Millns, ‘An Introduction to Comparative Law, 3rd Edition’ (1999) 48 *International and comparative law quarterly* 982.

³⁶ McConville and Chui (n 29) 163.

³⁷ For example, see: Thomas Lindhqvist, ‘Policies for Waste Batteries’ (2010) 14 *Journal of Industrial Ecology* 537; Robert Lee, ‘Marketing Products under the Extended Producer Responsibility Framework: A Battery of Issues’ (2008) 17 *Review of European Community & international environmental law* 298.

these co-authored works have been included in the appendix of this thesis. Both of these articles were written as part of this thesis' original research, and as a result, they are referred to in the text below as a means of aiding discussion. Note, however, that where the author of this thesis is not listed as the publication's 'first author', an equal and thus significant contribution was made to that of the first author.

The published works are as follows:

- Appendix 1: Ahuja J, Dawson L and Lee R, 'A Circular Economy for Electric Vehicle Batteries: Driving the Change' (2020) 12 Journal of Property, Planning and Environmental Law 235.³⁸
- Appendix 2: Dawson L, Ahuja J and Lee R, 'Steering Extended Producer Responsibility for Electric Vehicle Batteries' (2021) 23 (2) Environmental Law Review 128.³⁹

4. Study Rationale

The highest polluting, ubiquitous and hard-to-collect products are managed within the EU by implementing the EPR principle. However, despite individual studies on the EPR principle and the Circular Economy, no such study has comprehensively examined the EU's implementation of the EPR principle and the extent to which they facilitate a Circular

³⁸ Ahuja, Dawson and Lee (n 9).

³⁹ Louis Dawson, Jyoti Ahuja and Robert Lee, 'Steering Extended Producer Responsibility for Electric Vehicle Batteries' (2021) 23 Environmental Law Review 128.

Economy in the EU.⁴⁰ The realisation of circularity is essential, given the waste, resource, climate and other environmental pressures that the EU faces. It is hoped that this research will contribute to the advancement of a Circular Economy in the EU by providing sound conclusions.

5. Limitations

Significantly, there are around 400 examples of global implementation of the EPR principle.⁴¹ This study is concerned with the EU's EPR frameworks, and as a result, it does not explore implementation of the EPR principle outside of the EU, other than, for the reasons noted in Section 3 of this chapter, the former EU Member State, the UK. Likewise, although this research considers export, it does not intend to engage with the global conception of the Circular Economy and any justice dimensions in non-EU countries and the UK. Nonetheless, it is acknowledged that further study on global implementation of the EPR principle and the extent to which it invokes circularity could be warranted in the future to garner further learning. Additionally, it is important to note at this stage, that this area of law and policy is evolving at pace. The study, therefore, focuses on the four EU waste Directives in force between November 2018 and January 2023. Where possible, the study has been updated to reflect upcoming changes, particularly regarding the EU's repeal of the batteries, end-of-life vehicles and waste packaging Directives and their replacements via Regulation.

⁴⁰ Kieran Campbell-Johnston and others, 'Future Perspectives on the Role of Extended Producer Responsibility within a Circular Economy: A Delphi Study Using the Case of the Netherlands' (2021) 30 *Business Strategy and the Environment* 4054.

⁴¹ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23).

The study occurred during a tumultuous period for the EU and the UK owing to Brexit. This research was conceptualised and commenced in 2018, and at that point, the UK was a Member State of the EU. Given this, it was deemed appropriate at the outset of this research for the thesis to use UK transpositions as an exemplar of the way in which each of the analysed Directive's objectives and measures had been implemented. However, the UK withdrew from the EU in January 2020 and entered a transitional arrangement governed by a Withdrawal Agreement until December 2020.⁴² During the transitional period, the EU primarily treated the UK as a 'Member State'. Nonetheless, upon the expiry of this period, the UK and the EU's transitional arrangements were replaced with a Trade and Cooperation Agreement (TCA).⁴³ The UK is now a third country but has retained all EU laws to maintain legal continuity.⁴⁴ Brexit has undoubtedly been a complicating factor in how, and to what extent, the research has considered and interacted with the UK.

6. Structure of Thesis

Chapter 2 introduces the theoretical and policy concepts of both the Circular Economy and the EPR principle. At the outset, it will initially explore the Circular Economy's historical and theoretical underpinning as well as assess its policy adoption. This will lead to a similar assessment of the theory and the EPR principle, before examining the principle's implementation through EPR policy instruments. *The OECD*, as previously explained, notes

⁴² Agreement on the withdrawal of the United Kingdom of Great Britain and Northern Ireland from the European Union and the European Atomic Energy Community [2019] OJ C 384/1; European Union (Withdrawal) Act 2018.

⁴³ The EU-UK Trade and Cooperation Agreement [2021] OJ L 149.

⁴⁴ European Union (Withdrawal) Act 2018.

that the EPR principle is typically implemented through a mix of EPR policy instruments, including product take-back requirements, economic and market-based instruments, regulations, performance standards, and information-based instruments, and these will be assessed in turn.⁴⁵ The chapter will thereafter consider the EPR principle, and its implementation, in the EU before concluding.

Chapter 3 instigates the substantive analysis of the four EU Directives that are to be assessed by this thesis. This analysis will commence with the Batteries Directive before successively analysing the End-of-life Vehicles Directive, Waste Electrical and Electronic Equipment Directive and Waste Packaging Directive. Each of these chapters will be comprised of a similar structure so as to aid analysis and comparative opportunities. Nevertheless, a detailed summary of the contents of each chapter is provided below.

Chapter 3 assesses the Batteries Directive and the extent to which it supports circularity. Initial research has identified a world that is diversifying and increasing its use of large industrial, automotive, and smaller portable batteries.⁴⁶ In particular, it has noted the electrification of vehicles and the impending rise in the disposal of increasingly large lithium-ion batteries.⁴⁷ Batteries contain a mixture of potentially toxic and critical or rare earth materials, and their sound management is considered critical.⁴⁸ Therefore, the chapter will initially summarise the Directive before examining its design and end-of-life management provisions. This will lead to an assessment of the Directive's measures on export,

⁴⁵ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23).

⁴⁶ The Batteries Directive.

⁴⁷ Dawson, Ahuja and Lee (n 39); Ahuja, Dawson and Lee (n 9).

⁴⁸ Dawson, Ahuja and Lee (n 39); Ahuja, Dawson and Lee (n 9).

enforcement and economic instruments. Lastly, the chapter will briefly outline the core provisions of the newly proposed 'Batteries Regulation'.

Following this, the 4th Chapter will assess the End-of-life Vehicles Directive and the extent to which it supports the circularity of end-of-life vehicles.⁴⁹ Housing a mixture of hazardous as well as valuable materials, end-of-life vehicles have an average lifespan of 13.9 to 22 years, and their design and management can be complex.⁵⁰ Using the same framework outlined above, the chapter will first summarise the Directive before assessing its design and end-of-life provisions. After that, the chapter will assess the Directive's export, end-user information, and further economic and enforcement measures. Before concluding, the chapter will outline the EU's proposal to repeal and replace the Directive with a Regulation.

The 5th Chapter will follow a similar framework to the substantive chapters outlined above by assessing the Waste Electrical and Electronic Equipment Directive and the extent to which it invokes circularity.⁵¹ Given the growing importance of such equipment, the original Directive was 'recast' in 2012, though it kept much of its main provisions.⁵² Initial research noted that electrical and electronic equipment waste, which can contain up to 60 metals, is the fastest-growing waste stream globally.⁵³ At the outset, this chapter will provide a summary of the Directive before assessing its design and end-of-life measures. After that, it

⁴⁹ The End-of-Life Vehicles Directive.

⁵⁰ Monika Kosacka-Olejnik, 'How Manage Waste from End-of-Life Vehicles? - Method Proposal' (2019) 52 IFAC-PapersOnLine 1733; European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' SWD (2021) 60 Final.

⁵¹ The WEEE Directive (Recast).

⁵² *ibid.*

⁵³ Christine Cole and others, 'An Assessment of Achievements of the WEEE Directive in Promoting Movement up the Waste Hierarchy: Experiences in the UK' (2019) 87 Waste Management 417.

will assess the Directive's export, end-user information, further economic instruments, and enforcement measures, before concluding.

The next chapter, Chapter 6, analyses the extent to which the Waste Packaging Directive, the oldest Directive assessed by this thesis, supports circularity.⁵⁴ To maintain comparative opportunities, this chapter will again follow the same framework as detailed in the previous chapter summaries. In doing so, it will initially summarise the Directive before analysing its design and end-of-life measures. The chapter will then analyse the Directive's export, end-user information, further economic instruments and enforcement measures. As with Chapters 3 and 4, the chapter will summarise the EU's proposals to repeal and replace the Directive with a Regulation.

Chapter 7 concludes this thesis and will initially provide an overview of the study. After that, the chapter will answer both the primary and subsidiary research questions. The thesis concludes that although the EU's EPR frameworks have increased the collection and recycling of targeted products, it has not sufficiently supported the advance towards a Circular Economy.

⁵⁴ Onwughara Innocent Nkwachukwu and others, 'Focus on Potential Environmental Issues on Plastic World towards a Sustainable Plastic Recycling in Developing Countries' (2013) 4 International Journal of Industrial Chemistry 34.

Chapter 2: An Introduction to the Circular Economy and Extended Producer Responsibility

1. Introduction

Economic growth, a key goal for most governments, is typically coupled with the increased production and consumption of goods.⁵⁵ This is concerning as most economies are linear and based on the premise of 'take, make, use and throw'.⁵⁶ Increased production and consumption rates can result in environmental degradation due to the excessive exploitation of natural resources and large quantities of waste.⁵⁷ In the last 20 years, production and consumption patterns have seen an eight-fold increase, leading some to suggest that there is now a waste and resource crisis.⁵⁸

The transition from a linear consumption model to one which is circular by design has been forwarded to reduce environmentally damaging resource extraction and waste.⁵⁹ The Circular Economy goals are to prevent waste, keep resources at their highest utility value at all times by allowing resources to travel in a continuously looped cycle, and allow nature to

⁵⁵ United Nations, 'UN Sustainable Development Goals' (*United Nations*) <<https://www.un.org/sustainabledevelopment/sustainable-consumption-production/>> accessed 7 February 2022; United Nations Environment Programme Sustainable Consumption, 'Decoupling Natural Resource Use and Environmental Impacts from Economic Growth' (United Nations Environment Programme Sustainable Consumption 2011) <<https://www.resourcepanel.org/reports/decoupling-natural-resource-use-and-environmental-impacts-economic-growth>> accessed 3 February 2022.

⁵⁶ Sveinung Jørgensen and Lars Jacob Tynes Pedersen, 'The Circular Rather than the Linear Economy', *RESTART sustainable business model innovation* (Springer 2018).

⁵⁷ Nora Haenn, Allison Harnish and Richard Wilk (eds), *The Environment in Anthropology (Second Edition): A Reader in Ecology, Culture, and Sustainable Living* (NYU Press 2016) 140.

⁵⁸ Bjoern Jaeger and Arvind Upadhyay, 'Understanding Barriers to Circular Economy: Cases from the Manufacturing Industry' (2020) 33 *Journal of Enterprise Information Management* 729; Katrien Steenmans, 'Brexit and Circular Economy Law: Challenges and Opportunities' [2020] *Coventry Law Journal* 25.

⁵⁹ Dawson (n 17).

regenerate.⁶⁰ Extended Producer Responsibility (EPR), which predates the drive to circularity, is touted as a principle that may effectuate Circular Economy goals. With over 400 operational schemes globally, the EPR principle aims to extend a producer's responsibility for their products to its whole life cycle, although implementation of the principle often only focuses on a product's end-of-life management.⁶¹ The *Ellen MacArthur Foundation*, a foundation that seeks to lobby for an accelerated transition from a linear economy to one which is circular, notes the 'collection, sorting, and recycling [...] of products] typically costs more to do than the money it makes' and as such, the implementation of the EPR principle 'is the only proven and likely way to provide funding that is dedicated, ongoing and sufficient'.⁶²

Initially, this chapter will examine the concept of the Circular Economy by exploring its roots, theoretical framework and adoption. The chapter will also introduce the EPR principle as a potential circular driver by examining its conceptualisation and theoretical foundation before exploring its implementation. This section will explore the implementation of the EPR principle within the EU before offering concluding remarks.

2. The Circular Economy

⁶⁰ *ibid*; Ellen MacArthur Foundation, 'Towards a Circular Economy: Business Rationale for an Accelerated Transition' (Ellen MacArthur Foundation 2015) <https://www.ellenmacarthurfoundation.org/assets/downloads/publications/TCE_Ellen-MacArthur-Foundation_26-Nov-2015.pdf> accessed 22 April 2021.

⁶¹ Dawson, Ahuja and Lee (n 39).

⁶² Ellen MacArthur Foundation, 'Extended Producer Responsibility: A Necessary Part of the Solution to Packaging Waste and Pollution' (*Ellen MacArthur Foundation*, 2021) <<https://plastics.ellenmacarthurfoundation.org/epr>> accessed 3 February 2022.

The modern theory of the Circular Economy is not new but rather a reframing of existing individual concepts.⁶³ Describing a ‘cowboy economy’ obsessed with consumption and pollution, *Kenneth Boulding’s* ‘The Economics of the Coming Spaceship Earth’ acknowledged the earth’s need for a symbiotic relationship between man and the environment.⁶⁴ Here, *Boulding* theorised a ‘spaceship economy’ where ‘man must find [...] [a] place in a cylindrical ecological system capable of continuous reproduction of material form’.⁶⁵ *Pearce and Turner* built on *Boulding’s* work by assessing the linear, open-ended economy.⁶⁶ They considered the unsustainability of the natural world, which acts as a source of material that drives production and consumption processes as well as a waste outlet.⁶⁷ Given this, the authors proposed a new economic model of consumption, termed the Circular Economy.⁶⁸ Together, these works influenced *Stahel and Reday-Mulvey’s* industrial economics research that conceptualised looped industrial strategies to increase resource efficiency and prevent waste whilst increasing jobs.⁶⁹ Since this conceptualisation, the Circular Economy has continued to evolve and has been theoretically influenced by several different ‘schools of thought’.⁷⁰ These included cradle-to-cradle, looped and performance

⁶³ Denise Reike, Walter JV Vermeulen and Sjors Witjes, ‘The Circular Economy: New or Refurbished as CE 3.0? — Exploring Controversies in the Conceptualization of the Circular Economy through a Focus on History and Resource Value Retention Options’ (2018) 135 *Resources, Conservation and Recycling* 246.

⁶⁴ Martin Geissdoerfer and others, ‘The Circular Economy – A New Sustainability Paradigm?’ (2017) 143 *Journal of Cleaner Production* 757.

⁶⁵ Kenneth Boulding, ‘The Economics of the Coming Spaceship Earth’ in Henry Jarrett (ed), *Environmental Quality in a Growing Economy: Essays from the Sixth RFF Forum* (Resources for the Future 1966) 7–8.

⁶⁶ David Pearce and Kerry Turner, ‘Economics of Natural Resources and the Environment’ (1991) 73 *American Journal of Agricultural Economics* 378; Geissdoerfer and others (n 64).

⁶⁷ Pearce and Turner (n 66); Geissdoerfer and others (n 64); Vasileios Rizos, Katja Tuokko and Arno Behrens, ‘The Circular Economy: A Review of Definitions, Processes and Impacts’ [2017] IDEAS Working Paper Series from RePEc.

⁶⁸ Pearce and Turner (n 66); Geissdoerfer and others (n 64); Rizos, Tuokko and Behrens (n 67).

⁶⁹ Walter Stahel and Geneviève Reday-Mulvey, *The Potential for Substituting Manpower for Energy: Final Report 30 July 1977 for the Commission of the European Communities* (Battelle, Geneva Research Centre 1977) <<https://books.google.co.uk/books?id=RTTzMgEACAAJ>>; Geissdoerfer and others (n 64).

⁷⁰ Ellen MacArthur Foundation, ‘Schools of Thought’ (*Ellen MacArthur Foundation*, 2017) <<https://www.ellenmacarthurfoundation.org/circular-economy/concept/schools-of-thought>> accessed 9 July 2021.

economy, biomimicry and blue economy concepts.⁷¹ The cradle-to-cradle concept, the most known influence on the Circular Economy, seeks to create a waste-free economy by using products or product materials and components regeneratively without reducing the quality of materials.⁷²

The Circular Economy has yet to achieve its authoritative or accepted definitional form, and as such, it lacks conceptual clarity.⁷³ *Adams and Others* contend that the lack of an accepted definition has caused the concept to evolve, which has hindered its adoption.⁷⁴ Given this, *Kirchherr and others* analysed 114 Circular Economy definitions and used this data to subsequently term the concept as:

‘an economic system that is based on business models which replace the “end-of-life” concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations’.⁷⁵

⁷¹ *ibid.*

⁷² Jaeger and Upadhyay (n 58).

⁷³ Eléonore Maitre-Ekem, ‘Re-Thinking Producer Responsibility for a Sustainable Circular Economy from Extended Producer Responsibility to Pre-Market Producer Responsibility’ (2021) 286 *Journal of Cleaner Production* 125454; Reike, Vermeulen and Witjes (n 63).

⁷⁴ Katherine Tebbatt Adams and others, ‘Circular Economy in Construction: Current Awareness, Challenges and Enablers’ (2017) 170 *Proceedings of the Institution of Civil Engineers - Waste and Resource Management* 15.

⁷⁵ Julian Kirchherr and others, ‘Barriers to the Circular Economy: Evidence From the European Union (EU)’ (2018) 150 *Ecological Economics* 264.

However, the *Ellen MacArthur Foundation* defines the Circular Economy as ‘an economy that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility value at all times’.⁷⁶ It therefore contends that the key goals of the Circular Economy is to (1) reduce waste by designing and disposing of products, components and materials in an environmentally conscious manner; (2) keep products, components and materials at their highest utility value at all times; and, (3) protect the environment to allow nature to regenerate.⁷⁷ Given this, a Circular Economy, as an alternative to the traditional and current linear model of ‘take, make, use and throw’, is a systemic economic business model that aims to create an economy which prevents waste by eco-designing products, collecting them at the end of their life, and circulating them, and their materials or components, at their highest utility value at all times (see Figure 1) as a means of protecting the environment and allowing nature to regenerate.⁷⁸ Preventing waste (1) and keeping products, components and materials at their highest utility value at all times (2) will likely lead to greater environmental protection (3).

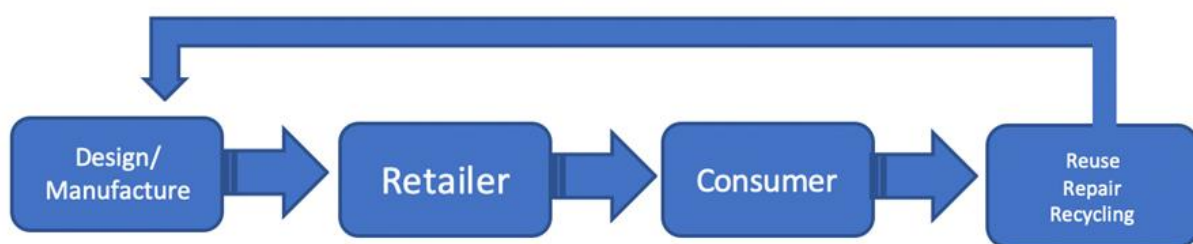


*Figure 1: Simple depiction of a Circular Economy*⁷⁹

⁷⁶ Ellen MacArthur Foundation, ‘Towards a Circular Economy: Business Rationale for an Accelerated Transition’ (n 60).

⁷⁷ Ellen MacArthur Foundation, ‘What Is a Circular Economy?’ (n 18).

⁷⁸ Dawson (n 17).

⁷⁹ Ahuja, Dawson and Lee (n 9).

Considering the above, the Circular Economy is more holistic than described by *Ghisellini and others*, who note that the concept is merely an efficient waste management tool.⁸⁰ This is because a Circular Economy needs to reduce waste, drive greater resource productivity, stimulate a competitive economy, redress resource scarcity, and reduce the environmental impacts of production and consumption to be successful.⁸¹ As a result, the Circular Economy can promote the environmentally conscious design and production of products and help citizens consume and dispose of them consciously.⁸² To do so, waste should be designed out by increasing the collection, treatment and circular management of goods, including their repair, remanufacture, reuse and recycling. *Stahel* also suggests that a Circular Economy should champion sustainable ownership of goods by promoting alternative selling techniques.⁸³ By way of example, *Ahuja, Dawson and Lee*, conceptualised a Circular Economy model for electric vehicles that relied on the leasing of lithium-ion batteries, see Appendix 1.⁸⁴

To incentivise the transition from linear to circular, European governments have increasingly employed the EPR principle ‘as the only proven and likely way to provide funding that is dedicated, ongoing and sufficient’ to collect, treat and reuse or recycle end-of-life products and incentivise their eco-design; a detailed introduction to the EPR principle is provided in

⁸⁰ Patrizia Ghisellini, Catia Cialani and Sergio Ulgiati, ‘A Review on Circular Economy: The Expected Transition to a Balanced Interplay of Environmental and Economic Systems’ (2016) 114 *Journal of Cleaner production* 11.

⁸¹ The Waste and Resources Action Programme, ‘WRAP and the Circular Economy’ (WRAP, 2021) <<https://wrap.org.uk/about-us/our-vision/wrap-and-circular-economy#>>.

⁸² *ibid.*

⁸³ Walter Stahel, ‘The Product Life Factor’ [1982] *An Inquiry into the Nature of Sustainable Societies: The Role of the Private Sector* (Series: 1982 Mitchell Prize Papers), NARC 74.

⁸⁴ *Ahuja, Dawson and Lee* (n 9).

Section 3 of this chapter.⁸⁵ However, a Circular Economy can also be constructed with the help of so-called ‘R-hierarchies’.⁸⁶ Initially, this revolved around the premise of ‘reduce, reuse and recycle’, although in recent years, this has expanded to include up to ten ‘R’s’, some of which have been detailed above, including ‘repair’, ‘remanufacture’ and ‘repurpose’.⁸⁷ *Campbell and others* contend that such hierarchies can ‘cascade’ and is a ‘method of retaining the added value of materials [for] as long as possible’ by ‘sequential use of resources for different purposes, usually (or ideally) through multiple materials re(use) phases before energy extraction/recovery operations’.⁸⁸

However, the Circular Economy concept is not without its critics. Here, *Corvellec, Stowell and Johansson* note that advocates of the Circular Economy are deliberately vague when defining it, and in doing so they are ‘approbatory, uncritical, descriptive and deeply normative’.⁸⁹ It is also argued that ‘conflicts, trade-offs, and problems of leaving the linear economy are overlooked’.⁹⁰ Moreover, *Gregson and others* position the potential for decoupling economic growth from consumption and environmental degradation as a ‘myth’.⁹¹ This is despite a 2011 report by the *EU Environment Programme* on ‘Decoupling Natural Resources Use and Environmental Impacts from Economic Growth’, which found

⁸⁵ Ellen MacArthur Foundation, ‘Extended Producer Responsibility: A Necessary Part of the Solution to Packaging Waste and Pollution’ (n 62).

⁸⁶ Kirchherr and others (n 75); Reike, Vermeulen and Witjes (n 63); Kieran Campbell-Johnston and others, ‘The Circular Economy and Cascading: Towards a Framework’ (2020) 7 *Resources, Conservation & Recycling*: X 100038.

⁸⁷ Kirchherr and others (n 75); Campbell-Johnston and others (n 86); *ibid.*

⁸⁸ Campbell-Johnston and others (n 86).

⁸⁹ Hervé Corvellec, Alison F Stowell and Nils Johansson, ‘Critiques of the Circular Economy’ (2022) 26 *Journal of Industrial Ecology* 421.

⁹⁰ *ibid.*

⁹¹ Nicky Gregson and others, ‘Interrogating the Circular Economy: The Moral Economy of Resource Recovery in the EU’ (2015) 44 *Economy and society* 218.

that although not absolute, circular application has partially decoupled economic growth from consumption and environmental degradation.⁹²

Notwithstanding the above, this research adopts the *Ellen Macarthur Foundation's* definition and associated goals of a Circular Economy; namely to create 'an economy that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility value at all times'.⁹³ This definition, and its associated goals to (1) reduce waste by disposing of products, components and materials in an environmentally conscious manner; (2) keep products, components and materials at their highest utility value at all times; and, (3) protect the environment to allow nature to regenerate, has been adopted as it is compressive, meaning that it places emphasis on both design and the subsequent management of end-of-life products and their materials as a means of achieving environmental protection. This is considered important, and deemed appropriate, for the product/waste streams (batteries, vehicles, electrical and electronic equipment and packaging) analysed by this thesis, given that such products are ubiquitous in nature and contain valuable and/or environmentally hazardous materials, many of which have been traditionally landfilled or incinerated. Additionally, the *Ellen Macarthur Foundation* is a 'global thought leader, establishing the [C]ircular [E]conomy on the agenda of decision makers across business, government and academia'.⁹⁴ It is anticipated, in adopting this

⁹² Reike, Vermeulen and Witjes (n 63); United Nations Environment Programme Sustainable Consumption (n 55).

⁹³ Ellen MacArthur Foundation, 'Towards a Circular Economy: Business Rationale for an Accelerated Transition' (n 60).

⁹⁴ Paul Ekins and others, 'The Circular Economy: What, Why, How and Where' (UCL Institute for Sustainable Resources, University College London 2019) 9 <<https://www.oecd.org/cfe/regionaldevelopment/Ekins-2019-Circular-Economy-What-Why-How-Where.pdf>> accessed 6 February 2024; David Lazarevic and Helena Valve, 'Narrating Expectations for the Circular Economy: Towards a Common and Contested European Transition' (2017) 31 Energy Research & Social Science 60.

definition, that the thesis will be of increased importance on an applied, as well as academic, level.

2.1. Transitioning to a Circular Economy in the EU

No economy is fully circular, and as a result, the concept is still in its infancy.⁹⁵ Despite this, China is at the forefront of policy development after they enacted their 'Cleaner Production Promotion Law' in 2002.⁹⁶ The law established the country's ambition to transition from linear to circular by focusing on resources.⁹⁷ Since then, the country has sought to continue their development of advanced Circular Economy policies.⁹⁸ The most significant of these was the 2009 'Circular Economy Promotion Law' that promoted resource efficiency and environmental protection by reducing waste and incentivising reuse and recycling.⁹⁹ A full assessment of such policies is not within the scope of this thesis, though it is noted that more research on the Chinese and, indeed, worldwide application of circular policies is needed.

Compared to China, the EU did not signal a firm intention to move towards a Circular Economy until 2014.¹⁰⁰ Nevertheless, this intention was the culmination of the EU's rich history of environmental protection, first afforded by the 1987 Single European Act, which amended Part 3 of the Treaty establishing the European Economic Community (Treaty of

⁹⁵ Kirchherr and others (n 75).

⁹⁶ Cleaner Production Promotion Law 2002 (China) 2002.

⁹⁷ *ibid.*

⁹⁸ Circular Economy Promotion Law 2009 (China) 2009; Kirchherr and others (n 75).

⁹⁹ Circular Economy Promotion Law 2009 (China); Kirchherr and others (n 75).

¹⁰⁰ European Commission, 'Towards a Circular Economy: A Zero Waste Programme for Europe' COM (2014) 398 final.

Rome (EEC)) to include an ‘environment’ title.¹⁰¹ This title positioned the ‘prudent and rational utilization of resources’ (now Article 191 of the Treaty on the Functioning of the European Union) as a guiding principle, thus providing the legal basis for protecting resources as well as the wider environment within the EU.¹⁰² Against this backdrop, the EU’s ‘Europe 2020 Strategy’ promoted ‘a more resource efficient, greener and more competitive economy’ to achieve ‘sustainable growth’ in 2010 and, in doing so, designated ‘resource efficiency’ as one of seven flagship projects.¹⁰³ Termed ‘Resource Efficient Europe’, the project aimed to ‘help decouple economic growth from the use of resources, support the shift towards a low carbon economy, increase the use of renewable energy sources, modernise [...] [the] transport sector and promote energy efficiency’.¹⁰⁴ This later provided for the introduction of a ‘Roadmap to a Resource Efficient Europe’ in 2011, which aimed for the EU’s economy to have ‘grown in a way that respects resource constraints and planetary boundaries’ by 2050.¹⁰⁵ As part of this strategy, the *European Commission* highlighted the need for ‘sustainable consumption and production’ by, for example, ‘improving products and changing consumption patterns’ and ‘turning waste into a resource’.¹⁰⁶

In 2014, the *European Commission* published ‘Towards a Circular Economy: a zero-waste Programme for Europe’, which established a framework for transitioning from a linear

¹⁰¹ Single European Act [1987] OJ L 169/30 Art. 25; Treaty establishing the European Economic Community (EEC Treaty) [1958]; Bell and others (n 27) Ch 6. Art. 25 amended ‘Part Three’ of the EEC Treaty and provided for Art. 130r, establishing environmental objectives.

¹⁰² Consolidated Version of the Treaty on European Union [2008] OJ C115/13 (TFEU) Art. 191.

¹⁰³ European Commission, ‘Europe 2020 - a Strategy for Smart, Sustainable and Inclusive Growth’ COM (2010) 2020 3–4.

¹⁰⁴ *ibid* 4.

¹⁰⁵ European Commission, ‘Roadmap to a Resource Efficient Europe’ COM (2011) 571 final S 2.

¹⁰⁶ *ibid* 3.1.

economy to a Circular Economy.¹⁰⁷ Here, the *European Commission* introduced a range of policy ideas, such as green entrepreneurship and employment, as well as encouraging sustainable building, eco-design and reductions in greenhouse gas emissions.¹⁰⁸ Most notably, however, the *European Commission* focused much of its attention on recycling and preventing the loss of valuable materials, and in doing so, it targeted the doubling of resource productivity (Gross Domestic Product (GDP) relative to consumption of raw materials) by 2030. This was accompanied by a legislative proposal that sought to amend six waste Directives, including the Waste Framework Directive (2008/98/EC), Waste Packaging Directive (94/62/EC), Landfill Directive (1991/31/EC), End-of-life Vehicles Directive (2000/53/EC), Batteries Directive (2006/66/EC) and Waste Electric and Electrical Equipment (WEEE) Directive (2012/19/EC).¹⁰⁹ Though the proposal primarily sought to uplift existing targets, it also sought to simplify reporting obligations and set 'minimum operating conditions' for the application of the EPR principle.¹¹⁰ The overarching strategy and accompanying legislative proposals were termed the 'Circular Economy Package', although the *European Commission* withdrew this package in 2014 (the same year it was published) to provide a basis for 'more ambitious' measures.¹¹¹

¹⁰⁷ Consolidated Version of the Treaty on the Functioning of the European Union [2012] OJ C326/47 (TFEU) Art 191; European Commission, 'Roadmap to a Resource Efficient Europe' (n 105); European Commission, 'Towards a Circular Economy: A Zero Waste Programme for Europe' (n 100).

¹⁰⁸ Ellen MacArthur Foundation, 'The EU's Circular Economy Action Plan' (n 17).

¹⁰⁹ European Commission, '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' COM (2014) 397 final.

¹¹⁰ *ibid* 3.1.

¹¹¹ Sara Priestley, 'EU Circular Economy Package' (House of Commons Library 2015) Research Briefing <<https://commonslibrary.parliament.uk/research-briefings/cbp-7416/>> accessed 13 December 2023.

In 2015, the EU reaffirmed its circular intentions when the *European Commission* adopted a newly devised ‘Circular Economy Package’ comprising a ‘Circular Economy Action Plan’ and four legislative proposals seeking to amend waste Directives.¹¹² The Action Plan, which contained 54 ‘actions’, sought to ‘close the loop’ of product life cycles, and in consequence, the plan sought to target the entire life cycle of products, including production, consumption and waste management.¹¹³ The accompanying legislative proposals targeted the Waste Framework Directive (2008/98/EC), Waste Packaging Directive (94/62/EC) and Landfill Directive (1991/31/EC) individually, and the End-of-life Vehicles Directive (2000/53/EC), Batteries Directive (2006/66/EC) and Waste Electric and Electrical Equipment (WEEE) Directive (2012/19/EC) collectively.¹¹⁴ The legislative proposals, amending the aforementioned Directives, were formally adopted in 2018 and included the introduction of common targets for recycling municipal and packaging waste, set at 55% and 65%, respectively, by 2025 and maximum landfill targets of 10% by 2035.¹¹⁵ However, a recent ‘early warning’ report noted that most Member States are likely to miss these targets.¹¹⁶ The

¹¹² European Commission, ‘Closing the Loop: Commission Adopts Ambitious New Circular Economy Package to Boost Competitiveness, Create Jobs and Generate Sustainable Growth’ (2015) <https://ec.europa.eu/commission/presscorner/detail/en/IP_15_6203> accessed 13 December 2023; Ana de Jesus and Sandro Mendonça, ‘Lost in Transition? Drivers and Barriers in the Eco-Innovation Road to the Circular Economy’ (2018) 145 *Ecological Economics* 75.

¹¹³ European Commission, ‘Closing the Loop - An EU Action Plan for the Circular Economy’ COM (2015) 614 final. The Annex of this communication details 54 actions for the fulfillment of the Action Plan.

¹¹⁴ European Commission, ‘Proposal for a Directive of the European Parliament and of the Council Amending Directive 2008/98/EC on Waste’ COM (2015) 595 final; European Commission, ‘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; European Commission, ‘Proposal for a Directive of the European Parliament and of the Council Amending Directive 94/62/EC on Packaging and Packaging Waste’ COM (2015) 596 final; European Commission, ‘Proposal for a Directive of the European Parliament and the Council Amending Directives 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’ COM (2015) 593 final.

¹¹⁵ Ellen MacArthur Foundation, ‘The EU’s Circular Economy Action Plan’ (n 17); The Waste Framework Directive; The Waste Packaging Directive; Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste [1999] OJ L 182 (as amended). Note, however, stated targets for municipal waste, relating to 2025, had been reduced from 60% by weight (at the proposal stage) to 55% (at enactment).

¹¹⁶ European Commission, ‘Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Identifying Member States at

legislative revisions also sought to harmonise batteries, vehicles, electrical and electronic equipment, and packaging waste streams and promote reuse as a circular driver.¹¹⁷

In 2019, the *European Commission* announced the ‘European Green Deal’, which strives for a climate-neutral environment, and in doing so, reaffirmed its commitment to ‘the efficient use of resources by moving to a clean, Circular Economy’.¹¹⁸ Given this, the first ‘Circular Economy Action Plan’, with all 54 actions either adopted or implemented, was superseded by ‘A New Circular Economy Action Plan’ in 2020.¹¹⁹ The *European Commission* contends that this plan provides:

‘a future-oriented agenda for achieving a cleaner and more competitive Europe’ and thus ‘accelerate[s] the transition towards a regenerative growth model that gives back to the planet more than it takes, advance[s] towards keeping its resource consumption within planetary boundaries, and [...] reduce[s] its consumption footprint’.¹²⁰

Given this, the 2020 Action Plan sought to incentivise sustainable production and achieve ‘less waste, more value’ by focusing on resource-intensive products that can achieve circularity, such as textiles, electronics, batteries and vehicles, to a significant degree.¹²¹ The Action Plan identifies the further implementation of the EPR principle as one of the

Risk of Not Meeting the 2025 Preparing for Re-Use and Recycling Target for Municipal Waste, the 2025 Recycling Target for Packaging Waste and the 2035 Municipal Waste Landfilling Reduction Target’ (n 6).

¹¹⁷ Ellen MacArthur Foundation, ‘The EU’s Circular Economy Action Plan’ (n 17).

¹¹⁸ European Commission, ‘The European Green Deal’ COM (2019) 640 final.

¹¹⁹ European Commission, ‘A New Circular Economy Action Plan’ (n 17).

¹²⁰ *ibid.*

¹²¹ *ibid.*

means by which a Circular Economy, which it touts as a means of tackling societal issues, such as resource over-consumption, waste generation, and climate change, could be realised.¹²²

Amongst other actions, the 2020 Action Plan aimed to produce a '[p]roposal for a new regulatory framework for batteries', '[r]eview [...] the rules on end-of-life vehicles' as well as review elements of the existing regime on waste packaging and WEEE. The European Commission released its first draft of a newly devised Batteries Regulation at the end of 2020, which was subsequently adopted in July 2023 and takes effect from February 2024.¹²³ Likewise, after review, the *European Commission* released a proposal for repealing and replacing the End-of-life Vehicles Directive with a newly devised End-of-life Vehicles Regulation in July 2023.¹²⁴ In addition to this, the *European Commission* also proposed a new packaging Regulation in November 2022 and is currently evaluating the effectiveness of the WEEE Directive, and its repeal and replacement is possible, though to date a proposal has not been forwarded.¹²⁵

3. The Extended Producer Responsibility Principle

¹²² *ibid*; Campbell-Johnston and others (n 40).

¹²³ Regulation (EU) 2023/1542 of 12 July 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and repealing Directive 2006/66/EC [2023] OJ L 191 Art. 96.

¹²⁴ European Commission, 'Proposal for a Regulation of the European Parliament and of the Council on Circularity Requirements for Vehicle Design and on Management of End-of-Life Vehicles, Amending Regulations (EU) 2018/858 and 2019/1020 and Repealing Directives 2000/53/EE and 2005/64/EE' COM (2023) 451 final.

¹²⁵ European Commission, 'Proposal for a Regulation of the European Parliament and of the Council on Packaging and Packaging Waste, Amending Regulation (EU) 2019/1020 and Directive (EU) 2019/904, and Repealing Directive 94/62/EC' COM (2022) 677 final Art. 64.

The drive towards a Circular Economy demands that products and their materials remain in use, and at their highest utility value at all times.¹²⁶ With this, the regulatory approach to managing products has evolved from traditional command-and-control mechanisms, which required producers to take specific, or limited, responsibility (producer responsibility) for their product's environmental impact by, for example, mitigating externalities from production or, as *Bell and others* note, providing 'a bare requirement to recover and recycle', towards a more encompassing and sophisticated whole life cycle approach.¹²⁷ Given this, increased attention has been paid to, as it is termed in this thesis, the EPR principle, which aims to extend the producer's responsibility for its products to the whole life cycle of a product. In other words, as *Steenmans and Malcolm* note, the EPR principle aims to hold 'producers responsible at all stages throughout the life-cycle of their products'.¹²⁸

When first envisioned by *Thomas Lindqvist* in the mid-1970s, the EPR principle was conceptualised as a means of improving resource efficiency in industrial ecology and management sciences.¹²⁹ By 1992, *Lindhqvist and Lidgren* defined the EPR principle, and its method of implementation, in a *Swedish Ministry of Environment and Natural Resources* report as:

'an environmental protection strategy to reach an environmental objective of a decreased total environmental impact from a product, by making the manufacturer of

¹²⁶ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23).

¹²⁷ Noah Sachs, 'Planning the Funeral at the Birth: Extended Producer Responsibility in the European Union and the United States' (2006) 30 Harv. Envtl. L. Rev. 51; Bell and others (n 27) 696.

¹²⁸ Steenmans and Malcolm (n 21).

¹²⁹ Thomas Lindhqvist, 'Extended Producer Responsibility in Cleaner Production: Policy Principle to Promote Environmental Improvements of Product Systems' (Lund University 2000) 29; Antonio Massarutto, 'The Long and Winding Road to Resource Efficiency – An Interdisciplinary Perspective on Extended Producer Responsibility' (2014) 85 Resources, Conservation and Recycling 11.

the product responsible for the entire lifecycle of the product, and especially for the take-back, recycling and final disposal of the product. The Extended Producer Responsibility is implemented through administrative, economic, and informative instruments. The composition of these instruments determines the precise form of the Extended Producer Responsibility'.¹³⁰

In characterising the implementation of the EPR principle, *Lindhqvist* later identified five forms of responsibility and these included: liability, referring to 'the responsibility for proven environmental damages caused by the product in question'; economic responsibility, where 'the producer will cover all or part of the expenses, for example, for the collection, recycling or final disposal of the product he is manufacturing'; physical responsibility, 'where the manufacturer is involved in the physical management of the products and/or their effects'; and, informative responsibility 'requiring producers to supply information on the environmental properties of the products they are manufacturing'.¹³¹ It was also noted that manufacturers may retain responsibility for their product and thus be linked to their 'environmental problems'.¹³²

In consequence, *Lindhqvist's* thesis later defined EPR as a:

'principle to promote total life-cycle environmental improvements of product systems by extending the responsibilities of the manufacturer of a product to various parts of

¹³⁰ Lindhqvist (n 129); Thomas Lindhqvist and Karl Lidgren, 'Towards an Extended Producer Responsibility - Analysis of Experiences and Proposals' [1992] Ministry of the Environment and Natural Resources, Stockholm.

¹³¹ Lindhqvist (n 129) IV.

¹³² *ibid.*

the entire life-cycle of the product, and especially to the take-back, recycling and final disposal of the product' and 'is implemented through administrative, economic and informative policy instruments'.¹³³

Notably, however, *the OECD* regards the EPR principle as being primarily concerned with a product's end-of-life management rather than, as Lindhqvist conceptualised, 'the entire lifecycle of the product'.¹³⁴ Here, *the OECD* contends that the implementation of the EPR principle results in 'a producer's responsibility for a product [...] [being] extended to the post-consumer stage of a product's life-cycle'.¹³⁵ Similarly, *Steenmans and Malcolm* note that although the EPR principle was conceptualised to 'cover a product's entire life cycle', it is 'in practice' often only implemented 'at a product's end-of-life'.¹³⁶ For a wider discussion on the implementation of the EPR principle through policy instruments, see Section 3.1 of this chapter.

The OECD notes that although the implementation of the EPR principle focuses on a product's end-of-life management, its implementation can incentivise 'producers to incorporate environmental considerations in the design of their products'.¹³⁷ Indeed, *Dawson, Ahuja and Lee* note that the implementation of the EPR principle has two main aims: 'one, to reduce the immediate environmental impact of the product via mitigating the

¹³³ *ibid* V.

¹³⁴ Lindhqvist (n 129); Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23).

¹³⁵ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23).

¹³⁶ Steenmans and Malcolm (n 21).

¹³⁷ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility* (n 23).

product's harm at the end of its life and, the other, to influence the long-term design of a product'.¹³⁸ Sachs describes this as an assignment of:

'long-term environmental responsibility for products to producers in an attempt to internalise costs and convert the linear 'cradle-to-grave' production and distribution chain into a 'cradle-to-cradle' system that encourages recycling, reuse, and improved product design'.¹³⁹

Given this, it had been widely assumed that any application of the EPR principle was likely to result in the eco-design of a product because producers would seek to reduce their end-of-life management costs by producing products that were easier to treat, reuse and recycle. Nonetheless, *Brouillat and Oltra* contend that there is a 'lack of empirical and theoretical thinking on how such incentives work through the whole production chain'.¹⁴⁰

In an EU context, *Campbell-Johnson and others* have noted that the EPR principle has predominately been implemented as a means to collect products for their eventual reuse and recycling rather than being applied to incentivise eco-design.¹⁴¹ Here they note that 'despite the EPR principle being 'originally conceived as a means to incentivise eco-design and sustainable product innovation, [...] in practice, across EU applications, it primarily focuses on the collection and processing of post-consumer products while claiming to encourage eco-design'.¹⁴² That said, it is notable that all four of the Directives analysed

¹³⁹ Sachs (n 127) 53.

¹⁴⁰ Eric Brouillat and Vanessa Oltra, 'Extended Producer Responsibility Instruments and Innovation in Eco - Design: An Exploration through a Simulation Model' (2012) 83 *Ecological Economics* 236.

¹⁴¹ Campbell-Johnston and others (n 40).

¹⁴² *ibid.*

within this thesis contain explicit provisions affecting product design, and as a result, the EU does not merely rely on physical or economic incentives to encourage eco-design.

3.1. Implementing the EPR Principle through EPR Policy Instruments

With over 400 adoptions, the EPR principle has been extensively implemented globally.¹⁴³ In particular, Europe has been an early adopter of the EPR principle, targeting the collection, treatment and recycling of a range of waste streams, namely, batteries, vehicles, electrical and electronic equipment and packaging, as well as tyres and textiles.¹⁴⁴ Despite this, implementation of the EPR principle has often been piecemeal and inconsistent, resulting in scheme disparities.¹⁴⁵ To some extent, disparities are to be expected, given that EPR is a principle rather than a policy instrument *per se*. In a practical sense, this means that the EPR principle, as outlined in Section 3, is a guiding principle that lawmakers can implement by selecting one or more policy instruments, set within one or multiple statutes. In other words, the EPR principle is distinct and separate from the policy and is a guiding principle that is embedded into law through the selection of policy instruments, each of which result in differing levels of effectiveness, costs and compliance.¹⁴⁶ Depending on the mix of policy instruments adopted, implementation of the EPR principle can reduce the use of natural resources, prevent and reduce waste, encourage the environmentally friendly design of products and ensure resource efficiency by closing material loops, as well as relieve

¹⁴³ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23).

¹⁴⁴ Kaffine, O'Reilly and Börkey (n 21).

¹⁴⁵ Campbell-Johnston and others (n 40).

¹⁴⁶ Panate Manomaivibool, 'Extended Producer Responsibility in a Non-OECD Context: The Management of Waste Electrical and Electronic Equipment in India' (2009) 53 *Resources, Conservation and Recycling* 136; Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility* (n 23); Brouillat and Oltra (n 140); Helen Forslind, 'Implementing Extended Producer Responsibility: The Case of Sweden's Car Scrapping Scheme' (2005) 13 *Journal of Cleaner Production* 619.

municipalities from some, or all, of the financial burden of responsibility for a product's end-of-life waste management.¹⁴⁷

To invoke the EPR principle, *Lindhqvist* characterised five forms of responsibility: informative, physical, economic, ownership and liability.¹⁴⁸ A mixture of administrative, economic, and informative policy instruments is often employed as a transformative tool for implementing such responsibilities.¹⁴⁹ In parallel, *the OECD*, in their 'Updated Guidance for Efficient Waste Management', noted that lawmakers typically invoke the EPR principle through several distinct categories of policy instruments (hereafter, termed EPR policy instruments), namely, product take-back; economic and market-based instruments; standards or industry-based instruments; and information-based responsibilities.¹⁵⁰ EPR policy instruments can be considered 'carrot-and-stick' in nature given that they can give rise to incentives (carrot) and regulation (stick). However, as the below exploration depicts, such EPR policy instruments can be more nuanced and complex than a simple 'reward-and-punishment' system of regulation.

3.1.1. Product Take-back

¹⁴⁷ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility* (n 23); Margaret Walls, 'EPR Policy Goals and Policy Choices: What Does Economics Tell Us' (Organisation for Economic Co-Operation and Development 2004).

¹⁴⁸ Lindhqvist (n 129) 38D; Dawson (n 17).

¹⁴⁹ Lindhqvist (n 129) 38; Dawson (n 17); Yamini Gupt and Samraj Sahay, 'Review of Extended Producer Responsibility: A Case Study Approach' (2015) 33 *Waste Management & Research* 595.

¹⁵⁰ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23) 22.

Product take-back is the most ubiquitous EPR policy instrument employed by lawmakers to implement the EPR principle, and amounts to over three-quarters of enacted instruments.¹⁵¹ Indeed, varieties of the take-back responsibility pertain to all four Directives that are to be analysed by this thesis. The EPR policy instrument typically passes physical or economic responsibility for managing a product to the producer, particularly at its end-of-life.¹⁵² Its aims are two-fold: to facilitate the end-of-life management of products and to provide incentives for eco-design. The former is typically achieved through mandating product collection, transportation, and environmentally sound disposal.¹⁵³ Given the cost implications of this, the producer is therefore incentivised to eco-design as a means of reducing their cost burden. Though design incentives were initially the primary purpose of 'take-back', the extent to which it leads to eco-design is an 'open' question.¹⁵⁴

Take-back mandates are often supported and incentivised by the implementation of mandatory or voluntary targets.¹⁵⁵ In the EU, these targets typically require producers to collect an 'x' percentage of the products that they place on the market. For example, the Batteries Directive requires an annual collection rate of 45%.¹⁵⁶ Nonetheless, product take-back requirements, be they physical or financial, may be fulfilled by the producer individually

¹⁵¹ Atalay Atasu and Ravi Subramanian, 'Extended Producer Responsibility for E-Waste: Individual or Collective Producer Responsibility?' (2012) 21 *Production and Operations Management* 1042; Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23).

¹⁵² Walls, 'EPR Policy Goals and Policy Choices: What Does Economics Tell Us' (n 147); Kaffine, O'Reilly and Börkey (n 21).

¹⁵³ Walls, 'EPR Policy Goals and Policy Choices: What Does Economics Tell Us' (n 147); Atasu and Subramanian (n 151); Atalay Atasu, Luk N Van Wassenhove and Miklos Sarvary, 'Efficient Take-Back Legislation' (2009) 18 *Production and Operations Management* 243.

¹⁵⁴ Margaret Walls, 'Extended Producer Responsibility and Product Design: Economic Theory and Selected Case Studies' (2006) 06–08 RFF Discussion Paper 1

<https://papers.ssrn.com/sol3/papers.cfm?abstract_id=901661#> accessed 10 May 2021.

¹⁵⁵ Walls, 'EPR Policy Goals and Policy Choices: What Does Economics Tell Us' (n 147).

¹⁵⁶ The Batteries Directive.

or collectively; for a detailed summary of individual and collective responsibility, see Section 3.2. Where the mandate is advanced collectively, which is the norm, producers are often permitted or required to set up and join 'Producer Responsibility Organisations' (PRO).¹⁵⁷ These organisations typically assume full or partial responsibility for discharging their members' obligations, including take-back.¹⁵⁸ Producers fund the activities of PROs, which can be operationalised on a profit-making or not-for-profit basis.¹⁵⁹

3.1.2. Economic and Market-Based Instruments

Over 28% of enacted EPR policy instruments incorporate economic or market-based incentives.¹⁶⁰ Such EPR policy instruments 'provide a direct financial incentive' to producers to bear life-cycle responsibility for their product, particularly at its end-of-life.¹⁶¹ Some commentators argue that product take-back can also be regarded as an economic and market-based EPR policy instrument as it seeks to extend a producers responsibility for their product to its end-of-life, and in doing so there is an economic incentive for it to eco-design.¹⁶² However, other economic or market-based EPR policy instruments may include

¹⁵⁷ Kieren Mayers, 'Strategic, Financial, and Design Implications of Extended Producer Responsibility in Europe: A Producer Case Study' (2007) 11 *Journal of Industrial Ecology* 113.

¹⁵⁸ Rachel Waugh and others, 'Development of Guidance on Extended Producer Responsibility (EPR)' (European Commission 2014) 8

<https://ec.europa.eu/environment/archives/waste/eu_guidance/pdf/report.pdf>; Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23) 28.

¹⁵⁹ Dawson (n 17).

¹⁶⁰ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility* (n 23).

¹⁶¹ *ibid* 41.

¹⁶² Chiara Magrini, Filippo D'Addato and Alessandra Bonoli, 'Municipal Solid Waste Prevention: A Review of Market-Based Instruments in Six European Union Countries' (2020) 38 *Waste Management & Research* 3.

deposit return schemes, advanced disposal fees and virgin material taxes, which are briefly summarised below.¹⁶³

3.1.2.1. Deposit Return Schemes

A deposit return scheme seeks to incentivise the return of products by levying an additional fee at the purchase point, which is then refunded on its return.¹⁶⁴ Consequently, deposit return schemes often support the take-back of easily discarded and low-value products.¹⁶⁵ Where a product is not returned, the unclaimed levy is used to mitigate that product's environmental impact or support its collection through alternative means.¹⁶⁶ For example, in 2020, Scotland presented plans to introduce a 'Deposit and Return Scheme' targeting drinks containers.¹⁶⁷ Initially set to launch in July 2022, though now delayed to 2025, the scheme charges consumers an extra 20p for each single-use drinks container purchased, which is refunded at the point the item is returned to a designated collection point.¹⁶⁸ This, therefore, incentivises the return of products so as to facilitate their onward and, in some cases, circular end-of-life management.

¹⁶³ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility* (n 23) 41–44.

¹⁶⁴ Margaret Walls, 'The Role of Economics in Extended Producer Responsibility: Making Policy Choices and Setting Policy Goals' (2003) <<http://ageconsearch.umn.edu/record/10855>>.

¹⁶⁵ *ibid.*

¹⁶⁶ *ibid.*

¹⁶⁷ The Deposit and Return Scheme for Scotland (Scotland) Regulations 2020, SI 2020/154 (Draft); Zero Waste Scotland, 'The Regulations' (*Zero Waste Scotland*, 2022) <<https://depositreturnscheme.zerowastescotland.org.uk/regulations>> accessed 13 January 2022; Scottish Environment Protection Agency, 'Scotland's Deposit Return Scheme' (*SEPA*, 2022) <<https://www.sepa.org.uk/regulations/waste/deposit-return-scheme/>> accessed 13 January 2022. The UK government is also consulting on the introduction of a drinks container Deposit Return Scheme in England, Wales and Northern Ireland.

¹⁶⁸ Department for Levelling Up, Housing & Communities, 'Policy Statement: Scottish Deposit Return Scheme - UK Internal Market Exclusion' (HM Government 2023) <<https://www.gov.uk/government/publications/scottish-deposit-return-scheme-uk-internal-market-exclusion/policy-statement-scottish-deposit-return-scheme-uk-internal-market-exclusion>> accessed 6 June 2023.

3.1.2.2. Advanced Disposal Fees

Unlike the traditional last owner-pays model, an advanced disposal fee can be levied on a product at its first sale.¹⁶⁹ An advanced disposal fee is a specific up-front fee that is attached to a product and can be levied by a Government or a PRO to take account of its collection, treatment, reuse and recycling costs at the product's end of life.¹⁷⁰ Simply put, an advanced disposal fee, which may be levied visibly or invisibly, covers the cost of a product's disposal at the point of purchase.¹⁷¹ This could, for example, include a visible charge on the consumption of plastic carrier bags, which is then used to facilitate its collection and end-of-life management. In practice, however, any implementation of the EPR principle will likely lead to the internalisation of environmental costs, which are ultimately passed to producers on an invisible basis.¹⁷² Though consumers do not see this fee, the internalisation of costs can result in eco-design incentives.¹⁷³ This is because, in a competitive economy, producers can reduce the final cost of their product by increasing, for example, the recyclability of their products which may result in decreased end-of-life management costs.

3.1.2.3. Virgin Material Taxes

¹⁶⁹ Naoko Tojo, Thomas Lindhqvist and Gary Davis, 'EPR Programme Implementation: Institutional and Structural Factors', *Proceeding of OECD Seminar on Extended Producer Responsibility, Paris, France* (Citeseer 2001).

¹⁷⁰ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility* (n 23).

¹⁷¹ *ibid.*

¹⁷² Sachs (n 127); Forslind (n 146).

¹⁷³ Beverly Thorpe and Alexandra McPherson, 'Extended Producer Responsibility' (Clean Production Action 2004) <https://www.cleanproduction.org/static/ee_images/uploads/resources/EPRtoolkitColourFinal.pdf> accessed 8 January 2023.

A virgin material tax is a charge that is placed on the use of virgin materials to correct market failures that perversely incentivise the use of virgin materials in the design of product over that of secondary materials.¹⁷⁴ Indeed, *Söderholm* suggests that the use of such taxes has been found to effectively reduce virgin materials whilst simultaneously stimulating the use of secondary materials in production processes.¹⁷⁵ In April 2022, the *UK Government* introduced a tax on plastic packaging, where producers are charged a rate of £200 per tonne if they do not incorporate 30% recycled plastic into the design of their packaging.¹⁷⁶ The introduction of the tax was expected to result in a 40% increase in the use of recycled plastics, thus increasing the desirability of packaging collection.¹⁷⁷ Despite this, such schemes may have the unintended consequence of stimulating recycling over other higher utility value end-of-life processes, such as reuse.

3.1.3. Standards and Industry-Based Instruments

The OECD notes that the introduction of ‘regulations or design standards’ can incentivise the take-back of products, as well as encourage their eco-design.¹⁷⁸ Indeed, all four of the Directives analysed in the substantive chapters of this thesis contain explicit design requirements as a means of facilitating the eco-design, take-back and end-of-life

¹⁷⁴ Annegrete Bruvoll, ‘Taxing Virgin Materials: An Approach to Waste Problems’ (1998) 22 *Resources, Conservation and Recycling* 15.

¹⁷⁵ Patrik Söderholm, ‘Taxing Virgin Natural Resources: Lessons from Aggregates Taxation in Europe’ (2011) 55 *Resources, Conservation and Recycling* 911.

¹⁷⁶ HM Revenue & Customs, ‘Plastic Packaging Tax: Steps to Take’ (*GOV.UK*, 2022) <<https://www.gov.uk/guidance/check-if-you-need-to-register-for-plastic-packaging-tax>> accessed 19 January 2022.

¹⁷⁷ HM Revenue & Customs, ‘Introduction of Plastic Packaging Tax from April 2022’ (*GOV.UK*, 20 July 2021) <<https://www.gov.uk/government/publications/introduction-of-plastic-packaging-tax-from-april-2022/introduction-of-plastic-packaging-tax-2021>> accessed 2 August 2023; HM Revenue & Customs (n 217).

¹⁷⁸ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23) 22.

management of products. Lead-acid vehicle batteries provide one example of how standardisation can result in the eco-design and effective end-of-life management of products. Here, the standardisation of lead-acid batteries, and their economic value at their end-of-life, has stimulated an advanced collection and recycling economy, with some suggesting that a collection and recycling rate of 98% has been achieved in the EU.¹⁷⁹ However, the standardisation of all product groups is said to be ‘far too heavy and slow a process from both [a] environmental and administrative point of view’ and may result in the stifling of technological advancements.¹⁸⁰

Moreover, lawmakers may opt to enact industry-based instruments that promote alternative business models such as product leasing and servicing, thus helping to maintain a product at its highest utility value.¹⁸¹ The former has been discussed extensively by *Ahuja, Dawson and Lee*, who conceptualised an industry-based servitisation model for electric vehicles.¹⁸² The conceptualised model ensures that all electric vehicle batteries are leased from the original manufacturer, regardless of the rest of the ownership of the vehicle.¹⁸³ Such a model allows the original manufacturer to retain ownership of the battery and monitor its performance, health and upkeep to aid its longevity and potential for second-life application.¹⁸⁴ At the end of the leased term, the consumer must return the battery to its

¹⁷⁹ Dana L Thompson and others, ‘The Importance of Design in Lithium Ion Battery Recycling – a Critical Review’ (2020) 22 *Green Chem.* 7585; Jean-Paul Skeete and others, ‘Beyond the Event Horizon: Battery Waste, Recycling, and Sustainability in the United Kingdom Electric Vehicle Transition’ (2020) 69 *Energy Research & Social Science* 101581; The Faraday Institution, ‘Towards a Greener Lead Acid Battery Recycling Process’ (*The Faraday Institution*, 2021) <<https://www.faraday.ac.uk/success-stories/greener-lead-acid-battery-recycling/>> accessed 18 November 2022.

¹⁸⁰ Petrus Kautto, ‘New Instruments – Old Practices? The Implications of Environmental Management Systems and Extended Producer Responsibility for Design for the Environment’ (2006) 15 *Business Strategy and the Environment* 377.

¹⁸¹ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility* (n 23) 45.

¹⁸² Ahuja, Dawson and Lee (n 9).

¹⁸³ *ibid.*

¹⁸⁴ *ibid.*

original manufacturer, who subsequently facilitates its reuse, remanufacture, repurposing, or recycling. For a more significant discussion on this servitisation model, see Section 4.2.3 of Chapter 3 and Appendix 1.¹⁸⁵

3.1.4. Information-Based Instruments

Nowakowski notes that the education of consumers is one of the most critical factors in increasing the collection and circularity of products.¹⁸⁶ Information-based EPR policy instruments require producers to bear physical and/or financial responsibility for disseminating information to end users.¹⁸⁷ Although not exclusively the case, information based EPR policy instruments are typically employed as a mechanism to promote the collection of targeted products at their end-of-life, and can include product labelling and public information campaign requirements.¹⁸⁸ Producers may be required to, for example, raise consumer awareness of product take-back and prohibitions on the landfill of certain products, which as a result, supports the functioning of other EPR policy instruments. By way of example, the UK recently launched a television campaign, which sought to raise awareness of product take-back by directing consumers to refrain from disposing of waste electrical and electronic equipment in municipal waste streams.¹⁸⁹ Likewise, the End-of-life

¹⁸⁵ *ibid.*

¹⁸⁶ Piotr Nowakowski, 'Investigating the Reasons for Storage of WEEE by Residents – A Potential for Removal from Households' (2019) 87 *Waste Management* 192.

¹⁸⁷ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23) 22.

¹⁸⁸ *ibid.*

¹⁸⁹ Joshua Doherty, 'Nationwide TV Campaign Launches to Tackle WEEE' (*letsrecycle.com*, March 29 2023) <<https://www.letsrecycle.com/news/nationwide-tv-campaign-launches-to-tackle-weee/>> accessed 20 July 2023.

Vehicles Directive requires producers to supply product designs to recyclers and dismantlers to aid their remanufacture, repurposing or recycling.¹⁹⁰

3.2. Individual and Collective Responsibility

As noted in Section 3 of this chapter, whilst the EPR principle was originally conceptualised as a means of extending a producer's responsibility to the whole life cycle of its product, this seldom occurs in practice, and instead EPR policy instruments focus on producers bearing physical or financial responsibility for their products end-of-life management. In doing so, this responsibility can be passed to producers on an individual or collective basis.¹⁹¹ In brief, individual responsibility requires producers to discharge responsibilities for their product only.¹⁹² This differs from collective responsibility, which empowers producers of the same product group to discharge their responsibility together as a collective, regardless of brand.¹⁹³

3.2.1. Individual Responsibility

As noted above, individual responsibility indicates that producers maintain responsibility for their own products. Where product take-back, the most ubiquitous EPR policy instrument

¹⁹⁰ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23) 22.

¹⁹¹ Emma Watkins and others, 'EPR in the EU Plastics Strategy and the Circular Economy: A Focus on Plastic Packaging' (Institute for European Environmental Policy 2017) <<https://ieep.eu/uploads/articles/attachments/95369718-a733-473b-aa6b-153c1341f581/EPR%20and%20plastics%20report%20IEEP%209%20Nov%202017%20final.pdf?v=63677462324>> accessed 16 March 2021.

¹⁹² Naoko Tojo, 'Extended Producer Responsibility as a Driver for Design Change - Utopia or Reality?' (Lund University 2004).

¹⁹³ *ibid.*

used to implement the EPR principle, is employed on an individual basis then producers may need to use reverse logistics to backhaul their product before, by way of example and if so directed by the relevant legislation, reusing or recycling the end-of-life product.¹⁹⁴ However, in most instances, individual responsibility is invoked by allocating costs to each producer based on the number of products that have been collected at their end-of-life.¹⁹⁵ In other words, producers operate as a collective to take-back and, for example, reuse and recycle products as per legislative requirements, though each producer is allocated the total cost of their individual product management.¹⁹⁶ This cost allocation sends a strong signal to producers to eco-design their products so as to reduce their eventual end-of-life management cost burden.¹⁹⁷ This is because in theory a product that is, for example, easier to dismantle, reuse and recycle will cost less to manage at its end-of-life.¹⁹⁸ However, some argue that individual responsibility results in increased logistical challenges in identifying costs for each producer and its goods.¹⁹⁹

3.2.2. Collective Responsibility

¹⁹⁴ Vera Susanne Rotter, Perrine Chancerel and Wolf-Peter Schill, 'Practicalities of Individual Producer Responsibility under the WEEE Directive: Experiences in Germany' (2011) 29 *Waste Management & Research* 931; Gerhard Roller and Martin Führ, 'Individual Producer Responsibility: A Remaining Challenge under the WEEE Directive¹' (2008) 17 *Review of European Community & International Environmental Law* 277.

¹⁹⁵ Individual Producer Responsibility Working Group, 'Waste Electrical and Electronic Equipment (WEEE) Regulations: Individual Producer Responsibility (IPR) in a UK Context.' (HM Government 2012) <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/34569/12-1007-waste-electrical-and-electronic-weee-regulations-individual-producer-ipr-responsibility.pdf> accessed 21 March 2021.

¹⁹⁶ *ibid.*

¹⁹⁷ *ibid.*

¹⁹⁸ *ibid.*

¹⁹⁹ Atasu and Subramanian (n 151).

Considering the above, producers typically favour collective responsibility, enabling them to share their responsibility collectively rather than individually.²⁰⁰ This means that the producer's costs will reflect their market share rather than the management costs of their individual products.²⁰¹ Consequently, there is no distinction between individual products in a collective scheme.²⁰² This may ultimately reduce the design incentives associated with the implementation of the EPR principle because the producer has a reduced incentive to eco-design, given that they, themselves, will merely benefit from the reduced management costs of the product on a proportional basis.²⁰³ Nonetheless, such assertions may be rebuffed through the implementation of fee modulation, which takes account of the product's recyclability, thus incentivising design improvements. Here, producers may be rewarded for eco-designed products by being charged lower fees on a modulated basis, according to the products design.²⁰⁴ For example, producers that alter their products' design to reduce plastic use may be rewarded through the allocation of lower fees, whereas those using higher quantities will attract penalties. Some observers have noted that collective responsibility is simpler to implement and typically more cost-effective than effectuating individual responsibility, as it operates on a economies of scale basis, is highly efficient and more accessible to consumers²⁰⁵

²⁰⁰ Global Forum on Environment: Promoting Sustainable Materials Management through Extended Producer Responsibility (EPR), 'The State of Play on Extended Producer Responsibility (EPR): Opportunities and Challenges' (Organisation for Economic Co-Operation and Development 2014) <<https://www.oecd.org/environment/waste/Global%20Forum%20Tokyo%20Issues%20Paper%2030-5-2014.pdf>> accessed 19 April 2021.

²⁰¹ Atasu and Subramanian (n 151).

²⁰² Maitre-Ekern (n 73).

²⁰³ *ibid*; Atasu and Subramanian (n 151).

²⁰⁴ Luyi Gui and others, 'Design Incentives under Collective Extended Producer Responsibility: A Network Perspective' (2018) 64 *Management Science* 4967.

²⁰⁵ Deepali Sinha Khatriwal, Philipp Kraeuchi and Rolf Widmer, 'Producer Responsibility for E-Waste Management: Key Issues for Consideration – Learning from the Swiss Experience' (2009) 90 *Journal of Environmental Management* 153.

3.3. The EPR principle in the EU

The EPR principle is a cornerstone of waste policy in the EU, with over 45% of waste legislation encompassing the principle.²⁰⁶ The EU's existing EPR regulatory frameworks target waste batteries, vehicles, electrical and electronic equipment, and packaging.²⁰⁷ Nonetheless, Member States often legislate more widely by implementing the EPR principle to manage products, such as textiles, tyres, oil and fishing gear.²⁰⁸ The EPR principle has been enshrined in EU law under Article 8 of the Waste Framework Directive (2008/98/EC) and states that:

'In order to strengthen the reuse and the prevention, recycling and other recovery of waste, Member States may take legislative or non-legislative measures to ensure that any natural or legal person who professionally develops, manufactures, processes, treats, sells or imports products (producer of the product) has extended producer responsibility.

Such measures may include an acceptance of returned products and of the waste that remains after those products have been used, as well as the subsequent management of the waste and financial responsibility for such activities. These

²⁰⁶ Zero Waste Europe, 'Extended Producer Responsibility – Creating the Frame for Circular Products' (*Zero Waste Europe*, 2017) <<https://www.zerowasteeurope.eu/wp-content/uploads/2017/01/EPRpolicypaper.pdf>> accessed 15 July 2019; Kleoniki Pouikli, 'Concretising the Role of Extended Producer Responsibility in European Union Waste Law and Policy through the Lens of the Circular Economy' (2020) 20 *ERA Forum* 491.

²⁰⁷ European Commission and others, 'Study to Support Preparation of the Commission's Guidance for Extended Producer Responsibility Scheme: Recommendations for Guidance' (Publications Office of the European Union 2020) <<https://op.europa.eu/en/publication-detail/-/publication/ecb86ea2-932e-11ea-aac4-01aa75ed71a1/language-en>> accessed 28 July 2022.

²⁰⁸ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23).

measures may include the obligation to provide publicly available information as to the extent to which the product is re-usable and recyclable.’²⁰⁹

Maitre-Ekern’s study notes that Article 8’s interpretation of the EPR principle is narrowly drafted and inconsistent with the ‘all-encompassing environmental protection strategy’ first, envisaged by *Lindhqvist*, which aimed to extend a producer’s responsibility to the whole life cycle of its product.²¹⁰ This was particularly the case because Article 8 did not seek to incentivise the eco-design of the products it targeted. Nevertheless, in an attempt to strengthen the EU’s EPR framework and better align the Directive with Circular Economy goals, the Waste Framework Directive was amended in 2018.²¹¹ Building on the original Article 8’s wording, the amended Waste Framework Directive emphasises a product life-cycle approach to waste management and promotes alignment with the waste hierarchy. The Directive, therefore, sets out that Member States ‘may’ take appropriate measures to encourage the eco-design of products and their components to reduce its ‘environmental impact and the generation of waste’ during its production, use and end-of-life.²¹² Member States ‘may’ also encourage the development, production and marketing of products and components:

‘that are suitable for multiple use, that contain recycled materials, that are technically durable and easily repairable and that are, after having become waste, suitable for

²⁰⁹ The Waste Framework Directive Art 8.

²¹⁰ *Maitre-Ekern* (n 73).

²¹¹ The Waste Framework Directive Art 8.

²¹² The Waste Framework Directive Art 8 (2).

preparing for reuse and recycling in order to facilitate proper implementation of the waste hierarchy'.²¹³

Given that these amendments were advanced after the EU set out its ambitions to transition from a linear to a Circular Economy, it is surprising that they are rather weakly drafted in so much as they are not obligatory nor enforceable, as depicted by the words 'may'. Notably, however, the amended Waste Framework Directive attempts to align the implementation of the EPR principle with that of the waste hierarchy, as set out in Article 4 of the Waste Framework Directive.²¹⁴ This ranks waste disposal from best to worst, see *Figure 2: Waste hierarchy*.**Error! Reference source not found.**²¹⁵ The hierarchy notes that prevention is the preferred form of managing waste. However, where this is not possible, waste should be prepared for reuse, and failing that, it should be recycled. The least preferred options for waste is 'other disposal', which includes energy recovery (recovery), and lastly, disposal by landfill and incineration (disposal).

²¹³ *ibid* Art 8 (2).

²¹⁴ The Waste Framework Directive Art. 4.

²¹⁵ European Commission, 'Waste Prevention and Management' (n 2).



Figure 2: Waste hierarchy²¹⁶

In applying the EPR principle, Article 8 and 8a of the Waste Framework Directive requires Member States to adhere to a number of so-called general ‘minimum standards for EPR schemes’, which were established in July 2018 and became mandatory in January 2023.²¹⁷ ‘EPR schemes’ is defined by the Waste Framework Directive as a ‘set of measures taken by Member States to ensure that producers of products bear financial responsibility or financial and organisational responsibility for the management of the waste stage of a product’s life cycle’.²¹⁸ By way of summary, the general minimum standards require scheme participants to have clearly defined roles and responsibilities, and they should also contain targets that are aligned with the waste hierarchy, have appropriate reporting systems as a means of monitoring scheme performance, and producers and products should be treated

²¹⁶ *ibid.*

²¹⁷ The Waste Framework Directive Art. 8 and 8a.

²¹⁸ *ibid* Art. 3 (21).

equally, regardless of their size and origin.²¹⁹ *Steenmans* has commented that though these provisions ‘provide a good platform for improving the effectiveness of EPR schemes’, they do not contain sufficient detail, nor is there acceptable guidance on their application.²²⁰

The Waste Framework Directive also sets out several specific provisions that focus on the design of EPR schemes and their financing. Here, the Directive permits collective or individual fulfilment of financial responsibility assigned to producers by EPR schemes, though where the former is employed, the costs associated with the end-of-life management of a product should be modulated to take account of its design.²²¹ This means that the product end-of-life management costs should be reflective of the product's durability, repairability, re-usability and recyclability and the presence of hazardous substances.²²² On this, *the OECD* note that the modulation of fees provides producers with an additional incentive to eco-design and will ‘lower [the] environmental impacts of products’ as well as ‘[l]ower costs of EPR implementation in the long term’, which ‘will be reflected in lower costs to PROs and firms, either benefitting the firms themselves or lowering prices for consumers’.²²³

The Waste Framework Directive establishes requirements for producers to cover their products' total end-of-life management costs, including the product's transport and treatment.²²⁴ Cost coverage should extend to data gathering and reporting as well as costs

²¹⁹ *ibid* Art. 8a (1) (a) - (d).

²²⁰ Katrien Steenmans, ‘Extended Producer Responsibility: An Assessment of Recent Amendments to the European Union Waste Framework Directive’ (2019) 15 *The Journal of Environment & Development*.

²²¹ The Waste Framework Directive Art. 8a (4) (b).

²²² *ibid*.

²²³ Frithjof Laubinger and others, ‘Modulated Fees for Extended Producer Responsibility Schemes (EPR)’ (Organisation for Economic Co-Operation and Development 2021) 15
<[https://one.oecd.org/document/ENV/WKP\(2021\)16/En/pdf](https://one.oecd.org/document/ENV/WKP(2021)16/En/pdf)> accessed 8 January 2023.

²²⁴ The Waste Framework Directive Art. 8a (4) (a).

associated with the supply of ‘adequate information to waste holders’.²²⁵ It is permissible for product management costs to be offset by reuse and secondary material sales or unclaimed deposits where deposit return schemes are in operation.²²⁶ Somewhat oddly, the financial provisions noted in this paragraph do not apply to the EU’s existing regimes on waste batteries, end-of-life vehicles, and waste electrical and electronic equipment and can be departed from on economic viability grounds.²²⁷

3.3.1. Key terms as defined by the Waste Framework Directive

In addition to the measures above, the Waste Framework Directive defines several terms that are referred to throughout this thesis. These terms are key to better understand the Circular Economy and the implementation of the EPR principle in practice. The first is the term ‘waste’, defined by the Waste Framework Directive as ‘any substance or object which the holder discards or intends or is required to discard’.²²⁸ It is relatively uncontentious that the ‘holder’ of waste is deemed to mean the ‘waste producer’ or the natural or legal person in possession of the waste.²²⁹ However, the terms ‘discards’ or ‘intends to discard’ have been far more contentious and, although a discussion on this is outside the scope of this thesis’ remit, have been subject to significant litigation.²³⁰

²²⁵ *ibid.*

²²⁶ *ibid* Art. 8a (4).

²²⁷ *ibid* Art. 8a (4).

²²⁸ The Waste Framework Directive Art. 3 (1).

²²⁹ *ibid* Art. 3 (6).

²³⁰ *Joined Cases C-418/97 & C-419/97 ARCO Chemie Nederland v Minister Van Volkshuisvesting* [2000] ECR I-4475; *Case C – 9/00 Palin Granit Oy* [2002] ECR I-3533; Vincent Brown, ‘The End of Waste under EU Law’ (2013) 28 *Natural Resources & Environment* 41.

It is also pertinent to discuss other terms that are highly relevant to the thesis, those being higher utility practices, including prevention, reuse and recycling and lower utility practices, including 'other recovery' and 'disposal'. 'Prevention' means any 'measures taken before a substance, material or product has become waste' and has the effect of reducing 'the quantity of waste, including reuse or the extension of the life span of products', 'the adverse impacts of the generated waste on the environment and human health' or 'the content of hazardous substances in materials and products'.²³¹

'Reuse' is defined by the Waste Framework Directive to mean 'any operation by which products or components that are not waste are used again for the same purpose for which they were conceived'.²³² This definition is somewhat narrowly construed, given that materials must be reused for 'the same purpose for which they were conceived', and where reuse is expressly incentivised, this may exclude other practices such as repurposing. Nonetheless, the definition of 'reuse' is different to that of 'preparing for reuse' which, means 'checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing' and, as a result, this can include the practices of repair and remanufacture, which are not explicitly defined by the Directive.²³³ The key distinction between 'reuse' and 'preparing for reuse' is that the former has not, at that stage, met the definition of 'waste', whereas the latter has.²³⁴ Additionally, the Waste Framework Directive

²³¹ The Waste Framework Directive Art. 3 (12).

²³² *ibid* Art. 3 (13).

²³³ *ibid* Art. 3 (16).

²³⁴ European Commission – Directorate-General for Environment, 'Guidance on the Interpretation of Key Provisions of Directive 2008/98/EC on Waste' (2012)

<<https://ec.europa.eu/eurostat/documents/342366/351811/WEEE-2+Guidance+of+interpretation+Directive+2008-09-EC+on+waste.pdf/cb1c4f5e-d534-470a-cd71-3dc8b7d53bf7?t=1621959857496>> accessed 10 January 2024.

defines recycling as 'any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes'.²³⁵ However, materials that are being reprocessed for use as 'energy recovery', 'fuels' or 'backfilling operations' do not fall within the scope of this definition.²³⁶

The term 'other recovery', which is one removed from disposal on the waste hierarchy (see Figure 2), is not fully defined by the Waste Framework Directive. However, 'recovery' itself is defined as:

'any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy.'²³⁷

Notwithstanding the above, the *European Commission* notes that 'other recovery' is 'any operation meeting the definition for 'recovery under the [Waste Framework Directive] but failing to comply with the specific requirements for preparation for re-use or for recycling'.²³⁸ For example, this includes incineration, where waste is used as a fuel.²³⁹ The least preferred method of dealing with waste, as per the waste hierarchy is 'disposal', which is defined by the Directive as 'any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy'.²⁴⁰ This definition

²³⁵ The Waste Framework Directive Art. 3 (17).

²³⁶ *ibid* Art. 3 (17).

²³⁷ *ibid* Art. 3 (15) & Annex II.

²³⁸ European Commission – Directorate-General for Environment (n 234).

²³⁹ *ibid*.

²⁴⁰ The Waste Framework Directive Art. 3 (19).

therefore includes the landfill and incineration (without using waste as a fuel) of products and materials.²⁴¹

3.4. The EPR Principle and the Polluter Pays Principle

Notwithstanding the above discussion, the EPR principle is often regarded as an application of the polluter pays principle.²⁴² It is, therefore, essential to note that the polluter pays principle, which means that those who pollute are financially responsible for their environmental damage, is a key principle of EU environmental law and is enshrined in Article 191 (2) of the Treaty on the Functioning of the European Union.²⁴³ As explained by *Bell and Others*, other key principles of EU environmental law, namely, the preventative principle and the precautionary principle, focus on preventing environmental harm, whereas the polluter pays principle is typically, though not exclusively, activated after environmental harm has occurred.²⁴⁴ The words ‘though not exclusively’ are important here, given that *De Sadeleer* contends that the polluter pays principle when framed as complementary rather than mutually exclusive to principles seeking to prevent environmental harm, aim to ‘correct market failure’ by reflecting the cost of pollution in the ‘price of services and products and be borne by the polluters and not the society at large’ thus creating ‘an incentive for producers to place on the market environmentally friendly products’.²⁴⁵ *De Sadeleer* further contends that the polluter pays principle can be effectuated by a mixture of policy

²⁴¹ European Commission – Directorate-General for Environment (n 234).

²⁴² Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility* (n 23); Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23).

²⁴³ TFEU Art. 191 (2); Nicolas De Sadeleer, *Environmental Principles : From Political Slogans to Legal Rules* (Oxford University Press, Incorporated 2020) 37–38
<<http://ebookcentral.proquest.com/lib/usw/detail.action?docID=6376163>>.

²⁴⁴ Bell and others (n 27) 225.

²⁴⁵ Nicolas De Sadeleer, ‘The Polluter-Pays Principle in EU Law - Bold Case Law and Poor Harmonisation’, *Pro Natura: Festschrift til Hans Christian Bugge* (Universitetsforlaget 2012).

instruments containing ‘standards’ and ‘charges’. Standards, are made up of policy instruments that, for example, prescribe ‘through legally binding means, [...] levels of pollution’, whereas charges require ‘the polluter to assume his share of the costs in controlling the pollution he has caused’ through the use of ‘financial [policy] instrument[s]’.²⁴⁶ Given this, it is relatively simple to frame the implementation of the EPR principle within this context. While implementation of the EPR principle may allocate financial responsibility to producers (as polluters) for, by way of example, the take-back of its products at their end-of-life to a set standard, it also aims to incentivise eco-design, thus seeking to prevent environmental damage.

3.5. The EPR Principle: Legal Acts and Enforcement

As previously noted, the EU’s EPR regulatory frameworks target four waste streams: batteries, vehicles, electrical and electronic equipment and packaging, which are analysed in chapters three to six of this thesis.²⁴⁷ It is essential to note at the outset that environmental legislation within the EU, including legislation governing the EU’s EPR regulatory frameworks has traditionally been adopted by way of ‘Directive’, which are ‘binding, as to the result to be achieved, upon each Member State’ but leaves to ‘national authorities the choice of form and methods’ in which to implement its measures.²⁴⁸ Under this form of legislation, it is left to the Member States to interpret and subsequently incorporate (‘transpose’) the Directive into national law.²⁴⁹ *Macrory* explains that Directives offer a ‘large

²⁴⁶ Sadeleer (n 243) 37–38.

²⁴⁷ European Commission and others (n 207).

²⁴⁸ TFEU Art. 288; Bell and others (n 27) 178; Nigel Foster, *Foster on EU Law* (8th edn, Oxford University Press 2021) ch 4 <<https://www.oxfordlawtrove.com/10.1093/he/9780192897961.001.0001/he-9780192897961>>.

²⁴⁹ Bell and others (n 27) 183.

measure of discretion [...] to Member States in the choice of national instruments and mechanisms implementing Community policy objectives', and this goes 'hand-in-glove with the principle of subsidiarity', which 'recognises the strength of employing differing levels of government and administration'.²⁵⁰ Due to the discretion afforded to Member States in implementing its measures, Directives have a harmonising rather than standardising effect, meaning they set baseline or minimum standards that all Member States must achieve in their respective national transpositions. This can be juxtaposed with Regulations, which as explained in the latter half of this Section, have 'general application' and are binding in their entirety and 'directly applicable in all Member States', thus meaning they do not require transposition, which in turn, leads to a high level of uniformity.²⁵¹ Nonetheless, in primarily regulating by Directive for environmental matters, the EU recognises, per the subsidiarity principle, that Member States are often best placed to take account of national circumstances and, thus, allow for practical, innovative or novel solutions to the environmental issue or concern in which the Directive is attempting to regulate.²⁵²

Despite the benefits of Directives, namely harmonisation and flexibility, there are several associated drawbacks to this form of legal act. The first is that Directives are difficult to implement and amend in a timely manner, meaning that they often become out of date

²⁵⁰ Richard Macrory, 'Subsidiarity and European Community Environmental Law (1999)', *Regulation, Enforcement and Governance in Environmental Law* (Second Edition, Hart Publishing 1999) <<http://dx.doi.org/10.5040/9781474202138.ch-026>>. Eur-Lex notes that the principle of subsidiarity 'aims to ensure that decisions are taken at the closest possible level to the citizen and that constant checks are made to verify that action at the European Union (EU) level is justified in light of the possibilities available at the national, regional or local level. Specifically, it is the principle whereby the EU does not take action (except in the areas that fall within its exclusive jurisdiction), unless it is more effective than action taken at the national, regional or local level.'

²⁵¹ TFEU Art. 288.

²⁵² Ludwig Kramer, 'EU Enforcement of Environmental Laws: From Great Principles to Daily Practice - Improving Citizen Involvement Public Participation' (2014) 44 *Environmental Policy and Law* 247; Bell and others (n 27) 183.

relatively quickly.²⁵³ Secondly, Member States have free rein to take a path of least resistance and merely implement the Directives baseline (rather than go beyond) provisions, and as such, this can bear negative consequences where other, and often higher, standards are available. Thirdly, Directives are merely ‘binding, as to the result to be achieved, upon each Member State’ and as a result, broad discretion is afforded to Member States to achieve a Directive's objectives. Where Member States go beyond the Directives baseline or minimum standards, it can result in disparate regimes amongst Member States, and this in turn could subsequently undermine wider-EU policy objectives (including, for example, the transition from a linear to a Circular Economy).

However, the most notable concern relates to the monitoring and enforcement of Directives and resultant national transpositions, which are particularly problematic. Whilst national enforcement is usually a question for the Member States themselves, it is well understood that ‘[e]ffective enforcement of national environmental laws is fraught with difficulties’, primarily because of a lack of resources, impetus, and specialised know-how.²⁵⁴ Indeed, EU law itself has also not been particularly helpful in this regard, given that the Directives analysed by this thesis, expressly or implicitly (by extension of the Court of Justice of the European Union), require ‘effective, proportionate and dissuasive’ penalties and as such, do not offer up the size or form of criminal or civil sanctions or the ways and means of nationally enforcing their provisions. This is because, as *Macrory* notes, ‘[m]any Member States deeply resent what is seen as undue intrusion into national ways of doing things, and law

²⁵³ Marios Costa and Steve Peers, ‘15. Harmonisation’, *Steiner and Woods EU Law* (Oxford University Press 2023) <<https://www.oxfordlawtrove.com/view/10.1093/he/9780192884534.001.0001/he-9780192884534-chapter-15>>.

²⁵⁴ Richard Macrory, ‘The Enforcement of EU Environmental Law – Some Proposals for Reform (2005)’, *Regulation, Enforcement and Governance in Environmental Law* (Second Edition, Hart Publishing 1999) <<http://dx.doi.org/10.5040/9781474202138.ch-027>>.

enforcement is seen by many to fall squarely within a no-go area'.²⁵⁵ However, at the supranational level, Jack contends that it is 'well known' that Member States have a 'poor record' of implementation and application of EU environmental law, which, in the author's opinion, largely stems from the traditional use of Directives to regulate environmental issues.²⁵⁶

Unlike Regulations, once the EU adopts a Directive, Member States are required to transpose the measures into national law within the period of time stated within each Directive, and transpositions and any 'implementation reports' must at that point, be forwarded to the Commission, as 'guardians of the treaties'.²⁵⁷ Although Directives leave national authorities with 'the choice of form and methods' in which to implement its measures, the Commission checks for compliance by monitoring whether it has been fully incorporated into national law by the prescribed deadline and the extent to which it has been applied.²⁵⁸ The *European Commission* notes that '[t]here are a number of ways in which [...] [it] monitors the application of EU environment[al] law and detects infringements', including conducting its 'own investigations' and gathering:

²⁵⁵ Richard Macrory, 'European Moves on Environmental Enforcement (2014) European Moves on Environmental Enforcement', *European Moves on Environmental Enforcement (2014) European Moves on Environmental Enforcement* (Second Edition, Hart Publishing 1999) <<http://dx.doi.org/10.5040/9781474202138.ch-029>>.

²⁵⁶ Geert Van Calster and Leonie Reins, *EU Environmental Law* (Edward Elgar Publishing 2017) Chapter 4 <<https://www.elgaronline.com/view/9781782549178/9781782549178.xml>>; Brian Jack, 'Enforcing Member State Compliance with EU Environmental Law: A Critical Evaluation of the Use of Financial Penalties' (2011) 23 *Journal of environmental law* 73, 74.

²⁵⁷ Kramer (n 252) 2; European Commission, 'Implementing EU Law' (14 July 2023) <https://commission.europa.eu/law/application-eu-law/implementing-eu-law_en> accessed 12 February 2024; Jack (n 256) 75.

²⁵⁸ Richard Macrory and Joe Newbiggin, 'Emerging Issues with Enforcement Mechanisms' (Centre for International Governance Innovation 2017) <<http://www.jstor.org/stable/resrep15501.10>> accessed 12 February 2024; European Commission, 'Implementing EU Law' (n 257); Maria Lee, 'Environmental Past and Futures: The European Union and the "British Way"' (2019) 31 *Journal of Environmental Law* 559; Maria Lee, 'Accountability for Environmental Standards after Brexit' (2017) 19 *Environmental Law Review* 89.

‘other sources of information such as complaints from individuals, business[es] and organisations, petitions from the European Parliament, and questions from MEPS [Members of the European Parliament]’.²⁵⁹

However, *Kramer* highlights a number of issues with the Commission's monitoring processes, and in relation to the transposition of Directives, notes that it rarely conducts conformity studies itself, ‘owing to linguistic problems [...] and lack of human resources’. Instead, *Kramer* contends that the Commission routinely contracts third parties to conduct such studies, and these results are not always publicised.²⁶⁰

In relation to monitoring national application and enforcement of transposed Directives, *Kramer* contends that the Commission does not have its own inspectors or centralised enforcement agency and thus extensively relies on Member States' own ‘implementation reports’, and although these report ‘on the measures taken’, they do not report deficiencies or omissions in the application of respective Directives.²⁶¹ This, *Kramer* contends, leaves a citizen complaint, a right of every EU citizen to complain to the Commission about a potential breach of law in their respective Member State, as the only viable means of monitoring the application and enforcement of EU environmental Directives.²⁶² *Jack* further notes that ‘[r]eliance upon complaints has [...] been problematic’ as ‘they place the Commission in a largely reactive role and tend to concentrate upon certain [D]irectives or sectors of EU environmental law’.²⁶³

²⁵⁹ European Commission, ‘Legal Enforcement’ (8 February 2024) <https://environment.ec.europa.eu/law-and-governance/legal-enforcement_en> accessed 12 February 2024.

²⁶⁰ *Kramer* (n 252) 2.

²⁶¹ *ibid.*

²⁶² *ibid.*

²⁶³ *Jack* (n 356) 77.

Despite its limited means of monitoring compliance with, and application of, EU Directives, the Commission can, and actively does, launch enforcement action against Member States from time to time under Articles 258 and 260 of the Treaty on the Functioning of the European Union.²⁶⁴ This process is commonly referred to as the ‘infringement procedure’. Notably, in recent years, much of the enforcement action in the environmental domain, which *Macrory* notes is ‘often extraordinary cumbersome, and usually very reactive’, has increasingly focused on the European Green Deal’s three pillars, including the Circular Economy, which envelops the four analysed Directives in this thesis.²⁶⁵

Infringement proceedings can be brought by the Commission for non-communication, which is fairly easy to identify given that it relates to a Member States failure to notify the Commission of a Directive’s national transposition within a specified period of time.²⁶⁶ Of course, this also means that non-communication includes, as *Čavoški* notes, an ‘absolute failure to transpose a [D]irective’.²⁶⁷ Alternatively, the Commission can bring infringement proceedings for the incorrect or incomplete implementation (non-conformity) of EU environmental law, or for the inadequate (or non) application and enforcement (bad application) of it.²⁶⁸ A distinction can therefore be drawn between enforcement relating to, and stemming from, the transposition of Directives and a failure or refusal to (properly) enforce them at national level. In relation to the former, infringement proceedings may be

²⁶⁴ TFEU Art. 258 - 260.

²⁶⁵ *Macrory and Newbiggin* (n 258) 7–8; European Commission, ‘Legal Enforcement’ (n 259); *Macrory*, ‘The Enforcement of EU Environmental Law – Some Proposals for Reform (2005)’ (n 254).

²⁶⁶ Aleksandra Cavoski, ‘An Assessment of Compliance Strategies in the Environmental Policy Area’ (2016) 41 *European Law Review* 252; Suzanne Kingston, Veerle Heyvaert and Aleksandra Čavoški, *European Environmental Law* (Cambridge University Press 2017)

<<https://www.cambridge.org/core/product/6835791734BD396F2B7CD5B98259CC6B>>.

²⁶⁷ Cavoski (n 266).

²⁶⁸ TFEU Art. 258 - 260.

brought by the Commission where it considers that the Member State has not transposed a Directive correctly or at all. The latter, however, may result from a Member State failing to ensure that EU Law (be it Directives, Regulations or otherwise) are being applied and enforced correctly at the national level. Given the ‘costly and complex legal and institutional adjustments’ often required by Directives, particularly those relating to the environment, Member States may lack the necessary physical or financial resources and specialised knowhow to implement and apply EU environmental law fully or at all. Notwithstanding this, Čavoški contends that the failure to comply with EU environmental law can often be a conscious and deliberate decision of the Member States to ‘buy time’, given that it takes on average 19 months for the Commission to launch proceedings and in excess of 50 months for the case to proceed to the European Court of Justice.²⁶⁹

Nonetheless, under Article 258, the Commission can launch the infringement procedure by first sending a letter of formal notice to the Member State of concern, requesting further information and a formal response is usually required within two months of issuance.²⁷⁰ Where the Commission concludes that the Member State has not fulfilled its obligations, it may issue a ‘reasoned opinion’ requiring compliance within a further period of (usually) two months.²⁷¹ If the Commission believes the Member State has not taken satisfactory action to remedy the breach, they reserve the right to refer the matter to the European Court of Justice, which can, if they agree with the Commission, declare that the Member State has infringed the EU law in question.²⁷² The Member State must then comply with the judgement

²⁶⁹ Čavoški (n 266).

²⁷⁰ TFEU Art. 258; European Commission, ‘Infringement Procedure’ (15 July 2022)

<https://commission.europa.eu/law/application-eu-law/implementing-eu-law/infringement-procedure_en> accessed 12 February 2024.

²⁷¹ European Commission, ‘Infringement Procedure’ (n 270).

²⁷² *ibid.*

to remedy the breach, or it risks the Commission starting new infringement proceedings under Article 260, which, after applying the same infringement procedure, can result in the European Court of Justice imposing an economic penalty.²⁷³ Since the Lisbon Treaty however, the aforementioned process for imposing economic penalties in cases of ‘non-communication’ has been strengthened by the inclusion of Article 260 (3), which as *Kingston, Heyvaert and Čavoški* explain, permits the European Court of Justice to impose economic penalties on Member States on ‘the first round of infringement proceedings, without needing to obtain a prior judgment of infringement of Article 258 [Treaty on the Functioning of the European Union] [...] by that Member State’.²⁷⁴ Despite the above, scholars have consistently argued that the Commission has inadequate resources to both identify and enforce the transposition and application of EU environmental law, including that of waste law, and as a result, there is often a delay in compliance.²⁷⁵

As noted in Chapter 1, this study does not focus on the EU’s EPR frameworks beyond January 2023. However, it is important to note that the EU has announced the repeal and replacement of the batteries, end-of-life vehicles and waste packaging Directives with ‘Regulations’. This is significant as Regulations have ‘general application’, and do not, unlike Directives, require national transposition as they are binding in their entirety and ‘directly applicable in all Member States’.²⁷⁶ This removes the need for Member State interpretation, leading to increased uniformity and less fragmentation, which provides greater certainty for relevant actors (including that of, in the case of the EU’s EPR regulatory frameworks,

²⁷³ TFEU Art. 260.

²⁷⁴ TFEU Art. 260 (3); Kingston, Heyvaert and Čavoški (n 266) 188.

²⁷⁵ Jack (n 256); Kramer (n 252).

²⁷⁶ TFEU Art. 288; Kramer (n 352); Calster and Reins (n 256) Ch 3; Foster (n 248) Ch 4.

producers operating in the EU).²⁷⁷ Greater uniformity is coupled with reduced flexibility, meaning that Member States are not able to, or have less scope to, implement novel or innovative solutions to their environmental concerns. *Calster and Reins*, noting that ‘implementation and enforcement have always been key challenges for environmental law’, state that a reason for systemic enforcement issues relating to environmental law stems from regulation by ‘[D]irectives rather than directly enforceable [R]egulations’.²⁷⁸ However, whilst Regulations will certainly lead to greater uniformity, given that they remove the need for Member States to transpose the measures into national law, they may not, in the absence of a supranational enforcement agency as *Kramer* has long argued for, be a panacea for the greater enforcement of EU environmental law at the national level. This is because, whilst a Regulation is directly applicable, it still needs to be nationally applied and enforced. Indeed, as *Macrory* notes, national enforcement agencies may continue to lack the necessary resources, impetus or specialised know-how to enforce such measures.²⁷⁹ In such an event, the European Commission will likely resort to launching reactive infringement proceedings against Member States for the non-application of the Regulations.

4. Conclusion

This chapter has introduced the Circular Economy by reviewing its conceptualisation, theoretical framework, and policy adoption. The chapter found that the concept has yet to reach its accepted definitional form, although for the purposes of this research, the *Ellen*

²⁷⁷ Josephine van Zeben, ‘Environmental Law’ [2022] *The Oxford Encyclopedia of EU Law* <<https://opil.ouplaw.com/display/10.1093/law-oeel/law-oeel-e112>> accessed 8 February 2024; *Calster and Reins* (n 256) Ch 3.

²⁷⁸ *Calster and Reins* (n 256) ch 4.

²⁷⁹ *Macrory*, ‘The Enforcement of EU Environmental Law – Some Proposals for Reform (2005)’ (n 254); L Krämer, ‘The Future Role of the ECJ in the Development of European Environmental Law’, *The European Convention and the future of European Environmental Law*. Europa Law Publishing, Groningen (2003).

Macarthur Foundation's definition of the Circular Economy has been adopted. Circular Economy goals are therefore: (1) reduce waste by disposing of products, components and materials in an environmentally conscious manner; (2) keep products, components and materials at their highest utility value at all times; and, (3) protect the environment to allow nature to regenerate. The application of the EPR principle has been identified by the EU as one of the means by which a Circular Economy could be realised.

This chapter introduced the EPR principle by exploring its conceptualisation and theoretical underpinning before examining its implementation. It found that the EPR principle was originally conceptualised as a means of extending a producer's responsibility to the whole life cycle of its product, although in practice, it is often only implemented at a product's end-of-life. The EPR principle is a guiding principle for lawmakers, which can be embedded into legal systems through a selection of policy instruments (EPR policy instruments). EPR policy instruments are typically advanced through a product take-back mandate, which typically requires producers to physically or financially manage their product's collection, treatment and end-of-life management on an individual or collective basis. Other EPR policy instruments include: economic, informative and industry-based or standardisation measures.

Chapter 3: The Batteries Directive

1. Introduction

From cars to boats, torches to operating theatres, batteries and accumulators (hereafter referred to as ‘batteries’) are integral to daily life.²⁸⁰ In the European Union (EU) alone, over 1 million tonnes of batteries are placed on the marketplace annually, and this dependence is set to grow further owing to technological advancement.²⁸¹ For example, the United Kingdom (UK) aims to have its entire vehicular fleet powered by batteries by 2030, which could lead to 36 million electric vehicles by 2040.²⁸² Whilst this transition is a welcome advance in protecting the environment through decarbonisation, it is not without its challenges. One such challenge is that over time, a battery’s state of health degrades to the point that it is unable to store or expend enough energy to fulfil its intended purpose, which may ultimately lead to its disposal.²⁸³ Given that electric vehicle batteries will likely maintain a good state of health for eight to ten years, this could lead to 16,000 tonnes being disposed of annually by 2028.²⁸⁴

The degradation of batteries is not unique to electric vehicles, and is seen across the entire sector, from mobile phones and laptops to remote controllers. All batteries house a wide

²⁸⁰ European Commission, ‘On the Implementation and the Impact on the Environment and the Functioning of the Internal Market of Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on Batteries and Accumulators and Waste Batteries and Accumulators and Repealing Directive 91/157/EEC’ COM (2019) 166 final.

²⁸¹ European Commission, ‘Batteries & Accumulators’ (*European Commission*, 2020) <<https://ec.europa.eu/environment/waste/batteries/index.htm>> accessed 26 October 2020.

²⁸² Prime Minister’s Office, ‘Press Release on Green Industrial Revolution’ (*GOV.UK*, 18 November 2020) <<https://www.gov.uk/government/news/pm-outlines-his-ten-point-plan-for-a-green-industrial-revolution-for-250000-jobs>> accessed 9 August 2021.

²⁸³ Dawson, Ahuja and Lee (n 39).

²⁸⁴ *ibid.*

variety of hazardous substances and as such, are vulnerable to toxic leachate, fire or explosion upon negligent disposal.²⁸⁵ This means they pose a considerable environmental threat if not managed effectively.²⁸⁶ However, if managed appropriately, a battery is a valuable resource at its end-of-life, as it houses an eclectic and diverse mix of valuable materials. Many of these materials are 'critical', meaning they are of acute importance and are vulnerable to supply chain failures.²⁸⁷ Indeed, the rising demand for batteries has increased the risk of imminent mineral supply deficits in lithium, lead, cobalt, and graphite, all of which are abundantly incorporated into batteries during their production.²⁸⁸ This, coupled with a battery's propensity to cause environmental damage at its end-of-life, means that the realisation of a battery Circular Economy is vital.²⁸⁹

Since 1991, the EU has sought to reduce the impact of batteries on human health and the environment through Directive.²⁹⁰ However, the initial Directive 1991/157/EEC on batteries and accumulators containing certain dangerous substances was limited in scope and prohibited producers from using the most harmful substances in the design and manufacture of batteries.²⁹¹ By 2006, the 1991 Directive had been replaced by the all-encompassing regime of Directive 2006/66/EC (hereafter the 'Batteries Directive' or 'the Directive'), which

²⁸⁵ The Waste Framework Directive Art. 7 .

²⁸⁶ Ahuja, Dawson and Lee (n 9).

²⁸⁷ By 'critical', it is meant that these resources are essential for the continued supply of new batteries and are at risk of supply failure. This may be a result of political, geographical, ethical or environmental issues.

²⁸⁸ Circular, 'How the Circular Economy Is Solving the Problem of Spent Batteries' (*Circular Online*, August 2022) <<https://www.circularonline.co.uk/features/how-the-circular-economy-is-solving-the-problem-of-spent-batteries/>> accessed 8 January 2023.

²⁸⁹ *ibid.*

²⁹⁰ Sylvia Kierkegaard, 'Charging up the Batteries: Squeezing More Capacity and Power into the New EU Battery Directive' (2007) 23 Computer Law & Security Review 357; Council Directive 1991/157/EEC of 18 March 1991 on batteries and accumulators containing certain dangerous substances [1991] OJ L 78.

²⁹¹ Council Directive 1991/157/EEC of 18 March 1991 on batteries and accumulators containing certain dangerous substances [1991] OJ L 78.

seeks to implement the Extended Producer Responsibility (EPR) principle.²⁹² At the outset of this chapter, it is essential to note that the *European Commission* proposed to replace the Batteries Directive with a Batteries Regulation, which was adopted in July 2023 and will take effect from February 2024.²⁹³ Importantly, however, the Batteries Directive will not be repealed until August 2025 and remains in force.²⁹⁴ Therefore, the Batteries Directive will be the subject of this chapter's substantive analysis, though an initial assessment of the Batteries Regulation is provided in Section 8.²⁹⁵

This chapter will analyse the Batteries Directive to assess the extent to which it promotes circularity. The Circular Economy goals are to reduce waste, ensure that products, components and materials are kept at their highest utility value at all times, and protect the environment. The EPR principle extends producers' responsibility for their products to all life stages, though in practice, it is often only implemented at a products end-of-life.²⁹⁶ At first instance, this chapter summarises the Batteries Directive before assessing its design and end-of-life measures, including financing, collection, treatment, reuse and recycling. It will thereafter provide an assessment of the Directive's export, further economic instruments and enforcement provisions. Lastly, the chapter will briefly summarise the newly devised Batteries Regulation before concluding.

2. Overview of the Batteries Directive

²⁹² The Batteries Directive.

²⁹³ Regulation (EU) 2023/1542 of 12 July 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and repealing Directive 2006/66/EC [2023] OJ L 191 Art. 96.

²⁹⁴ *ibid* Art. 96.

²⁹⁵ *ibid* Art. 95.

²⁹⁶ Watkins and others (n 191).

The Batteries Directive was incepted on the 6th of September 2006 and established baseline provisions relating to waste batteries.²⁹⁷ Owing to the nature of the legislation, the Directive sets a series of objectives that all Member States must achieve. Unlike an EU Regulation, the Directive is not directly applicable, meaning that Member States were required to transpose the Directive's measures to meet its objectives by the 26th of September 2008.²⁹⁸ Some Member States incorporated the Directive in domestic legislation in two stages. The UK, for example, first implemented the Directive's design (or 'placing on the market') requirements, and nearly a year later, it transposed the Directive's end-of-life measures.²⁹⁹ The Directive's primary objectives are to protect, preserve and improve the environment and human health by reducing a battery's threat, particularly at its end-of-life.³⁰⁰ Unlike the predecessor Directive, the Batteries Directive also aims to increase resource efficiency and initiate a reduction in greenhouse gas emissions and, in theory, is more closely aligned with Circular Economy goals.³⁰¹ The Directive is 'carrot-and-stick' in nature, and places certain physical and financial responsibilities on the producer and, significantly, those that necessitate the collection, treatment, and recycling of spent batteries.

The Directive targets all forms and variations of batteries aside from those incorporated into essential security equipment.³⁰² Batteries are defined as:

²⁹⁷ The Batteries Directive Art. 26(1).

²⁹⁸ *ibid* Art. 26(1).

²⁹⁹ The Batteries and Accumulators (Placing on the Market) Regulations 2008, SI 2008/2164 (as amended); Waste Batteries and Accumulators Regulations 2009, SI 2009/890 (as amended).

³⁰⁰ The Batteries Directive (1).

³⁰¹ European Commission, 'Evaluation of the Directive 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators an Repealing Directive 91/157/EEC' SWD (2019) 1300 final.

³⁰² Council Directive 1991/157/EEC of 18 March 1991 on batteries and accumulators containing certain dangerous substances [1991] OJ L 78; Lee, 'Marketing Products under the Extended Producer Responsibility Framework: A Battery of Issues' (n 37).

'any source of electrical energy generated by direct conversion of chemical energy and consisting of one or more primary battery cells (non-rechargeable) or consisting of one or more secondary battery cells (rechargeable)'.³⁰³

At the waste battery collection and treatment stage, the Directive divides batteries into three categories with differing obligations, namely: portable, industrial and automotive. Portable batteries are sealed and can be hand-carried without difficulty; for example, a traditional AA battery.³⁰⁴ Due to their size and value, portable batteries are vulnerable to disposal through mixed or 'general' municipal waste streams and may be landfilled or incinerated.³⁰⁵ Given the environmental and resource efficiency concerns that sit alongside this, portable batteries are the focus of the Directive's most rigorous provisions and industrial and automotive battery producers are subject to less stringent obligations.³⁰⁶ A battery is classified as 'industrial' when designed solely for industrial or professional use.³⁰⁷ Oddly, this definition includes batteries used in electric vehicles, which neither reflects their increasing importance, their propensity to cause environmental harm, nor their rich makeup of resources; see Appendix 2 for a detailed discussion on the Batteries Directive and its interlink with growing rates of electric vehicles.³⁰⁸ Lastly, the Directive defines an automotive battery as an 'automotive starter, lighter or igniter'.³⁰⁹ At the recycling stage, batteries are split differently into lead-acid, nickel-cadmium, or 'other' chemical composition batteries. The ramifications of these divisions will be discussed in detail throughout this chapter.

³⁰³ The Batteries Directive Art. 3. Transposed by Waste Batteries and Accumulators Regulations 2009 Reg. 2.

³⁰⁴ *ibid* Art. 3 (3).

³⁰⁵ Lee, 'Marketing Products under the Extended Producer Responsibility Framework: A Battery of Issues' (n 37).

³⁰⁶ Waste Batteries and Accumulators Regulations 2009.

³⁰⁷ The Batteries Directive Art. 3 (6).

³⁰⁸ Dawson, Ahuja and Lee (n 39).

³⁰⁹ The Batteries Directive Art. 3 (5).

3. Design

As noted in Chapter 2, the Circular Economy demands that products are designed in an environmentally conscious manner to prevent waste, keep them and their materials at their highest utility value at all times and protect the environment. In the same vein, legislation enveloping the EPR principle can affect the design of products, be it explicitly by invoking industry-based measures or by implicit incentives. The Batteries Directive sets a number of explicit design provisions, including removability and labelling obligations, each of which will be discussed below (see sections 3.1 to 3.3). Implicit eco-design largely stems from the implementation of financial responsibility and will be discussed in section 4.1 and throughout the chapter.

3.1. Material Prohibitions

The chapter's introduction noted that batteries can house several hazardous materials and substances. Upon careless disposal, batteries may leach these materials or substances into the wider environment with problematic consequences for both humans and ecosystems.³¹⁰ This risk is exacerbated by the ubiquitous nature of smaller batteries, which are easily discarded in municipal waste streams. To combat the risk of leachate, the Directive introduced limitations on selling batteries containing mercury and cadmium.³¹¹ Despite being

³¹⁰ Ahuja, Dawson and Lee (n 9).

³¹¹ Sebastian Recknagel, Hendrik Radant and Regina Kohlmeyer, 'Survey of Mercury, Cadmium and Lead Content of Household Batteries' (2014) 34 Waste Management 156.

labelled as a 'prohibition', the Directive somewhat confusingly tolerates their use in small quantities, namely, 0.005% (mercury) and 0.0002% (cadmium) of the total battery weight.³¹²

The Directive details several exemptions that permit the uncontrolled use of cadmium and mercury in the design of batteries, which are incorporated into alarm systems and other emergency or medical devices.³¹³ This is troubling because these batteries continue to pose an immediate environmental threat at their end-of-life if not disposed of correctly. Likewise, the collection of these batteries may hinder the development of a Circular Economy, given that they may contaminate the expected recyclate. However, it is acknowledged that the availability of such exemptions is far narrower than at conception, given that power drills and button cells are no longer exempt from the Directive's prohibitions, as was previously the case.³¹⁴

Interestingly, the Directive does not require the routine collection of data on the material makeup of batteries, and as a result, the prescribed limits on cadmium and mercury are regularly exceeded by producers.³¹⁵ Owing to the lack of monitoring, the Directive's prohibitions are considered unenforceable, thus undermining the provision's effectiveness as well as the Circular Economy goal of protecting the environment. Despite this, evidence

³¹² The Batteries Directive Art. 3 (1) (a).

³¹³ *ibid* Art. 4 (2) - (4).

³¹⁴ Council Directive 2013/56/EU of 20 November 2013 amending Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators as regards the placing on the market of portable batteries and accumulators containing cadmium intended for use in cordless power tools, and of button cells with low mercury content, and repealing Commission Decision 2009/603/EC [2013] OJ L 329 Art. 1 (1)(b).

³¹⁵ European Commission, 'Proposal for a Directive of the European Parliament and of the Council Reviewing the Targets in Directives 2008/98/EC on Waste, 94/62/EC on Packaging and Packaging Waste, and 1999/31/EC on the Landfill of Waste, Amending Directives 2000/53/EC on End-of-Life Vehicles, 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators, and 2012/19/EC on Waste Electrical and Electronic Equipment' COM (2014) 397 final 29.

suggests that such prohibitions do act as a deterrent, with recent studies suggesting that mercury and lead levels have dropped throughout the EU since the Directive's enactment.³¹⁶

Though the Directive's prohibitions have demonstrated effectiveness in reducing targeted materials, it is notable that the provision merely limits the use of just two heavy metals out of many.³¹⁷ One notable omission is the ubiquitous and highly toxic heavy metal lead. Presumably, this is because lead is widely recycled and captured by the Directive's collection, treatment, and recycling obligations.³¹⁸ Nonetheless, traces of lead and other heavy metals, such as nickel, copper, zinc and chromium, have been consistently found leaching in municipal landfill sites.³¹⁹ The presence of such heavy metals, all of which pose environmental threats, particularly to aquatic life, suggests that the Directive's current heavy metal prohibitions are limited in scope and fail to provide widespread environmental protection.³²⁰

3.2. Battery Removability

³¹⁶ European Commission, 'On the Implementation and the Impact on the Environment and the Functioning of the Internal Market of Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on Batteries and Accumulators and Waste Batteries and Accumulators and Repealing Directive 91/157/EEC' (n 280) 3.

³¹⁷ A Kasassi and others, 'Soil Contamination by Heavy Metals: Measurements from a Closed Unlined Landfill' (2008) 99 *Bioresource Technology* 8578.

³¹⁸ Lee, 'Marketing Products under the Extended Producer Responsibility Framework: A Battery of Issues' (n 37) 300.

³¹⁹ Kasassi and others (n 317).

³²⁰ European Commission, 'Evaluation of the Directive 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators and Repealing Directive 91/157/EEC' (n 301); Somjai Karnchanawong and Pawena Limpitprakan, 'Evaluation of Heavy Metal Leaching from Spent Household Batteries Disposed in Municipal Solid Waste' (2009) 29 *Waste Management* 550.

The incorporation of batteries in portable electronic devices is increasing.³²¹ Given this, the Directive requires producers of electrical and electronic equipment to design their products with a battery that can be removed by the consumer or an 'independent' qualified professional with the help of instructions.³²² Though dependent on the actions of the final user, this provision is welcome because the removed battery can then be fed into the end-of-life management systems established by the Directive. Likewise, in the context of electronic equipment, the removability of batteries may facilitate the extension of the product's life, as battery degradation can often be linked to the final disposal of such equipment.³²³ However, this provision is undermined by its drafting, which merely requires batteries to be 'removable' rather than 'replaceable'.³²⁴ Where a battery is not replaceable, the electronic equipment will likely become redundant, resulting in premature disposal, contrary to the Circular Economy goal of keeping products, components and materials at their highest utility value at all times.

In addition to the above, the Directive includes an onerous exemption that allows producers to bypass the requirement for removable batteries, whereby continuous power supply is necessary for the safety, performance, and data integrity of the electronic equipment or where the device is used for medical purposes.³²⁵ The availability of this exemption may weaken the Waste Electrical and Electronic Equipment Directive's alignment with Circular

³²¹ Darrel Moore, 'MPs Relaunch E-Waste and Circular Economy Inquiry' (*Circular Online*, 13 March 2020) <<https://www.circularonline.co.uk/news/mps-relaunch-e-waste-and-circular-economy-inquiry/>>.

³²² The Batteries Directive Art. 11; European Commission, 'Frequently Asked Questions on Directive 2006/66/EU on Batteries and Accumulators and Waste Batteries and Accumulators' (European Commission 2014) 18 <<https://ec.europa.eu/environment/waste/batteries/pdf/faq.pdf>> accessed 4 November 2020.

³²³ David W Faulkner, 'How Well Are We Handling Electronic-Waste?', *2012 17th European Conference on Networks and Optical Communications* (2012).

³²⁴ European Commission, 'Ex-Post Evaluation of Five Waste Stream Directives' (n 15) 8.

³²⁵ The Batteries Directive Art. 11; European Commission, 'Frequently Asked Questions on Directive 2006/66/EU on Batteries and Accumulators and Waste Batteries and Accumulators' (n 322) 18.

Economy goals, as it could be legitimately argued that a smartphone, laptop or other similar device requires continuous power to maintain data integrity, thus leading to premature disposal; a detailed assessment of the Waste Electrical and Electronic Equipment Directive is provided in Chapter 5. Linked to this exemption, the *European Commission* recently reported that removability is declining within the EU, which is adversely affecting the end-of-life management of batteries, including their collection and recycling.³²⁶ Therefore, this exemption also undermines the Circular Economy goal of keeping products, components and materials at their highest utility value at all times.

3.3. Labelling Requirements

The Batteries Directive incorporates three forms of prescriptive labelling obligations as a design and informative tool. At first instance, producers must clearly and legibly display a 'crossed-out wheelie bin' symbol on the battery's outer casing, as shown in *Figure 3*.³²⁷ The symbol, which denotes non-disposal via municipal waste streams, should cover at least 3%, or 1.5% if the cell is cylindrical, up to a maximum of 5cm x 5cm of the battery.³²⁸ The effects of this provision are unclear, though it is expected that such labelling has diverted some batteries away from municipal waste streams and presumably towards higher utility value practices, as per Circular Economy goals.

³²⁶ European Commission, 'Evaluation of the Directive 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators and Repealing Directive 91/157/EEC' (n 301) 39 & 85.

³²⁷ The Batteries Directive Art. 21 (1).

³²⁸ *ibid* Art. 21 (1).



Figure 3: Crossed-out Wheeled Bin Symbol³²⁹

Secondly, producers are mandated to place the capacity of the battery on the outer packaging for portable and automotive batteries only.³³⁰ Capacity labelling enables consumers to make informed choices on the longevity of the batteries that they are purchasing. Though aligned with the Circular Economy goal of preventing waste, evidence suggests this requirement has not succeeded as first envisaged, and such measures may depend on the consumers' interpretation of complex information.³³¹ Significantly, the Directive's informative requirements do not require public awareness campaigns to explain the significance of choosing between a higher or lower battery capacity, which somewhat undermines the measure's effectiveness. Likewise, a recent *European Commission* report observed frequent mis-capacity labelling, and as a result, enforcement of the Directive's measures is likely compromised.³³²

³²⁹ *ibid* Annex II.

³³⁰ Council Directive 2013/56/EU of 20 November 2013 amending Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators as regards the placing on the market of portable batteries and accumulators containing cadmium intended for use in cordless power tools, and of button cells with low mercury content, and repealing Commission Decision 2009/603/EC [2013] OJ L 329 Art. 1 (10) (a).

³³¹ European Commission, 'Ex-Post Evaluation of Five Waste Stream Directives' (n 15).

³³² *ibid*.

Lastly, any battery containing more than 0,0005 % mercury, 0,002 % cadmium or 0,004 % lead must be identified as a 'heavy metal' by displaying its chemical symbol (i.e. Pb for lead) on the battery.³³³ This provision was primarily devised to aid those sorting batteries at the point of their collection and ensure their efficient treatment and recycling.³³⁴ It is unclear however, why all or at least a broader number of batteries are not marked with their chemical composition so they can be managed more effectively at the end-of-life stage. Overall, evidence suggests that the Directive's labelling requirements have diverted some batteries from the 'general' or 'mixed' waste stream and have aided their sorting before treatment and recycling, thus partially aligning with the Circular Economy goal of waste prevention and helping to keep products, components and materials products at their highest utility value.³³⁵

4. End-of-Life Management

As noted in Chapter 2, the Circular Economy demands that waste is prevented and products and materials are kept at their highest utility value at all times. This can be effectuated by, for example, repairing, reusing, remanufacturing, and recycling goods at the end of their first life. Although the EPR principle was conceptualised as a means of extending a producer's responsibility to the whole life cycle of its product, Chapter 2 noted that it is often only applied at the end-of-life. In alignment with this, much of the Directive's measures focus on the end-

³³³ The Batteries Directive Art. 21 (3).

³³⁴ European Commission, 'Proposal for a Directive of the European Parliament and of the Council Reviewing the Targets in Directives 2008/98/EC on Waste, 94/62/EC on Packaging and Packaging Waste, and 1999/31/EC on the Landfill of Waste, Amending Directives 2000/53/EC on End-of-Life Vehicles, 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators, and 2012/19/EC on Waste Electrical and Electronic Equipment' (n 315) 59.

³³⁵ The Batteries Directive Art. 21 (1).

of-life management of a battery and these are discussed below. This section will analyse the Directive's finance, collection, treatment, reuse and recycling measures.

4.1. Financing

Under the Directive's financial provisions, portable, automotive and industrial battery producers or third-party Producer Responsibility Organisations (PRO) must finance the net costs arising from the collection, treatment and recycling of the batteries they have placed on the market.³³⁶ This 'net-cost' allocation not only ensures that producers mitigate the environmental impact of their product at its end-of-life but also incentivises resource efficiency, given that producers can reduce their costs through the sale of recyclate or reusable materials.³³⁷ This net-cost burden extends to the dissemination of information, where end-users must be provided with information on the incorporation of hazardous substances in batteries, the availability of collection schemes, and the meaning of product labels through information and awareness campaigns.³³⁸ Notably however, the Directive permits smaller producers to be exempt from financially contributing to the end-of-life management of batteries and the dissemination of information under *de minimis* rules, where it does not materially impact the functioning of collection and recycling schemes.³³⁹ *De minimis* rules are considered problematic in a Circular Economy, given that they lead to reduced financial responsibility, resulting in a reduced number of batteries being collected,

³³⁶ TFEU Art. 191 (2).

³³⁷ *ibid* Art. 191 (2).

³³⁸ The Batteries Directive Art. 20.

³³⁹ *ibid* Art. 18.

treated, and, for example, recycled at the end of their life, which in turn, means that these batteries are not kept at their highest utility value at all times.³⁴⁰

To analyse the Directive's financing provisions in further detail, the UK's national transposition via the Waste Battery and Accumulator Regulations is explored as an exemplar below.³⁴¹ Under the Waste Battery and Accumulator Regulations, a producer's financial responsibility varies depending on the type and form of the battery they manufacture. A 'producer' with a UK presence who places batteries on the marketplace on a 'professional basis' for the first time may deal with portable, automotive, or industrial batteries.

4.1.1. Portable Batteries

Under the Waste Battery and Accumulator Regulations, producers of portable batteries are required to finance the 'net cost' of collecting, treating, and recycling their 'share' of end-of-life batteries.³⁴² This means that the producer must finance the total cost of these end-of-life measures minus any proceeds from the sale of recycled or reused materials. The term 'share' denotes collectivity and is calculated by establishing the producer's average tonnage of batteries placed on the UK market for the first time over the compliance period and the two preceding years.³⁴³ The resultant figure is then applied to an increasing scale detailed within the Waste Battery and Accumulator Regulations.³⁴⁴ In 2009, the year of inception,

³⁴⁰ European Commission and others (n 207) S 5.3.5.

³⁴¹ Waste Batteries and Accumulators Regulations 2009.

³⁴² *ibid* Reg. 7.

³⁴³ *ibid* Reg. 8.

³⁴⁴ *ibid* Reg 8.

producers were required to finance the end-of-life management of just 10% of their portable battery share.³⁴⁵ However, through staircasing (where targets increase incrementally over time), this eventually rose to 45% in 2016 to correspond with the Batteries Directive's collection targets.³⁴⁶ Comparatively, this then means that producers are not required to finance the collection of 55% of the batteries they place on the market. This could lead to the majority of batteries being disposed of via municipal waste streams, subsequently undermining the advance to a Circular Economy as they will not be kept at their highest utility value at all times. This is concerning given that the advance to such an economy requires a minimum collection rate of between 80-95%, though ideally as close to 100% as reasonably possible.³⁴⁷

To discharge the producer's financial obligations, portable battery producers must join one of the UK's competing battery compliance schemes, otherwise known as a PRO.³⁴⁸ In turn, PROs discharge financial, as well as specific physical, responsibilities on behalf of its members, who are a collective of producers. However, as noted in Chapter 2, collective responsibility stifles eco-design incentives, as a producer's financial contribution does not reflect the true cost of their product's end-of-life management. For example, *WEEE Comply Ltd*, a UK PRO, charges members an annual registration fee of £560 and after that, a flat-rate fee of £80 per tonne of batteries collected.³⁴⁹ Consequently, a producer's financial contribution remains static even in spite of design improvements and as a result, such

³⁴⁵ The Batteries Directive art 10.

³⁴⁶ *ibid.*

³⁴⁷ Lindhqvist (n 37).

³⁴⁸ Waste Batteries and Accumulators Regulations 2009 Reg. 8.

³⁴⁹ WEEE Comply, 'Batteries' (*Weeeecomply.co.uk*, 2020) <<https://www.weeeecomply.co.uk/batteries.htm>> accessed 2 December 2020.

schemes do not provide sufficient incentives for producers to improve the eco-design of batteries so as to keep them at their highest utility value at all times.

Most Member States employ collective responsibility as a means of financing the end-of-life management of batteries, and as a result, face similar issues to the UK as discussed above. Nonetheless, owing to Article 8a of the Waste Framework Directive, from 2023, EU PRO's will effectively be prohibited from charging flat-rate end-of-life management fees.³⁵⁰ Instead, producers financial contributions will be required to be modulated, thus contributions will be reflective of a battery's durability, repairability, reusability and recyclability.³⁵¹ However, research suggests that in order for modulation to successfully incentivise eco-design, fees should be as closely associated with the product's end-of-life management costs as is reasonably possible, though *Sachdeva, Araujo and Hirschnitz-Garbers*, note that this rarely occurs in practice and as a result, eco-design incentives can be relatively weak.³⁵² Nonetheless, it remains significant that Article 8a of the Waste Framework Directive does not attempt to transition towards individual responsibility, which could, in theory associate the entire end-of-life management costs with its producers as a means of further incentivising eco-design.

4.1.2. Industrial and Automotive Batteries

³⁵⁰ The Waste Framework Directive Art 8a (4).

³⁵¹ *ibid.*

³⁵² Anurodh Sachdeva, Ariel Araujo and Martin Hirschnitz-Garbers, 'Extended Producer Responsibility and Ecomodulation of Fees' (Ecologic 2021) 8 <<https://rethinkplasticalliance.eu/wp-content/uploads/2021/08/Ecologic-report-EPR-and-ecomodulation-August2021-1.pdf>> accessed 6 January 2023.

Moving away from the discussion on portable batteries, producers of industrial and automotive batteries are afforded greater financial freedom and flexibility by the UK's Waste Battery and Accumulator Regulations, as permitted by the Directive's financing provisions.³⁵³ Here, producers can make 'alternative' financial arrangements for collecting, treating, and recycling waste batteries and in doing so, they often enter into commercial agreements with third parties on business terms.³⁵⁴ Automotive and industrial batteries likely hold positive value at the end of their life, owing to their rich makeup of valuable materials.³⁵⁵ Therefore, commercial arrangements mutually benefit the producer and their partner, who aim to profit from such an arrangement.³⁵⁶ Consequently, industrial and automotive battery producers merely act as a 'backstop' if 'normal operations of markets' have failed to finance the battery's end-of-life management.³⁵⁷ Given this, there is little point in rigorous financial regulation where a product is likely to hold a positive value at the end of its life as these schemes will likely be self-sustaining on economic grounds alone.³⁵⁸ Given that end-of-life management operations are financed under normal market conditions, costs are directly associated with producers and their contractual partners, and as a result, eco-design incentives are likely robust.

4.2. Collection

³⁵³ The Batteries Directive; Waste Batteries and Accumulators Regulations 2009.

³⁵⁴ Gavin Harper and others, 'Recycling Lithium-Ion Batteries from Electric Vehicles' (2019) 575 *Nature* 75.

³⁵⁵ *ibid.*

³⁵⁶ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility* (n 23).

³⁵⁷ REPIC Limited, 'Your Obligations as a Battery Producer' (REPIC, 2022)

<<https://repic.co.uk/producer/batteries-compliance-2/your-obligations-as-a-battery-producer/>> accessed 27 October 2022.

³⁵⁸ Lee, 'Marketing Products under the Extended Producer Responsibility Framework: A Battery of Issues' (n 37) 304.

To increase resource efficiency and ensure widespread environmental protection, the Directive requires the collection of all end-of-life batteries. As mentioned in the preceding section, the Directive separates the collection of these batteries into three defined classifications: portable, automotive, and industrial. The collection requirements for these three forms of batteries will be discussed in turn below.

4.2.1. Portable

Owing to their size and low monetary value at the end of life, portable batteries are susceptible to being disposed of through 'mixed' or 'general' municipal waste streams. Indeed, up to 300 million batteries were disposed of via such means in 2010.³⁵⁹ Given this and a portable battery's propensity to cause environmental damage at its end-of-life, the measures in the Batteries Directive are particularly focused on their collection. The Directive requires 'appropriate' collection schemes in all Member State territories.³⁶⁰ These collection schemes should enable end-users to discard their portable batteries 'at an accessible collection point in their vicinity, having regard to population density'.³⁶¹ Notably however, accessibility is not defined in the Directive, which means there are no firm targets for the 'x' amount of collection points per 'x' amount of people. However, end-users must be able to dispose of their spent batteries on a free-of-charge basis and without any obligation to purchase additional batteries.³⁶² To carry out this task, the Directive enlists the help of portable battery 'distributors' who are required to 'take-back' waste portable batteries at 'no

³⁵⁹ Michael J Smith and Fiona M Gray, 'Batteries, from Cradle to Grave' (2010) 87 *Journal of Chemical Education* 162.

³⁶⁰ The Batteries Directive art 8.

³⁶¹ The Batteries Directive Art. 8 (1) (a).

³⁶² *ibid* Art. 8 (1) (a).

charge' to the end-user.³⁶³ The practical effects of these requirements within a UK context is explored below as an exemplar.

Contrary to the polluter pays principle, the UK's collection scheme places most of the collection onus on distributors, who must 'take-back' portable batteries from end-users on a free-of-charge basis and without obligation to purchase additional batteries.³⁶⁴ Distributor collection facilities must be advertised via signage (posters) or online and in most cases PROs will, if contracted, support distributors by supplying kiosks and appropriate signage without charge.³⁶⁵ They are incentivised to do so because PROs must reach a stipulated collection rate as governed by the Regulations, see Section 4.2.1.1 for a discussion on portable battery collection targets. Once consumers have deposited sufficient portable batteries, they must be collected by one of five competing PROs at a time of the distributor's choosing.³⁶⁶ This collection, presupposed via contract, must occur within a 'reasonable timeframe' and without charge.³⁶⁷ Until the time of collection, distributors are exempt from needing a waste management license, as required by the Environmental Protection Act 1990.³⁶⁸ Given that waste collection is a licensable activity, the exemption means that distributors can collect and store portable batteries from consumers without fear of

³⁶³ *ibid* Art. 8 (1) (b).

³⁶⁴ HM Government, 'Battery Waste: Retailer and Distributor Responsibilities' (GOV.UK, 2020) <<https://www.gov.uk/battery-waste-supplier-reponsibilities>> accessed 5 November 2020; Waste Batteries and Accumulators Regulations 2009 Reg. 31.

³⁶⁵ Ecosurety, 'Batteries - Collections' (Ecosurety, 2020) <www.ecosurety.com/collections/batteries/> accessed 6 November 2020.

³⁶⁶ Environment Agency, 'National Packaging Waste Database' (Environment Agency, February 2020) <<http://npwd.environment-agency.gov.uk/PublicRegisterBatteriesSchemes.aspx?ReturnUrl=%2fBatteriesPublicRegisterLinks.aspx%3fReturnUrl%3d%252fPublic%252fBatteriesHome.aspx>> accessed 6 November 2020.

³⁶⁷ Waste Batteries and Accumulators Regulations 2009 Reg. 32.

³⁶⁸ Environmental Protection Act 1990 (as amended) S. 33 (1) (a) - (b).

prosecution; of course this is to be expected, given that distributors are mandated with collection responsibility.³⁶⁹

It is notable, however, that the *de minimis* principle is applied to small distributors selling under 32kg of batteries per annum, which is equivalent to approximately one pack of four AA batteries per day, meaning that they are exempt from the above-stated collection requirements.³⁷⁰ The UK comprises a diverse and eclectic mix of large and small retailers, yet a network of 'corner shops' still exists in areas with dense populations and these represent the most convenient place for householders to deposit spent batteries.³⁷¹ Nevertheless, owing to the *de minimis* rules, consumers may be unable to deposit their batteries at these locations, which could subsequently increase the likelihood of negligent disposal through 'general' or 'mixed' municipal waste.

Considering the above, although producers play a role in the collection of portable batteries, distributors bear the brunt of most of the regulatory force for their collection, which does not align well with the EPR principle, nor the polluter pays principle.³⁷² Likewise, given a portable battery's low monetary value and their ease of disposal, which means that they are more likely to be placed in general municipal waste streams, it is contrary to the Circular Economy goals of waste prevention and keeping products, components and materials at their highest utility value at all times that producers do not play a significant role in their collection at the kerbside or by deposit return schemes.³⁷³

³⁶⁹ Waste Management Licensing Regulations 1994, SI 1994/1056 (as amended).

³⁷⁰ HM Government, 'Battery Waste' (n 364).

³⁷¹ HM Government, 'Our Waste, Our Resources: A Strategy for England' (n 14).

³⁷² Lindhqvist (n 37).

³⁷³ *ibid.*

4.2.1.1. Portable Battery Collection Targets

Unlike industrial and automotive batteries, the Directive supports the collection of portable batteries through the use of collection targets, which are binding on Member States. Initially, these targets required 25% of portable batteries to be collected in 2012, although this was subsequently increased to 45% in 2016.³⁷⁴ Member States typically disseminate the collection targets to national producers, according to their share of the market. Thereafter, the Directive requires Member States to report their overall collection rates as a percentage to assess Member State performance.³⁷⁵ This is calculated by dividing the total weight of collected portable batteries within the compliance period by the average weight of portable battery sales in the compliance period and the preceding two years.³⁷⁶ *Turner and Nugent* contend that whilst 'such calculations provide a reasonable estimate of collection rates', they do not 'account for numerous uncertainties, such as the life span of a single-use battery [...], consumer behaviour [...], or the number of batteries that are shipped inside products'.³⁷⁷

The introduction of the above-mentioned portable battery targets has seen collection rates increase year-on-year since the Directive's introduction.³⁷⁸ At the supranational level, collection rates have increased from 55,000 tonnes (with 162,000 tonnes placed on the

³⁷⁴ The Batteries Directive Art. 10 (2) (b).

³⁷⁵ *ibid* Art. 10 & Annex I.

³⁷⁶ *ibid* Art. 10 & Annex I.

³⁷⁷ James Morton Turner and Leah M Nugent, 'Charging up Battery Recycling Policies: Extended Producer Responsibility for Single-Use Batteries in the European Union, Canada, and the United States' (2016) 20 *Journal of Industrial Ecology* 1148.

³⁷⁸ Eurostat, 'Waste Statistics: Recycling of Batteries and Accumulators' (*Eurostat*, 2020) <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics_-_recycling_of_batteries_and_accumulators&stable=0#Sales_and_collection_of_portable_batteries_and_accumulators> accessed 9 November 2020.

market) in 2009 to 88,000 tonnes (with 191,000 tonnes placed on the market) in 2018.³⁷⁹ This means that the percentage of 'collection to sales' increased from 35.2% to 47.5% between 2009 and 2018, a rise of 12.3%.³⁸⁰ Whilst it is positive that portable battery collection rates have increased, the statistics indicate that in spite of the Directive's collection targets, the majority of portable batteries, 52.5%, are still not collected. Indeed, a troubling *European Commission* review of the Directive concluded in 2019 that, as currently drafted, the Directive's exhibited collection targets do not promote 'high levels of collection'.³⁸¹ This position is supported by *Lindqvist*, who notes that prior to the adoption of the Directive, some had argued for higher collection targets of between 80 – 95% to promote increased levels of resource efficiency and environmental protection and thus circularity, though this was dismissed.³⁸²

Consequently, it is considered here that, as currently drafted, the Directive's portable battery collection targets do not reflect the EU's circular ambitions, as the majority of portable batteries are not collected. This is because the 45% collection target, which has been met at the supranational level, has remained static since 2016 and no longer provides sufficient collection incentives for producers to collect increasing rates of portable batteries, which again, is contrary to the Circular Economy goal of keeping products, components and materials at their highest utility value at all times. Although outside the scope of this research,

³⁷⁹ *ibid.*

³⁸⁰ *ibid.*

³⁸¹ European Commission, 'Evaluation of the Directive 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators and Repealing Directive 91/157/EEC' (n 301).

³⁸² *Lindqvist* (n 37).

it is notable that the EU's Battery Regulation (see Section 8) attempts to promote greater levels of battery circularity by increasing collection targets for portable batteries.³⁸³

4.2.2. Automotive Batteries

Automotive batteries are those used for 'automotive starter, lighting or ignition power'.³⁸⁴ This definition excludes electric vehicle batteries and instead focuses on those that are typically found under the bonnet of internal combustion engine vehicles. *Lee* contends that automotive battery recycling systems are well established and have been recycled in high numbers for many years, including pre-Directive.³⁸⁵ This is mainly because the incentive for collection and subsequent end-of-life management of an automotive battery is high because it holds positive value at its end-of-life and is therefore, commercially recyclable (i.e. it can be recycled for profit).³⁸⁶ This value derives from standardisation and the automotive sector's adoption of the lead-acid composition battery.³⁸⁷ Lead, the dominant material in such batteries, is valuable upon extraction and can be recycled and incorporated into 'new' automotive batteries (a form of closed-loop circularity) for profit. This means there is little need for regulators to incentivise the collection and recycling of such batteries as producers, or their contracted third parties, already hold an economic incentive to do so owing to market

³⁸³ Regulation (EU) 2023/1542 of 12 July 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and repealing Directive 2006/66/EC [2023] OJ L 191.

³⁸⁴ The Batteries Directive art 3 (5).

³⁸⁵ *Lee*, 'Marketing Products under the Extended Producer Responsibility Framework: A Battery of Issues' (n 37) 301.

³⁸⁶ *Linda Gaines*, 'The Future of Automotive Lithium-Ion Battery Recycling: Charting a Sustainable Course' (2014) 1–2 *Sustainable Materials and Technologies* 2, s 2.1.

³⁸⁷ *Thomas Hildebrandt and others*, '19 - Standards and Tests for Lead–Acid Batteries in Automotive Applications' in *Jürgen Garche and others (eds), Lead-Acid Batteries for Future Automobiles* (Elsevier 2017) <<https://www.sciencedirect.com/science/article/pii/B9780444637000000192>> accessed 20 November 2022.

forces.³⁸⁸ Despite this, the Directive still confers responsibility on producers by requiring them to collect automotive batteries, without charge or obligation, at the behest of end-users.³⁸⁹ To do so, producers often enter into commercial relationships with third parties, facilitating battery collection. Given that automotive batteries typically hold positive value at their end-of-life, producers act as a mere financial backstop.³⁹⁰

As a result of the above, the Directive does not expressly set out 'collection targets' or reporting requirements for automotive batteries. Though not explicitly written or monitored, it is considered here that producers are effectively burdened with a *de facto* 100% collection target.³⁹¹ This is because the Directive prohibits the disposal of automotive batteries by landfill or incineration.³⁹² The success of this prohibition is hard to assess because automotive battery producers or their third parties are not obliged to report on their collection rates. Nevertheless, as explained above, collection rates are considered high owing to the end-of-life value of such batteries. One study commissioned by the *European Automobile Manufacturers Association* concluded that despite the Directive's lack of targets, the current obligations have resulted in collection rates of over 99%.³⁹³ It noted that the Directive's obligations are:

³⁸⁸ Lee, 'Marketing Products under the Extended Producer Responsibility Framework: A Battery of Issues' (n 37).

³⁸⁹ The Batteries Directive Art. 8 (4).

³⁹⁰ REPIC Limited (n 357).

³⁹¹ Dawson, Ahuja and Lee (n 39).

³⁹² The Batteries Directive Art. 14. Transposed in the UK, by the Waste Batteries and Accumulators Regulations 2009, Reg. 56.

³⁹³ Martin Seban, Olivier Nowak and IHS Markit, 'An Analysis of EU Collection and Recycling of Lead-Based Automotive Batteries During the Period 2015-2017' (European Automobile Manufacturers Association 2020) 2 <<https://www.acea.auto/files/ES-RECYCLING-V10.pdf>> accessed 13 November 2022.

'considered one of the current success stories of the EU Circular Economy with a mature network of collection points for used batteries feeding strictly regulated secondary lead producers (recyclers). These facilities operate highly efficient processes meaning that nearly all the used battery is converted into raw materials that can be used in the EU to manufacture new batteries. The lead battery recycling process can be repeated indefinitely, meaning that new lead batteries are made with materials that have been recycled many times over.'³⁹⁴

Following this, the *Faraday Institution* recently contended that automotive battery recycling is 'a text-book example for a Circular Economy, with approximately 98% collected and recycled at their end-of-life.'³⁹⁵ It is therefore argued that the Directive's automotive battery collection mandate strikes the right balance and has demonstrated effectiveness at promoting circularity.

4.2.3. Industrial Batteries

Industrial batteries, which include 'any battery or accumulator designed exclusively for industrial or professional uses or used in any electric vehicle', are subject to the least control under the Batteries Directive.³⁹⁶ Here, the Directive notes that producers should 'not refuse to take-back waste industrial batteries and accumulators from end-users', and as a result, there is no proactive obligation for their free-of-charge collection.³⁹⁷ This is because, like automotive batteries, industrial batteries hold positive value at the end of their life and are

³⁹⁴ *ibid.*

³⁹⁵ The Faraday Institution (n 179).

³⁹⁶ The Batteries Directive Art. 3 (6).

³⁹⁷ *ibid* Art. 3.

more likely to be collected under normal market conditions.³⁹⁸ Despite this, it is unclear why the Directive does not mirror the automotive collection system, as 'a text-book example for a Circular Economy', where producers collect such batteries without charge or obligation at the behest of end-users, thus protecting against market failure.³⁹⁹

Like automotive batteries, the Directive does not establish take-back targets or reporting obligations for industrial batteries.⁴⁰⁰ This is concerning, given that electric vehicle batteries, which are growing exponentially due to supranational and Member State governmental drives to transition vehicle fleets from highly polluting internal combustion engines to zero-emissions vehicles, are included in the definition of industrial batteries.⁴⁰¹ Additionally, the Directive's take-back requirements have yet to be thoroughly tested and are unlikely to be for some time, as lithium-ion electric vehicle batteries have a life expectancy of eight to ten years.⁴⁰² Nevertheless, the Directive positively prohibits the disposal of industrial batteries, including those from electric vehicles, by way of landfill or incineration.⁴⁰³ This prohibition means that in theory, the targeted rate of industrial battery take-back is 100%, though evidence suggests that this is not achieved in practice.⁴⁰⁴ Instead, it is estimated that a relatively high average of 89% of industrial batteries are taken back at the end of their life.⁴⁰⁵ Yet this means that 11% of industrial batteries are not taken back when they reach their

³⁹⁸ Skeete and others (n 179).

³⁹⁹ The Batteries Directive Art. 8 (4); The Faraday Institution (n 179).

⁴⁰⁰ The Batteries Directive Art. 3.

⁴⁰¹ *ibid* Art. 3 (6); European Commission, 'The European Green Deal' (n 118); HM Government, 'Net Zero Strategy: Build Back Greener' (2021) <<https://assets.publishing.service.gov.uk/media/6194dfa4d3bf7f0555071b1b/net-zero-strategy-beis.pdf>> accessed 5 January 2024. Both the EU and, for example, the UK, have sought to transition from internal combustion engine vehicles to electric vehicles as part of their commitments to reach 'net-zero' emissions.

⁴⁰² Ahuja, Dawson and Lee (n 9).

⁴⁰³ The Batteries Directive Art. 14.

⁴⁰⁴ European Commission, 'Evaluation of the Directive 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators and Repealing Directive 91/157/EEC' (n 301) 43–44.

⁴⁰⁵ *ibid*.

end-of-life.⁴⁰⁶ Whilst this is a relatively small percentage, it indicates that the operationalisation of industrial battery take-back is not as efficient as the automotive collection system detailed in Section 4.2.2.

It is notable that the Directive does not, as *Stahel* suggests champion sustainable ownership of goods by promoting alternative selling techniques, as a means of advancing towards a Circular Economy.⁴⁰⁷ Owing to an industrial batteries high resource and monetary value, *Ahuja, Dawson and Lee* have previously conceptualised alternative ownership models as a means of ensuring the take-back of industrial batteries.⁴⁰⁸ This model focuses on the servitisation of industrial batteries, in this case, electric vehicle batteries, to facilitate their take-back and circular end-of-life management. Here the model required producers to maintain responsibility for the electric vehicle battery via lease, regardless of the overall ownership structure of the vehicle itself.⁴⁰⁹ In doing so the authors argued that the battery take-back was guaranteed at the expiry of the lease, thus facilitating its reuse, repurposing, or recycling in line with the Circular Economy goals of waste prevention and keeping products, components and materials at their highest utility value at all times.⁴¹⁰ For a detailed discussion on the servitisation model forwarded by *Ahuja, Dawson, and Lee*, see Appendix 1.⁴¹¹

4.3. Treatment, Reuse and Recycling

⁴⁰⁶ *ibid.*

⁴⁰⁷ *Stahel* (n 83).

⁴⁰⁸ *Ahuja, Dawson and Lee* (n 9).

⁴⁰⁹ *ibid.*

⁴¹⁰ *Dawson, Ahuja and Lee* (n 39).

⁴¹¹ *Ahuja, Dawson and Lee* (n 9).

It is generally accepted that battery treatment, recycling, and reuse of recovered or existing materials is much less environmentally costly than extracting new resources.⁴¹² As previously discussed, batteries typically house several critical materials vulnerable to supply failures owing to insufficient supply, price volatility, environmental concerns or other geographical and geo-political reasons.⁴¹³ Therefore to improve resource efficiency whilst reducing the immediate environmental impact of batteries at their end of life, the Directive mandates the proper treatment and recycling of all batteries, though notably, this does not extend to their reuse or repurposing.⁴¹⁴ As will become apparent at the treatment and recycling stage, batteries are no longer classified under the three-umbrella definitions, 'portable', 'industrial' and 'automotive' batteries and instead, they are managed as per their chemical makeup.

The Batteries Directive requires Member States to ensure that producers or their third parties properly treat end-of-life batteries before recycling.⁴¹⁵ Treatment broadly means 'any activity carried out on waste batteries and accumulators after they have been handed over to a facility for sorting, preparation for recycling or preparation for disposal'.⁴¹⁶ However, at a minimum, treatment should result in all fluids and acids being removed from the battery on impermeable surfaces with waterproof coverings or in suitable containers.⁴¹⁷ After the end-of-life battery has undergone treatment, the Directive mandates recycling using the best available techniques.⁴¹⁸

⁴¹² The Advanced Rechargeable & Lithium Batteries Association, 'The Batteries Report' (RECHARGE 2018) <<https://www.storelio.com/files/2018/05/RECHARGE-The-Batteries-Report-2018-April-18.pdf>> accessed 19 November 2020.

⁴¹³ Ahuja, Dawson and Lee (n 9) 240.

⁴¹⁴ The Batteries Directive Art. 12 (1).

⁴¹⁵ *ibid* Art. 12 (1).

⁴¹⁶ *ibid* Art. 3 (10).

⁴¹⁷ *ibid* Annex III, Part A (1).

⁴¹⁸ *ibid* Art. 12 (1).

As a result of the Directive's measures, the recycling of lead-acid, nickel-cadmium and 'other' batteries has collectively increased from 1.081 million tonnes in 2009 to 1.367 million in 2018, representing an approximate increase of 23%.⁴¹⁹ However, this tells just one side of the story, as the Directive also establishes recycling efficiency targets known as 'recycling to weight' percentages as a means of achieving high levels of material recovery from the recycling of batteries.⁴²⁰ This means that to adhere to the Directive's recycling requirements, a percentage sum of the battery should be recycled according to its weight. Although variations of recycling efficiencies are forwarded by each of the four analysed Directives in this thesis, they are not considered to fit well with the Circular Economy goal of keeping products, components and materials at their highest utility value at all times, considering that such targets do not mandate the recycling of the whole product and, instead, require a targeted percentage, according to weight, to be recycled.

The Directive's efficiency targets place all batteries into three categories: nickel-cadmium, lead-acid and 'other batteries' with 'percentage to weight' targets of 75%, 65% and 50%, respectively, and these targets have not been amended since the Directive's inception.⁴²¹ However, the efficiency targets forwarded by the Directive no longer reflect the growing uptake of batteries and their increasingly rich and diverse material makeup. For example, laptops, mobile phones and electric vehicles each house a lithium-ion battery of varying sizes. Under the current regime, a mere 50% of these batteries' weight must be recycled once collected.⁴²² This is particularly low when considering that an electric vehicle battery

⁴¹⁹ Eurostat, 'Waste Statistics: Recycling of Batteries and Accumulators' (n 378).

⁴²⁰ The Batteries Directive Annex III (Part B).

⁴²¹ *ibid* Annex III (Part B).

⁴²² Ahuja, Dawson and Lee (n 9); Dawson, Ahuja and Lee (n 39).

cell housing equates to 35% of the total battery weight.⁴²³ As a result, recyclers can easily achieve the targeted recycling efficiency without being compelled to target their many critical, rare earth or hazardous materials and substances, thus failing to align with Circular Economy goals. Given this, the Directive's recycling efficiencies do not acceptably promote the recovery of critical, scarce, and valuable materials housed within batteries, such as cobalt and nickel.⁴²⁴

As drafted, the Batteries Directive's end-of-life provisions do not meaningfully incentivise the circularity of batteries, and as a result, they are not kept at their highest utility value at all times. Due to its age and inability to keep pace with technological and circular advancement, the Directive is overly focused on recycling batteries rather than preventing waste, or incentivising their higher utility management, such as reuse and preparing for reuse. This is concerning, as modern batteries have significant potential to be reused or even repurposed. For example, an electric vehicle battery will no longer be able to provide enough traction to propel a vehicle where its battery has degraded below 70 to 80%, constituting the end of its first life.⁴²⁵ Nonetheless, the battery's residual power is significant, and as a result, other, higher utility value processes could be explored before recycling, including its reuse and redeployment as an energy storage device.⁴²⁶ Despite this, the current regulatory regime perversely, and rather troublingly, incentivises lower utility value practices over and above that of other higher utility practices and as result it does not align with Circular Economy goals.

⁴²³ Ahuja, Dawson and Lee (n 9); Dawson, Ahuja and Lee (n 39).

⁴²⁴ Ahuja, Dawson and Lee (n 9); Dawson, Ahuja and Lee (n 39).

⁴²⁵ Dawson, Ahuja and Lee (n 39); Ahuja, Dawson and Lee (n 9).

⁴²⁶ Silvia Bobba, Fabrice Mathieux and Gian Andrea Blengini, 'How Will Second-Use of Batteries Affect Stocks and Flows in the EU? A Model for Traction Li-Ion Batteries' (2019) 145 *Resources, Conservation and Recycling* 279.

5. Further Economic Measures

As noted in Chapter 2, the implementation of the EPR principle can be supported through further economic measures, which may drive waste prevention or increased collection, reuse or recycling of products, thus helping to keep products, components and materials at their highest utility value. Indeed, the Directive permits the application of further economic instruments to promote the collection of waste batteries and facilitate the sale of batteries that contain lower quantities of hazardous materials.⁴²⁷ Examples include deposit return schemes, advancing 'phasing out subsidies' to disincentivise the production of single-use batteries or the promotion of reusable alternatives or fee modulation (see 4.1.1) to promote increased eco-design.⁴²⁸ Despite this, such measures are not mandated and as a result, their full potential has not been realised, given that a mere four Member States have employed them.⁴²⁹ This is troubling, particularly as 55% of portable batteries are not collected annually.⁴³⁰ Indeed, owing to the low take-up of further economic measures, the EU has previously mooted the idea of a portable battery deposit return scheme, though this was dismissed on feasibility grounds.⁴³¹ Notably however, the EU-wide portable battery deposit return scheme was dismissed prior to the Directive's inception in 2006, and as such, Europe was not at that stage, advancing towards a Circular Economy.⁴³² Though the

⁴²⁷ The Batteries Directive Art. 9 .

⁴²⁸ *ibid* Annex IVa; Pouikli (n 206).

⁴²⁹ European Commission, 'Ex-Post Evaluation of Five Waste Stream Directives' (n 15).

⁴³⁰ Kierkegaard (n 290). It is noted here that Annex IVa of the Waste Framework Directive provides examples of additional economic instruments that could be mandated.

⁴³¹ Lee, 'Marketing Products under the Extended Producer Responsibility Framework: A Battery of Issues' (n 37).

⁴³² *ibid*.

Directive permits such schemes, few Member States have employed them as collection drivers of waste portable batteries.⁴³³

6. Export

The Directive permits the export of spent batteries to meet the treatment and recycling mandate.⁴³⁴ Any export must comply with relevant transshipment regulations, and treatment and recycling may only be undertaken outside the EU where there is 'sound evidence that the recycling operation took place under the same conditions equivalent to the requirements' of the Directive.⁴³⁵ However, some have questioned the relevance of the provision, considering that the EU has sufficient capacity to deal with the Directive's treatment and recycling obligations.⁴³⁶ It is argued that such a provision, if not needed, may stifle the EU's circular ambitions, as any export represents lost material that could be repaired and reused, remanufactured or recycled within a closed-loop Circular Economy.

7. Enforcement

Owing to the legislative nature of Directives, Member States were required to transpose (and then apply and enforce) the Batteries Directive into national law by the 26th of September 2008.⁴³⁷ Failure to do so could have resulted in the commencement of infringement proceedings at the supranational level, under the enforcement mechanisms

⁴³³ Kierkegaard (n 290).

⁴³⁴ The Batteries Directive Art. 15.

⁴³⁵ *ibid* Art. 15 (2).

⁴³⁶ Skeete and others (n 179); Ahuja, Dawson and Lee (n 9).

⁴³⁷ The Batteries Directive Art. 26(1).

set out within Articles 258 and 260 in the Treaty on the Functioning of the European Union.⁴³⁸ Indeed, by way of example, in June 2021 the *European Commission* urged seven Member States (Belgium, Greece, Finland, Croatia, Luxembourg, Malta and Slovakia) to update their national transpositions to align with the Directive by issuing reasoned opinions.⁴³⁹ For a wider discussion on supranational monitoring and enforcement practices, refer to Chapter 2, Section 3.5.

The Directive instructs Member States, when transposing its measures, to ‘lay down rules on penalties applicable to infringements of national provisions’ and thereafter, ‘take all necessary measures to ensure that they are implemented’.⁴⁴⁰ In doing so, it notes that the ‘penalties provided for must be effective, proportionate and dissuasive’.⁴⁴¹ Despite this, in a 2014 implementation report, the *European Commission* noted deficiencies in the national monitoring and enforcement of Member State transpositions, and these covered both design and end-of-life measures.⁴⁴² It is considered here that the lack of Member State monitoring and enforcement noted in the abovementioned report likely stem from, as depicted in Chapter 2, Section 3.5, a lack of resource rather than a lack of national enforcement measures or strict enough penalties.⁴⁴³ This is because, taking the UK transposition as an example, both the Batteries and Accumulators (placing on the market) Regulations 2008 and the Waste Batteries and Accumulator Regulations 2009, contain monitoring and

⁴³⁸ European Commission, ‘June Infringements Package: Key Decisions’ (*European Commission*, 2021) <https://ec.europa.eu/commission/presscorner/detail/en/inf_21_2743> accessed 5 March 2023; TFEU Art. 258 - 260.

⁴³⁹ European Commission, ‘June Infringements Package’ (n 438); TFEU Art. 258 - 260.

⁴⁴⁰ The Batteries Directive Art. 25. It must be noted that the UK, as a former Member State, can no longer be subject to infringement proceedings at the supranational level.

⁴⁴¹ *ibid* Art. 25.

⁴⁴² European Commission, ‘Ex-Post Evaluation of Five Waste Stream Directives’ (n 15) Ch 4.

⁴⁴³ Macrory, ‘European Moves on Environmental Enforcement (2014) European Moves on Environmental Enforcement’ (n 255).

enforcement, offences and penalty provisions.⁴⁴⁴ Each of the respective Regulations provides relevant national regulators (such as the Environment Agency or other national equivalents) to monitor for potential breaches of the Regulations, and in doing so, they have a wide remit to gather evidence and check for compliance by, for example, making 'test purchases' or ensuring that relevant documentation is 'delivered up'.⁴⁴⁵ Failure to comply with the Regulations can result in a compliance notice, and where this notice is not adhered to within the time specified, further enforcement action can be taken, including requiring certain actions or requiring goods to be modified, withdrawn or prohibited.⁴⁴⁶ Failure to comply with an enforcement notice is an offence under the Regulations and can result in a fine not exceeding the statutory maximum.

8. Batteries Regulation

As demonstrated throughout this chapter, the global rush for batteries and their ever-changing uses and compositions have outpaced the Directive's ability to effectively manage batteries at the end of their life. As a result, the Directive is no longer fit for purpose in a modern, environmentally conscious, technological society. Whilst the Directive has undoubtedly played an important role in invoking reasonable levels of battery recycling, it has not and was never designed to invoke circularity and with this, it has not entirely fulfilled its potential to heighten environmental protection. With that in mind, replacing the Batteries Directive has long been on the agenda within the EU, and at the end of 2020, the first draft

⁴⁴⁴ The Batteries and Accumulators (Placing on the Market) Regulations 2008; Waste Batteries and Accumulators Regulations 2009.

⁴⁴⁵ The Batteries and Accumulators (Placing on the Market) Regulations 2008 Reg.9.

⁴⁴⁶ *ibid* Reg.14.

of a newly devised Batteries Regulation was released.⁴⁴⁷ Over two years, intensive negotiations culminated in a political agreement on adopting the final Regulation.⁴⁴⁸ This proposal was subsequently adopted in July 2023 and will take effect from February 2024.⁴⁴⁹ Most notably, however, the Regulation does not repeal the Batteries Directive until 24 months have passed, and as a result, it remains enforceable until 2025.⁴⁵⁰ This is troubling given the expected increase in battery adoption and the Directive's inability to deal effectively with these batteries in a way that ensures they are kept at their highest utility value at all times.

A detailed examination of the newly devised Regulation is outside this chapter's scope, and as such, the below is merely a summary of its provisions. Further study is warranted and should be pursued in the future. Nonetheless, it is essential to note at the outset that the Regulation continues to be based on the EPR principle, and with this, there are significant similarities with the provisions detailed in the existing Directive.⁴⁵¹ However, the Regulation will be directly applicable meaning that the legislation in this area no longer represents mere

⁴⁴⁷ European Commission, 'Proposal for a Directive of the European Parliament and of the Council Reviewing the Targets in Directives 2008/98/EC on Waste, 94/62/EC on Packaging and Packaging Waste, and 1999/31/EC on the Landfill of Waste, Amending Directives 2000/53/EC on End-of-Life Vehicles, 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators, and 2012/19/EC on Waste Electrical and Electronic Equipment' (n 315).

⁴⁴⁸ European Council of the European Union, 'Council and Parliament Strike Provisional Deal to Create a Sustainable Life Cycle for Batteries' (*European Council of the European Union*, 9 December 2022) <<https://www.consilium.europa.eu/en/press/press-releases/2022/12/09/council-and-parliament-strike-provisional-deal-to-create-a-sustainable-life-cycle-for-batteries/#:~:text=19%3A00-,Council%20and%20Parliament%20strike%20provisional%20deal%20to%20create%20a%20sustainable,for%20batteries%20and%20waste%20batteries.>> accessed 21 February 2023.

⁴⁴⁹ Regulation (EU) 2023/1542 of 12 July 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and repealing Directive 2006/66/EC [2023] OJ L 191 Art. 96.

⁴⁵⁰ European Commission, 'Proposal for a Regulation of the European Parliament and of the Council Concerning Batteries and Waste Batteries, Repealing Directive 2006/66/EC and Amending Regulation (EU) No 2019/1020 5469/23' COM (2020) 798 final art 78.

⁴⁵¹ The Waste Framework Directive.

'minimum standards'. Refer to Chapter 2, Section 3.5 for a wider discussion on Regulations, including enforcement.

On circularity, the EU states that the newly devised Regulation 'aims to promote a Circular Economy by regulating batteries throughout their life-cycle'.⁴⁵² One area where it hopes to promote circularity is by increasing collection targets for waste batteries. For example, by 2027 producers will be required to collect 63% of portable batteries, rising to 73% by 2030.⁴⁵³ This is a marked increase from the current required collection rate of 45%, though it is questionable whether this is ambitious enough to invoke a full battery Circular Economy. Markedly, the Regulation proposes the introduction of a newly devised collection target for 'light means of transport' batteries (for example, e-scooters and e-bikes). The collection rate is initially set as 51%, rising to 61% by 2031; again this is encouraging, yet it is unclear whether such targets are ambitious enough.⁴⁵⁴ Alongside increasing collection targets, the Regulation is set to introduce revised recycling efficiencies and minimum levels of recycled materials. For example, in the Directive, the recycling efficiencies were set for lead-acid (65%), nickel-cadmium (75%) and 'other' batteries (50%). Under the new Regulation, alongside revised targets for the existing categories, an additional category for 'lithium-based' batteries will be implemented, with a 65% target.⁴⁵⁵

Concerning design, one of the most significant revisions alongside introducing a 'battery passport', is the requirement for incorporated portable batteries to be removable and

⁴⁵² European Council of the European Union (n 448).

⁴⁵³ European Commission, 'Proposal for a Regulation of the European Parliament and of the Council Concerning Batteries and Waste Batteries, Repealing Directive 2006/66/EC and Amending Regulation (EU) No 2019/1020 5469/23' (n 450).

⁴⁵⁴ *ibid.*

⁴⁵⁵ *ibid* Annex XII, Part B.

replaceable by end-users; notably, such a provision will likely lead to reduced rates of waste electrical and electronic equipment. Perversely, such a provision may lead to increasing careless battery disposal rates by consumers.⁴⁵⁶ Given the concern raised in this chapter on the Batteries Directive's inability to deal with electric vehicle batteries, the Regulation's adoption of a bespoke electric vehicle battery definition and obligations is welcome. Here, measures include the requirement for producers to declare electric vehicle batteries 'carbon footprint', in addition to further labelling and minimum recycled content obligations. Nonetheless, upon initial assessment, it is contended that the Regulation does not provide radical solutions that are likely to result in a battery Circular Economy, as batteries will not, for example, always be kept at their highest utility value; particularly in light of the aforementioned targets noted above.

9. Conclusion

Undoubtedly, the Batteries Directive has positively affected the design and end-of-life management of batteries. The major and most notable success is that in line with the Directive's objectives, the collection and recycling of batteries has likely increased.⁴⁵⁷ Of course, such success should be championed for its positive environmental impact. However, the Directive is approaching 20 years since its enactment and is no longer keeping pace with technological or societal changes. Compared to 20 years ago, batteries are now seen as portability and decarbonisation drivers, and with this, their importance is ever-growing. Likewise, economies have only recently realised the importance of circularity. The Directive

⁴⁵⁶ *ibid.*

⁴⁵⁷ The word 'likely' here is intentional, given that this increase is more evident for portable batteries than it is for automotive or industrial batteries, owing to the Directives reporting requirements.

has failed to keep pace with such changes on both counts, despite some successes, particularly with automotive batteries. Indeed, it seems that the EU's Batteries Regulation addresses some of the issues outlined in this chapter, although upon initial assessment this Regulation fails to fully embrace the radical solutions that may invoke full circularity; however, further study is needed.

Chapter 4: End-Of-Life Vehicles Directive

1. Introduction

Vehicles, of which 258 million are registered within the European Union (EU), are a staple ingredient for modern mobility, and their uptake continues to increase, with a 5.7% rise from the five years to 2017.⁴⁵⁸ The growth of the automotive industry is increasingly crucial for Europe's prosperity, representing 6.8% of the EU Gross Domestic Product (GDP) and 13.3 million jobs.⁴⁵⁹ Nevertheless, vehicles have a finite lifespan, ranging from between 15 and 22 years, and owing to their ubiquitous nature, between 7 and 8 million vehicles reach the end of their life each year within the EU.⁴⁶⁰ In 2017 alone, 12.7 million tonnes of end-of-life vehicle (hereafter, ELV) waste was generated.⁴⁶¹ Yet, owing to their rich, diverse and complex makeup, an ELV represents both an environmental hazard and a resource opportunity.⁴⁶² This is because, on the one hand, a vehicle houses materials such as lead, mercury, cadmium, and hexavalent chromium, as well as substances such as fuels, oils, brake fluids, and coolants, all of which can be environmentally problematic if vehicles are not managed effectively at the end of their life.⁴⁶³ On the other hand, a vehicle at the end of its life is a valuable resource, housing several materials, including ferrous and non-ferrous

⁴⁵⁸ European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50) 13; Kosacka-Olejnik (n 50); Selman Karagoz, Nezir Aydin and Vladimir Simic, 'End-of-Life Vehicle Management: A Comprehensive Review' (2020) 22 *Journal of Material Cycles and Waste Management* 416.

⁴⁵⁹ Kosacka-Olejnik (n 50); European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50).

⁴⁶⁰ European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50) 16.

⁴⁶¹ European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50) 13; Kosacka-Olejnik (n 50); Karagoz, Aydin and Simic (n 458).

⁴⁶² European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50) 16.

⁴⁶³ *ibid* 13; Kosacka-Olejnik (n 50); Karagoz, Aydin and Simic (n 458).

metals, glass, rubber, and plastics, which can be reused, repurposed, remanufactured, or recycled.⁴⁶⁴

The EU designated ELVs as a priority waste stream in 1991 and proposed harmonised legislation in 1997.⁴⁶⁵ This aimed to increase resource efficiency by promoting reuse, recycling, and recovery while encouraging environmentally friendly manufacturing and dismantling. However, it was not until 2000 that the EU agreed and incepted the End-of-Life Vehicles Directive (2000/53/EC) (hereafter, the 'ELV Directive' or 'the Directive').⁴⁶⁶ This Directive was the first to include the Extended Producer Responsibility (EPR) principle, which aims to extend a producers' responsibility for their product to all life stages, though it is often only implemented at a products end-of-life.⁴⁶⁷

This chapter will assess the ELV Directive and the extent to which it induces circularity. As discussed in the previous chapters, the Circular Economy goals are to prevent waste, ensure that products, components, and materials are kept at their highest utility value at all times and protect the environment. The chapter will discuss the ELV Directive before assessing its design measures, which include waste prevention, material prohibitions and design information. At this point, the chapter will analyse the Directive's end-of-life measures, including collection, treatment, reuse and recycling. Finally, the chapter will

⁴⁶⁴ European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50) 13; Kosacka-Olejnik (n 50); Karagoz, Aydin and Simic (n 458).

⁴⁶⁵ Massimiliano Mazzanti and Roberto Zoboli, 'Economic Instruments and Induced Innovation: The European Policies on End-of-Life Vehicles' (2006) 58 *Ecological Economics* 318; European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50).

⁴⁶⁶ The End-of-Life Vehicles Directive.

⁴⁶⁷ Watkins and others (n 191).

discuss export, end-user information, further economic measures, and enforcement before concluding.

2. Overview of the End-Of-Life Vehicles Directive

The ELV Directive was adopted on 21 October 2000, after ELVs were designated as a priority waste stream in 1991.⁴⁶⁸ Since its inception, the Directive has not seen any major revision.⁴⁶⁹ However, it should be noted that the *European Commission* released a proposal for repealing and replacing the ELV Directive in July 2023 ‘to facilitate the transition of the automotive sector to the [C]ircular [E]conomy, at all stages of the vehicle - from design to final treatment at end-of-life’.⁴⁷⁰ Although this proposal is outside the scope of this chapter and thesis, a brief overview is provided at Section 9.

The ELV Directive's first aim is to prevent vehicle waste by reusing and recycling vehicles and their components at their end-of-life.⁴⁷¹ Secondly, it targets improvements in the environmental performance of ‘all economic operators involved in the life-cycle of vehicles and especially the operators directly involved in the treatment of vehicles’.⁴⁷² As with the Batteries Directive (assessed in Chapter 3), the Directive includes a range of measures that firstly affect vehicle design. After that, the Directive mandates the collection, treatment, and recycling of vehicles and their components, which have reached the end of their useful life.

⁴⁶⁸ The End-of-Life Vehicles Directive.

⁴⁶⁹ European Commission, ‘Executive Summary of the Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles’ SWD P (2021) 60 final 1.

⁴⁷⁰ European Commission, ‘Proposal for a Regulation of the European Parliament and of the Council on Circularity Requirements for Vehicle Design and on Management of End-of-Life Vehicles, Amending Regulations (EU) 2018/858 and 2019/1020 and Repealing Directives 2000/53/EE and 2005/64/EE’ (n 124).

⁴⁷¹ The End-of-Life Vehicles Directive Art. 1.

⁴⁷² *ibid* Art. 1.

Unlike the Batteries Directive, the ELV Directive lays measures for reusing materials housed in ELVs and their components, but it does not mention circularity, which is likely due to the age of the Directive.⁴⁷³

Definitionally, a ‘producer’ is the entity that places the vehicle or its components on the marketplace for the first time. In the main, the Directive targets vehicle manufacturers or their importers. By targeting ‘vehicles’, the Directive seeks to target 4-wheeled (and 3-wheeled) vehicles and their components that are used for passenger carriage and have no more than eight seats (Class M1⁴⁷⁴), as well as vehicles that are used for the carriage of goods but do not exceed more than 3.75 metric tonnes (Class N1⁴⁷⁵). This means that 45 million EU vehicles, including motorbikes, lorries, and buses, are excluded from the Directive’s scope, with the *European Commission* noting that ‘these vehicles are currently not subject to any specific EU-wide rules regarding the treatment of the waste they generate, which [...] causes loss in circular economy terms’.⁴⁷⁶

However, as its name suggests, the Directive is predominately concerned with those vehicles that have reached the end of their useful life because it has been ‘written off’ or the car is no longer of use to the final holder, which could be due to age, technical specifications or condition.⁴⁷⁷ A vehicle will not fall under the Directive’s regime until it meets the definition of ‘waste’, as defined within the EU under the 2008 Waste Framework Directive as: ‘any

⁴⁷³ When enacted in 2000, the transition from a linear to a Circular Economy was not a policy objective of the EU.

⁴⁷⁴ Council Directive 1970/156/EEC of 6 February 1970 on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers [1970] OJ L 042 Annex IIA.

⁴⁷⁵ *ibid* Annex IIA.

⁴⁷⁶ European Commission, ‘Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles’ (n 50) 13.

⁴⁷⁷ Skeete and others (n 179) 4.

substance or object which the holder discards or intends or is required to discard' (see Section 3.3.1 of Chapter 2 for a further discussion on 'waste').⁴⁷⁸ Notably, the ELV Directive applies 'irrespective of how the vehicle has been serviced or repaired during use and whether it is equipped with components supplied' by third parties, providing they comply with EU law.⁴⁷⁹ From a circular perspective, this provision raises significant concerns regarding components that do not comply with EU law. Though it is unclear how final holders dispose of non-complying components, it is unlikely that they are managed in accordance with the Directive's measures, thus conflicting with the Circular Economy goals of waste prevention and keeping products, components and materials at their highest utility value at all times.

The ELV Directive required Member States to transpose its measures by 21 April 2002, although some measures were not enforceable until January 2007.⁴⁸⁰ The UK's transposition, for example, depicts a clear example of a multi-stepped approach to implementing the Directive's requirements. Here, implementation occurred in two stages, via the End-of-Life Vehicles Regulations 2003 and End-of-Life Vehicles (Producer Responsibility) Regulations 2005.⁴⁸¹ This approach has resulted in this area of UK law being complex, owing to its piecemeal and disordered nature. It is argued that a more coherent and ordered, thus less complex, body of law would have been achieved had the UK transposed the ELV Directive's measures into a single Regulation. Under the End-of-Life Vehicles Regulations 2003, the first UK implementation stage involved restricting vehicle design so that it could no longer contain a material make-up of hazardous heavy metals.⁴⁸²

⁴⁷⁸ The Waste Framework Directive Art. 3 (1).

⁴⁷⁹ The End-of-Life Vehicles Directive Art. 3 (1).

⁴⁸⁰ *ibid* Art. 12.

⁴⁸¹ End-of-Life Vehicles Regulations 2003, SI 2003/2635; End-of-Life Vehicles (Producer Responsibility) Regulations 2005, SI 2005/263.

⁴⁸² End-of-Life Vehicles Regulations 2003.

Producers were also required to ‘mark’ specific rubber and plastic vehicle components and publicly make vehicle design information available to facilitate future recycling. Notably, this stage also sought to infer responsibility on economic operators to introduce systems that enable the free take-back of vehicles placed on the UK marketplace after July 2002.⁴⁸³ After that, it introduced ‘certificates of destruction’, which certify that a vehicle has been ‘destroyed’ in compliance with ELV legislation.⁴⁸⁴ The second stage was implemented within the UK under the End-of-life Vehicles (Producer Responsibility) Regulations 2005.⁴⁸⁵ Namely, it required producers to provide for the free take-back of all vehicles, backed up by a mandatory requirement to collect and treat vehicles at their own cost. Collection and treatment monitoring targets and enforcement provisions were also introduced. Since the two statutory instruments were introduced, only two minor amendments have occurred in 2010 and 2016.⁴⁸⁶ This is largely due to the ELV Directive’s static nature owing to the fact, as noted above, that the Directive has not been subject to any major revision since its inception. This in itself is troubling, given that much of the EU’s policy on the advance towards a Circular Economy (see Chapter 2, 2.1) has occurred after the aforementioned dates.

3. Design

⁴⁸³ *ibid.*

⁴⁸⁴ *ibid.*

⁴⁸⁵ End-of-Life Vehicles (Producer Responsibility) Regulations 2005.

⁴⁸⁶ Department for Business, Innovation and Skills, ‘The End of Life Vehicles Regulations 2003, 2005 and 2010: Government Guidance Notes’ (HM Government 2010)
<<http://www.bis.gov.uk/assets/biscore/business-sectors/docs/e/10-897-elv-regulations-guidance-june-2010.pdf>> accessed 2 July 2020.

As detailed in Chapter 2, a vital goal of the Circular Economy is to ensure that products are designed in an environmentally conscious manner to prevent waste, keep products, components and materials at their highest utility value at all times and protect the environment. Legislation enveloping the EPR principle can affect product design on an explicit or implicit basis.⁴⁸⁷ The below discusses the Directive's explicit design measures, including waste prevention, material prohibitions and informative requirements. However, the Directive's implicit eco-design incentives, which can arise as a result of economic or physical responsibilities being passed to producers, are discussed throughout this chapter.

3.1. Waste Prevention

The ELV Directive introduced several measures to advance waste prevention, reuse, and recycling. Firstly, Member States were required to 'encourage' vehicle manufacturers, from the conception stage onwards, to limit or reduce their use of hazardous substances in the design of vehicles, thus aiming to prevent environmental damage and enable vehicular reuse and recycling.⁴⁸⁸ After that, Member States were required to 'encourage' the automotive sector to integrate increasing levels of recycled content into the design of their vehicles, a key goal of the Circular Economy Action Plan.⁴⁸⁹ In order to facilitate this, the sector was 'encouraged' to design and produce new vehicles with a focus on their end-of-life dismantling, reuse, and recycling.⁴⁹⁰

⁴⁸⁷ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility* (n 23).

⁴⁸⁸ The End-of-Life Vehicles Directive Art. 4 (1) (a).

⁴⁸⁹ *ibid* Art. 4 (1) (c).

⁴⁹⁰ *ibid* Art. (4) (1) (b).

However, merely requiring Member States to ‘encourage’ the automotive sector to apply entire life-cycle thinking in the design of their vehicles is weakly drafted as it is unspecific and unmeasurable. Indeed, it is unclear how the Member States have sought to transpose these measures, and a recent evaluation of the Directive by the *European Commission* concluded that:

‘These provisions have [...] had little to no impact on the design and manufacturing of new vehicles. It is doubtful that vehicles currently put on the market are easier to dismantle and recycle than in 2000, notably in view of the changes in the composition of cars, which includes a growing volume of plastics and electronics.’⁴⁹¹

Therefore, in their current form, the Directive’s waste prevention measures are largely ineffective.

3.2. Material Prohibition

In a more prescribed manner than the measure set out in the previous section, the Directive sought to restrict certain forms of hazardous material from the design of vehicles. Here, the Directive established measures affecting the use of certain hazardous substances in vehicles ‘to reduce them as far as possible from the conception of the vehicle onwards, so as in particular to prevent their release into the environment, make recycling easier, and avoid the need to dispose of hazardous waste’.⁴⁹² Given this, the Directive’s measures

⁴⁹¹ European Commission, ‘Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles’ (n 50) 20.

⁴⁹² The End-of-Life Vehicles Directive At. 4 (2); European Commission, ‘Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles’ (n 50) 20.

sought to prohibit the use of hexavalent chromium, lead, mercury and cadmium in large quantities, though notably, it counterproductively accepts their use in small quantities, namely, 0.1% of hexavalent chromium, lead, mercury and 0.001% of cadmium.⁴⁹³ However, other environmentally damaging heavy metals commonly found in the production of vehicles, such as copper and zinc, which are of particular concern to aquatic life and may contaminate eventual recycle, are somewhat oddly not targeted by the Directive.⁴⁹⁴ Likewise, as was noted in the Batteries Directive, numerous exemptions are available to producers and initially included, for example, wheel rims, engine parts and window levers, which contained lead as an alloy in aluminium; batteries and balance weights, which contained lead; electrical components which contained lead in a glass or ceramic matrix compound; and electric vehicles (EV) batteries which contained cadmium.⁴⁹⁵ However, unlike the Batteries Directive, this Directive contains a procedure for updating exemptions on a 'regular basis, according to technical and scientific progress'.⁴⁹⁶ Though it does not specify exact timeframes, the Commission has updated its exemption list on 11 occasions.⁴⁹⁷ As a result of the above, the Directive has been partly successful in influencing the design of vehicles by restricting hazardous materials used in the manufacturing of vehicles, which is welcome.⁴⁹⁸ Nonetheless, some exemptions continue to exist alongside an accepted tolerance for specific hazardous materials (i.e. 0.1% of lead is tolerated), which

⁴⁹³ The End-of-Life Vehicles Directive Annex II.

⁴⁹⁴ Fiona Napier, Brian D'Arcy and Chris Jefferies, 'A Review of Vehicle Related Metals and Polycyclic Aromatic Hydrocarbons in the UK Environment' (2008) 226 *Desalination* 143.

⁴⁹⁵ The End-of-Life Vehicles Directive Art. 4.

⁴⁹⁶ *ibid* Art. 4 (2) (b).

⁴⁹⁷ European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50).

⁴⁹⁸ Jason Gerrard and Milind Kandlikar, 'Is European End-of-Life Vehicle Legislation Living up to Expectations? Assessing the Impact of the ELV Directive on "Green" Innovation and Vehicle Recovery' (2007) 15 *Journal of Cleaner Production* 17.

may impact the ability and desirability of ELV waste management, including recycling, in the future.⁴⁹⁹

3.3. Design Information

In addition to the above measures, the Directive seeks to ‘encourage’ reuse and recycling by obligating certain information and coding requirements. Here, Member States must ensure that vehicle producers provide ‘dismantling information for each type of vehicle’ they place on the market within six months.⁵⁰⁰ The available information must, at a minimum, enable dismantlers and recycling facilities to ascertain the vehicle design components and the location of any hazardous material within the vehicle.⁵⁰¹ Additionally, the Directive sets out coding standards, ensuring end-users can identify material recoverability. As a result, producers are mandated to place identifying ‘ISO’ (International Standards Organisation) codes on specific vehicle components to denote the product’s reuse and recyclability, and the EU established ‘component and material coding standards for vehicles’ via Commission Decision.⁵⁰² Although this provision encourages the circular management of ELVs, the Directive’s drafting stunts its effect as it does not oblige producers to provide dismantling information on a free-of-charge basis, nor are they required to supply information that inhibits intellectual property rights.⁵⁰³

4. End-of-Life Management

⁴⁹⁹ Meng Hou, Longhui Li and Lei Wang, ‘Research on Correspondence between ELV Exemption and Auto Parts Products’ (2020) 555 IOP Conference Series: Earth and Environmental Science 012044.

⁵⁰⁰ The End-of-Life Vehicles Directive Art. 8 (3).

⁵⁰¹ *ibid* Art. 8 (3).

⁵⁰² *ibid* Art. 8 (1).

⁵⁰³ *ibid* Art. 8 (4).

As noted throughout this thesis, the Circular Economy demands waste should be prevented, and products and their materials should be kept at their highest utility value at all times. As is often the case with legislation implementing the EPR principle, the ELV Directive is primarily concerned with the end-of-life management of vehicles, and as a result, it dictates that they must be collected, treated and reused or recycled. Initially, this section will analyse the Directive's collection mechanisms before assessing its treatment, reuse and recycling measures.

4.1. Collection

The ELV Directive requires Member States to take necessary measures to ensure that 'economic operators set up systems for collecting all end-of-life vehicles', and in addition to this, any parts removed during vehicular repairs.⁵⁰⁴ After the ELV has been collected, all end-of-life vehicles are required to be transferred to 'authorised treatment facilities' without 'cost and at an accessible location for the end-user'.⁵⁰⁵ Once the vehicle has been transferred to an authorised treatment facility, the end-user should be issued with a certificate of destruction, discussed in Section 4.1.1, on a free-of-charge basis.⁵⁰⁶ Significantly, the vehicle producer should bear all or a significant part of the costs associated with collecting negative-value ELVs.⁵⁰⁷ In practice, however, producers will seldom bear financial responsibility for this collection, given that in most cases, vehicles will hold positive value at the end of their life, meaning that contracted third parties will collect these vehicles

⁵⁰⁴ The End-of-Life Vehicles Directive Art. 5 (1).

⁵⁰⁵ *ibid* Art. 5 (1).

⁵⁰⁶ *ibid* Art. 5 (3).

⁵⁰⁷ *ibid* Art. 5 (4).

under normal market conditions.⁵⁰⁸ As this is an important and complex area of the Directive, the analysis below assesses the take-back measure by exploring the UK's national transposition as an exemplar.

The UK implemented the Directive's collection obligations in two stages. At first instance, it established an approved vehicle disposal network.⁵⁰⁹ To that end, the End-of-Life Vehicles Regulations 2003 introduced 'Approved Treatment Facilities' (also known as 'ATF').⁵¹⁰ These facilities, which require planning permission, environmental permits and scrap dealers' licences, are a regulated version of the traditional 'scrap metal yard'.⁵¹¹ Such facilities acquire approval by agreeing to collect, treat, and recycle vehicles in compliance with the Regulations.⁵¹² There is a financial incentive in doing so, as the vehicle likely holds positive value at the end of its life, which can be exploited.⁵¹³

Despite the introduction of the above system, it has been suggested that in 2012, 317 non-approved and illegal ELV 'scrap yards' were operational in the UK.⁵¹⁴ However, it is important to note that the UK's ratio of illegal ELV collection facilities is relatively low compared to other EU Member States, such as France and Hungary.⁵¹⁵ In France, estimates

⁵⁰⁸ Paulo Ferrão, Pedro Nazareth and José Amaral, 'Strategies for Meeting EU End-of-Life Vehicle Reuse/Recovery Targets' (2006) 10 *Journal of Industrial Ecology* 77.

⁵⁰⁹ End-of-Life Vehicles Regulations 2003.

⁵¹⁰ *ibid.*

⁵¹¹ Environmental Permitting (England and Wales) Regulations 2016, SI 2016/1154.

⁵¹² *ibid.*

⁵¹³ Ferrão, Nazareth and Amaral (n 508).

⁵¹⁴ House of Commons Library, 'Scrap Metal Dealers Bill (Bill 9 of 2012-13)' (2012) Research Paper 4 <<https://researchbriefings.files.parliament.uk/documents/RP12-39/RP12-39.pdf>> accessed 2 September 2021.

⁵¹⁵ European Commission and others, 'Assessment of the Implementation of Directive 2000/53/EU on End-of-Life Vehicles (the ELV Directive) with Emphasis on the End of Life Vehicles of Unknown Whereabouts' (Publications Office of the European Union 2018) <<https://op.europa.eu/en/publication-detail/-/publication/1ca32beb-316a-11e8-b5fe-01aa75ed71a1>> accessed 7 September 2021.

suggest that there are 800-900 illegal collection facilities, which equates to approximately 40% of all operators, which rises to 80% in Hungary.⁵¹⁶ To what extent illegal facilities treat, reuse and recycle ELVs in accordance with national transpositions, and in turn, the Directive's measures, remains unclear, and as a result, the high prevalence of such facilities may work to undermine the advance to a Circular Economy.

The installation of the ATF network provided the groundwork for the second stage of implementing the Directive in the UK under the End-of-life Vehicle (Producer Responsibility) Regulations 2005.⁵¹⁷ Here, the Regulation implemented the EPR principle, and particularly the EPR policy instrument of product take back, by requiring producers to fund the collection of ELVs where the vehicle holds negative value only, and this system is argued to increase competition whilst keeping operational costs to a minimum.⁵¹⁸ Regardless of financing, 'take-back' schemes must be free-of-charge and 'reasonably accessible' to ELV holders, providing that the vehicle contains its 'essential components', such as its engine, transmission, coachwork, wheels and catalytic converter.⁵¹⁹ This means that where an ELV does not contain 'essential components', it will fall outside of the Regulation's scope, which in turn, increases the possibility of negligent disposal. The purpose of this exclusion remains unclear, given that the ELV continues to hold resource value without its 'essential components', through, for example, its external housing.⁵²⁰ However, it is presumed that such exclusions relate to the loss of economic value, rather than resource value and in

⁵¹⁶ *ibid.*

⁵¹⁷ End-of-Life Vehicles (Producer Responsibility) Regulations 2005.

⁵¹⁸ The Producer Responsibility Obligations (Packaging Waste) Regulations 2007, SI 2007/871 (as amended) Reg 10 (6).

⁵¹⁹ End-of-Life Vehicles (Producer Responsibility) Regulations 2005 Reg 10 (7).

⁵²⁰ N Kanari, JL Pineau and S Shallari, 'End-of-Life Vehicle Recycling in the European Union' (2003) 55 JOM 15.

consequence, the provision does not align with the Circular Economy goal of keeping products, components and materials at their highest utility value at all times.

To implement the collection mandate, vehicle producers in the UK typically contract third parties using several different ATFs. By way of example, *Citroen UK Limited*, *Nissan*, *Peugeot*, *Mazda* and most other large automotive producers all contract ‘*CarTake-back.com*’ as their ‘collection’ partner.⁵²¹ *CarTake-back.com* provides a network of ATFs for end-users to return their vehicles at their end-of-life.⁵²² This collective system differs from Germany, whereby producers must negotiate individual contracts with multiple ATFs although, in practice, either mechanism will likely have little effect on achieving the Directive’s objectives.⁵²³

The Directive’s producer take-back mandate has resulted in moderate increases in collection rates since its inception. In 2017, EU Member States collected 5.3 million vehicles, up from 5.1 million in 2008.⁵²⁴ As an example of the moderate increases in collection figures mentioned above, the UK’s collection of ELV’s rose just 0.1 million between 2008 (1.2 million) and 2017 (1.3 million).⁵²⁵ However, in 2009, the number of UK ELVs collected spiked significantly to 7.7 million, attributed to scrappage schemes to support the automotive industry during the global financial crisis.⁵²⁶ This demonstrates that alternative financial

⁵²¹ Citroën UK Limited, ‘ELV Directive’ (*Citroen.co.uk*, 2021) <<https://www.citroen.co.uk/maintain/end-of-life-vehicle-regulations-and-battery-waste.html>> accessed 2 September 2021.

⁵²² CarTakeBack.com Limited, ‘Scrap Car Recycling’ (*CarTakeBack.com*, 2021) <<https://www.cartakeback.com>> accessed 3 September 2021; Citroën UK Limited (n 590).

⁵²³ Bio Intelligence Service, ‘Guidance on Extended Producer Responsibility: Case Study on WEEE in the UK’ (2014) <<http://epr.eu-smr.eu/>> accessed 6 April 2020.

⁵²⁴ Eurostat, ‘End-of-Life Vehicle Statistics: Statistics Explained’ (*Eurostat*, 2020) <https://ec.europa.eu/eurostat/statistics-explained/index.php/End-of-life_vehicle_statistics#Number_of_end-of-life_vehicles> accessed 4 August 2020.

⁵²⁵ *ibid.*

⁵²⁶ *ibid.*

incentives (economic or market-based instruments), besides mere take-back provisions, can effectively increase the collection of ELVs and may further support the transition from a linear economy to a Circular Economy, if adopted permanently. However, the Directive's take-back provisions have not resulted in 100% collection rates and as a result, absolute circularity has not been achieved, despite most vehicles holding positive end-of-life value, thus products and their materials are not kept at their highest utility value at all times.⁵²⁷

Unlike the Batteries Directive, assessed in Chapter 3, the Directive does not contain collection targets. Despite this, a recent *European Commission* evaluation of the Directive contended that the ELV collection system generally worked well across the EU.⁵²⁸ This is mainly due to the Directive's requirement for producers to collect 'all' end-of-life vehicles, and as noted above, this means that where an ELV holds a positive value, it will be collected under normal market conditions. In contrast, when the ELV holds no or negative value, the original producer will bear financial responsibility for its collection. Despite the introduction of this system, as alluded to above, an absolute vehicular Circular Economy has not been achieved.⁵²⁹ It is argued that this largely stems from issues relating to the Directive's de-registration and certificate of destruction systems as well as its export provisions and the lack of enforcement, respectively discussed in Sections 4.1.1, 5 and 8. Here, estimates suggest that up to 35% of vehicles in the EU, or 3 to 4 million vehicles, are considered 'missing' or of 'unknown whereabouts each year' (which is known as 'leakage'), and by way of example, 500,000 to 800,000 of those relate to the UK.⁵³⁰ This inevitably undermines the

⁵²⁷ European Commission and others (n 515).

⁵²⁸ European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50).

⁵²⁹ European Commission and others (n 515).

⁵³⁰ *ibid*; Gareth Williams, "ELVs: Carrot or Stick?" (2017) 59 *CIWM Journal* <http://uk.emrgroup.com/files/ciwm-may-2017_emr.pdf> accessed 4 August 2020.

circular credentials of the Directive, given that these vehicles are unlikely to be reused, remanufactured, repurposed or recycled since they will not be managed at an ATF. With that, up to 55 million litres of potentially environmentally hazardous fluids are not effectively managed according to the Directive's de-pollution regime.⁵³¹ *Kitazume, Kohlmeyer and Oehme* note that the leakage of products (such as the 'missing' or 'unknown whereabouts' vehicles detailed above) is not an uncommon problem when implementing the EPR principle, and they argue that this can often be controlled through national enforcement mechanisms.⁵³²

4.1.1. Vehicle De-Registration

To aid the collection of ELVs, the Directive's take-back mandate is supported by a vehicle de-registration mandate, which requires ELV holders to be issued with a free-of-charge certificate of destruction at the point it is delivered up to an ATF.⁵³³ In turn, this certificate acts as a guarantee that the ELV will be managed in accordance with the Directive's measures, and on supplying this to a relevant vehicle registration authority, such as the UK's Driver and Vehicle Licensing Agency, the last owner will be able to de-register the vehicle, thus halting their tax liabilities.⁵³⁴ As the certificate can only be issued by an ATF, this should, in theory, provide the necessary incentive for the ELV holder to deliver their vehicle at such facilities and in doing so, the system should ensure that the Directive's collection, treatment

⁵³¹ European Commission and others (n 515); Williams (n 530).

⁵³² Christian Kitazume, Regina Kohlmeyer and Ines Oehme, 'Effectively Tackling the Issue of Millions of Vehicles with Unknown Whereabouts' (Umwelt Bundesamt 2020) S 4.3 <https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/sciopap_uba_elv_measures_to_combat_illegal_dismantling_2020_06_29.pdf> accessed 3 September 2021; Global Forum on Environment: Promoting Sustainable Materials Management through Extended Producer Responsibility (EPR) (n 200).

⁵³³ The End-of-Life Vehicles Directive Art. 5 (3).

⁵³⁴ Dawson, Ahuja and Lee (n 39).

and recycling obligations are realised. Given this, at inception, it was hoped that the de-registration system would increase compliance and reduce vehicle abandonment, illegal treatment facilities and export, thus helping ensure high levels of resource efficiency and environmental protection.⁵³⁵

However, evidence suggests that the Directive's de-registration system has been extensively undermined by some Member States, some of whom have taken a relaxed attitude towards implementing and enforcing the provision.⁵³⁶ For example, Austria allows for automatic de-registration as soon as the vehicle changes ownership, thus avoiding checks on the certificate of destruction.⁵³⁷ Likewise, the German Environment Agency identified that temporary de-registration could occur for an 'unlimited' timeframe for any given reason.⁵³⁸ Similar practices are available in the UK, where Indefinite Statutory Off Road Notification (ISORN) have been operationalised.⁵³⁹ As a result, such systems may not sufficiently track the whereabouts of vehicles, thus opening the possibility of fraudulent de-registration and the avoidance of the Directive's measures.⁵⁴⁰ Issues with the application of the de-registration requirements and subsequent enforcement at the national level, may explain the significant numbers of 'missing' vehicles within the EU, which undermines Circular Economy goals.

4.2. Treatment

⁵³⁵ European Commission and others (n 515).

⁵³⁶ *ibid.*

⁵³⁷ Jürgen Schneider and others, 'End of Life Vehicles: Legal Aspects, National Practices and Recommendations for Future Successful Approach' (European Parliament 210AD) 27 <[https://www.europarl.europa.eu/RegData/etudes/etudes/join/2010/447507/IPOL - ENVI_ET\(2010\)447507_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/etudes/join/2010/447507/IPOL - ENVI_ET(2010)447507_EN.pdf)> accessed 6 September 2021.

⁵³⁸ Kitazume, Kohlmeyer and Oehme (n 532).

⁵³⁹ European Commission and others (n 515) 45.

⁵⁴⁰ Kitazume, Kohlmeyer and Oehme (n 532).

To frame the discussion below and in Section 4.3 on reuse and recycling, it is essential to note at the outset that, unlike the Batteries Directive, the ELV Directive does not place any financial responsibility on producers to treat, reuse or recycle ELVs. Instead, ATFs bear much of the financial risk when the ELV is delivered-up.⁵⁴¹ This is problematic on two counts, with the first being that the ATF is incentivised to depollute, reuse and recycle the ELV cheaply, given that they are operated for profit, meaning that economic value, rather than circular value, likely takes preference. Secondly, since producers are not required to contribute financially to the vehicle's de-pollution, reuse and recycling, there is a limited eco-design incentive other than those derived from the reuse and recycling targets outlined in Section 4.3.

ELVs are classified, until being treated, as hazardous waste due to their potential for environmental damage upon negligent disposal.⁵⁴² This is mainly due to the many harmful materials and substances they house at their end of life, including screen wash, engine oils and brake fluids.⁵⁴³ As a result, the ELV Directive sets minimum standards for the storage and treatment (otherwise known as 'de-pollution') of ELVs within all the EU's 14,000 ATFs.⁵⁴⁴ To fully de-pollute a vehicle, treatment is required by removing any batteries, liquefied gas tanks, fuel, and motor oils, as well as cooling/antifreeze, brake, air-conditioning

⁵⁴¹ Baron, Yifaat and others, 'Study to Support the Impact Assessment for the Review of Directive 2000/53/EC on End-of-Life Vehicles' (European Commission 2023).

⁵⁴² The End-of-Life Vehicles Directive Art. 6.

⁵⁴³ Kosacka-Olejnik (n 50).

⁵⁴⁴ European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50).

fluids, and any parts containing mercury, and this should take place on impermeable surfaces with spillage collection facilities and water treatment operations.⁵⁴⁵

In addition to the above, the Directive requires the treatment process to be carried out in such a way as to ensure the suitability of vehicle components for reuse and recovery, and in particular for recycling'.⁵⁴⁶ To achieve this, the Directive's technical guidance, which solely focuses on recycling, requires the separate collection of catalysts and metal components containing copper, aluminium and magnesium, as well as tyres, significant plastic components and glass.⁵⁴⁷ In practice, however, evidence suggests that to maximise profit and efficiency, some ATFs shred depolluted ELVs before comprehensive sifting and sorting takes place so as to direct materials for separate recycling.⁵⁴⁸ The practice of shredding, prior to sifting and sorting, is concerning given that it bypasses circular end-of-life management processes, such as reuse, repair, remanufacture and repurposing, thus failing to align with the Circular Economy goals of waste prevention and keeping products, components and materials at their highest utility value at all times.⁵⁴⁹ Likewise, these practices do not align well with the waste hierarchy, which encourages prevention and reuse before that of recycling.

4.3. Reuse and Recycling

⁵⁴⁵ The End-of-Life Vehicles Directive Annex 1 (3).

⁵⁴⁶ *ibid* Art. 6.

⁵⁴⁷ *ibid* Annex I (4).

⁵⁴⁸ European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50) 21.

⁵⁴⁹ *ibid* 22–23.

Automotive vehicles house a diverse mix of materials in both their external housing and their internal components.⁵⁵⁰ As a result, a vehicle that has reached the end of its life can be exploited as per Circular Economy goals if it is managed correctly.⁵⁵¹ Consequently, the ELV Directive introduces requirements for the reuse and recycling of ELVs, supported by targets.⁵⁵² These measures are supplemented by Directive 2005/64/EC on 'the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability', thus pleasingly linking the EU's vehicular approval process to the eco-design of vehicles.⁵⁵³

Definitionally, the ELV Directive notes that recycling is 'the reprocessing in a production process of the waste materials for the original purpose or other purposes but excluding energy recovery', which is consistent with the Waste Framework Directive.⁵⁵⁴ Reuse means 'any operation by which components of end-of-life vehicles are used for the same purpose for which they were conceived'.⁵⁵⁵ Though this is also consistent with the Waste Framework Directive, the Directive's definition of reuse is narrow.⁵⁵⁶ Here, ELVs and their components are considered as being 'reused', where those parts are used for 'the same purpose for which they were conceived' (i.e. a windshield being used as a windshield). Though this seems to align with a closed-loop Circular Economy, it may be a barrier to open-loop circularity, as material repurposing and other circular end-of-life management techniques

⁵⁵⁰ Gerrard and Kandlikar (n 498).

⁵⁵¹ European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50) 13; Kosacka-Olejnik (n 50); Karagoz, Aydin and Simic (n 458).

⁵⁵² European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50) 13; Kosacka-Olejnik (n 50); Karagoz, Aydin and Simic (n 458).

⁵⁵³ Council Directive 2005/64/EC on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability and amending Council Directive 70/156/EEC [2005] OJ L 310/10.

⁵⁵⁴ The Waste Framework Directive Art. 3 (17).

⁵⁵⁵ The End-of-Life Vehicles Directive Art. 2 (6) & (7).

⁵⁵⁶ The Waste Framework Directive Art. 3 (13).

are not explicitly incentivised.⁵⁵⁷ For instance, a product reused in its exact form, albeit in a different application, would not be recognised as being reused and will instead likely be shredded and recycled as is the norm.⁵⁵⁸ Consequently, the current drafting of the Directive's reuse definition fails to consider circular thinking fully and, thus, misses a vital opportunity to keep products, components and materials at their highest utility value. This could have been easily avoided by expanding the reuse definition to explicitly include 'second-use', targeting repurposing and other circular end-of-life management techniques.⁵⁵⁹

As of 1 January 2006, weight-based targets have been operationalised by the EU to incentivise the reuse and recycling of ELVs. Again, the burden of responsibility for meeting these targets falls on the ATF, as the producer does not hold financial or physical responsibility for ELV recycling. This seems unjust, given that producers are best placed to influence the design of their products so as to meet the below recycling and reuse targets. However, it is noted that the Directive on 'type-approval of motor vehicles with regard to their reusability, recyclability and recoverability' attempts to form a link between the ELV Directive's targets and vehicular design.⁵⁶⁰ This link ensures that a vehicle cannot be approved and placed on the market where it is not able to meet the ELV Directive's reuse and recycling targets at the end of its life.⁵⁶¹ However, the Directive missed a further opportunity to strengthen this link through the introduction of financial responsibility at the treatment, reuse and recycling stage, and had they done so it is anticipated that producers

⁵⁵⁷ In a closed loop Circular Economy, materials will be circulated in their original form (i.e materials in a tin-can will be reformed and returned to the production of a tin-can).

⁵⁵⁸ 'End of Life Vehicles (ELVs): Guidance for Waste Sites' (GOV.UK) <<https://www.gov.uk/guidance/end-of-life-vehicles-elvs-guidance-for-waste-sites>> accessed 30 July 2020.

⁵⁵⁹ Dawson, Ahuja and Lee (n 39).

⁵⁶⁰ Council Directive 2005/64/EC on the type-approval of motor vehicles with regard to their reusability, recyclability and recoverability and amending Council Directive 70/156/EEC [2005] OJ L 310/10.

⁵⁶¹ *ibid.*

would not have merely sought to meet their recycling targets, they would have been financially incentivised to exceed them, thus helping to facilitate vehicular circularity.

The ELV Directive recycling and reuse targets are somewhat oddly conflated and originally stood at 75% of the vehicle weight, which thereafter climbed to 85% with the inclusion of recovery.⁵⁶² In 2015, the reuse and recycling target increased to 85% and 95% with the inclusion of recovery.⁵⁶³ As currently drafted, producers are not fully incentivised to keep products, components and materials at their highest utility value at all times or apply the waste hierarchy as there is no requirement for them to favour reuse over recycling. Instead, the Directive's conflation of its reuse and recycling targets suggests that they are tantamount. However, this is not consistent with the waste hierarchy, which ranks reuse above recycling, nor is it aligned with Circular Economy goals. Nevertheless, since its enactment, Member States have performed well in achieving the targets established by the Directive. Such performance has partly been fuelled by the mandatory nature of the Directive's reuse and recycling provisions, as noted above. Economics also plays a considerable role, given that many ELV components hold positive value, thus further incentivising greater reuse and recycling.⁵⁶⁴ However, the drafting of the targets themselves might also be a contributing factor, given that by combining reuse and recycling and focusing on total ELV weight, the targets arguably become more straightforward to achieve.

⁵⁶² The End-of-Life Vehicles Directive Art. 7 (2) (a).

⁵⁶³ *ibid* Art. 7 (2) (b).

⁵⁶⁴ Chartered Institute for Waste Management, 'End of Life Vehicles' (CIWM, 2023) <<https://www.ciwm.co.uk/ciwm/knowledge/end-of-life-vehicles.aspx>> accessed 6 July 2020.

Across the whole of the EU, the rate of reuse and recovery stood at 94% in 2017; Holland performed the best with a rate of 98%, whilst Italy attained the lowest at 83.2%.⁵⁶⁵ In the same year, the reuse and recycling figure averaged across the EU at 87.9%; Croatia performed the best with rates of 99.3%, whilst Slovakia performed the worst with a rate of 82.8%.⁵⁶⁶ The UK achieved a below-par reuse/recovery rate of 94.1% but an above-par reuse/recycling rate of 86.5%.⁵⁶⁷ This differs from 2015, the year higher targets came into force, where the UK exceeded targets set on both accounts, securing 96.9% and 87.3%, respectively.⁵⁶⁸

However, it is argued that targets based on the weight of a vehicle is not the most appropriate means of effectuating circularity. This is because such targets give rise to a perverse incentive for producers to target the vehicle's most ubiquitous and heavy components, regardless of their resource potential or environmental threat. For example, on average, an ELV primarily comprises ferrous metals, equating to 68.3% of its total weight.⁵⁶⁹ Under the current regime, economic operators are therefore incentivised to target such materials over other environmentally problematic components, such as plastic polymers (1.1% of a vehicle's total weight) or carpets (0.4% of a vehicle's total weight).⁵⁷⁰ The Directive could have reduced this perverse incentive through the incorporation of modulated targets that targeted specific, low-weighted, difficult to reuse or recycle vehicle components, such as plastics. For an example of material-specific recycling rates, see *Table 2* in Chapter 6, which relates to waste packaging. Despite this, weight-based efficiency targets do not sit

⁵⁶⁵ Eurostat, 'End-of-Life Vehicle Statistics: Statistics Explained' (n 524).

⁵⁶⁶ *ibid.*

⁵⁶⁷ *ibid.*

⁵⁶⁸ *ibid.*

⁵⁶⁹ Gerrard and Kandlikar (n 498).

⁵⁷⁰ *ibid.*

well with Circular Economy goals or the waste hierarchy, given they do not mandate the recycling of the whole collected vehicle and, instead, merely require a targeted percentage, according to weight, to be reused or recycled.

5. Export

Unlike the Batteries Directive, the Directive does not target the export of vehicles at the end of their life. Instead, the Directive relies on the EU's Waste Shipment Regulations to regulate exports to other Member States or countries that are members of *the Organisation for Economic Co-operation and Development (OECD)* or a signatory of The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal 1989.⁵⁷¹ Significantly, the Waste Shipment Regulations prohibit the export of ELVs outside of the EU.⁵⁷² That being said, there is no export prohibition for vehicles that have not reached their end-of-life and as such, these vehicles can be transhipped to all countries, regardless of their OECD membership or whether they are a Basel Convention signatory. Here, ageing vehicles that are approaching their end-of-life can legally be exported to low or middle-income countries under the guise of operational vehicles. Evidence suggests that these rules are being criminally exploited by the fraudulent declaration of ELVs as 'operational' vehicles, thus permitting their export.⁵⁷³ This is, in some cases, being supported or facilitated by dysfunctional Member State de-registration systems, as detailed at 4.1.1.⁵⁷⁴ Therefore,

⁵⁷¹ Regulation (EC) 1013/2006 of 14 June 2006 on shipments of waste [2006] OJ L 190; Decision of the Council on the Control of Transboundary Movements of Wastes Destined for Recovery Operations (OECD/LEGAL/0266); The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal 1989.

⁵⁷² Waste Shipment Regulations Title IV: Exports from the Community to Third Countries.

⁵⁷³ European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50) 34–36.

⁵⁷⁴ United Nations, 'Used Vehicles and the Environment' (United Nations Environment Programme 2020).

export, de-registration, and national enforcement practices are likely significant factors in the EU's 4 million 'missing' or 'unknown whereabouts' vehicles.

The exportation of vehicles, be it under a façade or otherwise, not only poses a significant environmental threat to the country of import, given that many low to middle-income countries have less robust end-of-life management practices, but also represents a circular threat to exporting nations.⁵⁷⁵ This is because housed materials are subsequently lost to other countries, meaning that they cannot be filtered back into a cylindrical model of consumption, which in turn may undermine the functioning of such systems.

6. End-User Information

Chapter 2 of this thesis identified that the EPR principle can be implemented through the adoption of information-based EPR policy instruments, which typically pass certain informative responsibilities to producers.⁵⁷⁶ Whilst an element of informative responsibility is highlighted in Section 3.3 (design information) of this chapter, only limited financial or physical obligations are placed on producers to provide information to end-users.⁵⁷⁷ Here, the Directive notes that producers should be obligated to publish information on the design of their vehicles so as to aid their recoverability and recyclability potential, and this should be made freely available to consumers.⁵⁷⁸ Likewise, the Directive mandates that producers should publish information on the environmentally sound treatment of end-of-life vehicles,

⁵⁷⁵ Ibid.; European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50).

⁵⁷⁶ Lindhqvist (n 129); Dawson (n 17).

⁵⁷⁷ The End-of-Life Vehicles Directive.

⁵⁷⁸ Ibid Art. 9 (2).

their optimisation for reuse, recycling and recovery, as well as the ‘progress achieved with regard to recovery and recycling’.⁵⁷⁹

Given the above, it can be said that the Directive end-user information provisions are *prima facie* aligned with that of Circular Economy goals, given that the provision of information attempts to prevent waste and keep products, components and materials in use for as long as possible by encouraging reuse and recycling, albeit excluding other circular management techniques. Nonetheless, the measure is neither specific nor measurable, and very little detail is given on the types and forms of information that should be provided to end-users. This is problematic because consumers are unlikely to be presented with a standardised set of information so as to make informed choices.

7. Further Economic Measures

Further economic measures are a helpful tool in realising Circular Economy goals by increasing the collection and circular management of ELVs, including reuse, repurposing, remanufacturing and recycling, through economic incentivisation. However, unlike the Batteries Directive, the ELV Directive is silent on the use of additional economic instruments to further the objectives of the Directive. Nevertheless, owing to the fact that the Directive does not explicitly prohibit the use of further economic measures, some Member States have sought to introduce them on their own accord to support collection rates and tackle the issue of missing or ‘unknown whereabouts’ vehicles.

⁵⁷⁹ *ibid.*

Sweden, for example, has a long-established deposit return scheme, which pre-dates the enactment of the Directive in the year 2000.⁵⁸⁰ In brief, this system requires a vehicle purchaser to transfer a monetary deposit to a Government-operated fund.⁵⁸¹ After that, this deposit is held as collateral until the vehicle has been returned to an ATF at the end of its life.⁵⁸² At this stage, the end-user is paid the deposit by the dismantler, which in turn seeks reimbursement for the Government operated fund.⁵⁸³ The scheme initially resulted in increased rates of ELV collection at ATFs (rather than illegal operators) and decreased the rate of missing vehicles.⁵⁸⁴ However, a significant drawback of the scheme was that the value of the original deposit decreased over time due to inflation and the length of vehicular ownership, and as a result, the end-users economic incentive to return the vehicle at its end-of-life was also reduced.⁵⁸⁵ That said, deposit return schemes are not the only way of supporting EPR and Circular Economy goals. For example, it is considered that virgin material taxes could play an important role in incentivising the recycling and reuse of vehicle materials by encouraging their use in their design, thus also stimulating their collection.⁵⁸⁶ Given this, it is unclear as to why a mandatory framework for the adoption of further economic instruments as a means of supporting the take-back, recycling and reuse measures was not pursued at the Directive's conception.⁵⁸⁷

8. Enforcement

⁵⁸⁰ Forslind (n 146); Panate Manomaivibool, 'Network Management and Environmental Effectiveness: The Management of End-of-Life Vehicles in the United Kingdom and in Sweden' (2008) 16 *Journal of Cleaner Production* 2006.

⁵⁸¹ Forslind (n 146); Mazzanti and Zoboli (n 465).

⁵⁸² Forslind (n 146); Mazzanti and Zoboli (n 465).

⁵⁸³ Forslind (n 146); Mazzanti and Zoboli (n 465).

⁵⁸⁴ Forslind (n 146); Manomaivibool (n 580).

⁵⁸⁵ Forslind (n 146); Manomaivibool (n 580).

⁵⁸⁶ Bruvoll (n 174); Söderholm (n 175); Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23).

⁵⁸⁷ Annex Iva of the Waste Framework Directive provides examples of additional economic instruments that could be mandated.

The End-of-Life Vehicles Directive is, owing to its legislative form, not directly applicable and as such, has needed Member States to transpose, and as per all forms of EU law, apply and enforce its measures. Notwithstanding the discussion on enforcement in Chapter 2, this means that at the supranational level, the European Commission can instigate infringement proceedings for non-transposition, incorrect or incomplete implementation or inadequate (or no) application and enforcement of the transposed Directive's measures under Article 258 and 260 of the Treaty on the Functioning of the European Union.⁵⁸⁸ For a wider discussion on supranational, and indeed, national enforcement, please refer to Chapter 2, Section 3.5

The End-of-Life Vehicles Directive is silent on how Member States should enforce the transposed Directive's measures. However, it is notable that, as mentioned in Chapter 2, by extension of the Court of Justice of the European Union it is a prerequisite that Member States should apply the Directives measures and provide for 'effective, proportionate and dissuasive' penalties.⁵⁸⁹ This has been achieved in the UK, for example, through the incorporation of measures permitting the monitoring and enforcement of the End-of-Life Vehicles Regulations.⁵⁹⁰ Here, failure to comply with certain obligations will result in a 'compliance notice' being issued, stating the grounds of the contravention and a time limit within which the offender must make good the contravention.⁵⁹¹ If this does not occur, a summary or indictment offence is committed, and the contravening party may be liable to a fine not exceeding the statutory maximum.⁵⁹² Under enforcement can therefore be linked, as

⁵⁸⁸ TFEU Art. 258 - 260.

⁵⁸⁹ Macrory, 'European Moves on Environmental Enforcement (2014) European Moves on Environmental Enforcement' (n 255).

⁵⁹⁰ End-of-Life Vehicles Regulations 2003.

⁵⁹¹ *ibid* Reg 9.

⁵⁹² *ibid* Reg 10.

it is by the *European Commission*, to national regulators having a lack of necessary fiscal and human resources to monitor and subsequently enforce ELV regimes effectively, rather than a lack of available monitoring and enforcement provisions.⁵⁹³ Nonetheless, under-enforcement may ultimately decrease its effectiveness in promoting a vehicle Circular Economy, which can be demonstrated by the EU's high rate of 'missing' vehicles.⁵⁹⁴

9. Proposed End-of-Life Vehicles Regulation

The *European Commission* released a proposal for the repeal and replacement of the ELV Directive with a newly devised End-of-life Vehicles Regulation in July 2023.⁵⁹⁵ This proposal is at the beginning of the legislative process, and as a result, it is unlikely to be adopted before 2025. At this point, the ELV Directive will not be repealed for 12 months, meaning it will likely remain in force until 2026.⁵⁹⁶ Though this proposal is outside of the scope of this research, given its significance, a summary is provided below.⁵⁹⁷ Noting current vulnerabilities of the ELV Directive, including the scope, design, poor treatment and the high rates of missing vehicles, the *European Commission's* proposed Regulation seeks to transition from the current linear vehicular economy to a Circular Economy.⁵⁹⁸ The proposal

⁵⁹³ *ibid* Reg 10; European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50) 36.

⁵⁹⁴ European Commission, 'Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles' (n 50) 36.

⁵⁹⁵ European Commission, 'Proposal for a Regulation of the European Parliament and of the Council on Circularity Requirements for Vehicle Design and on Management of End-of-Life Vehicles, Amending Regulations (EU) 2018/858 and 2019/1020 and Repealing Directives 2000/53/EE and 2005/64/EE' (n 124).

⁵⁹⁶ *ibid* Art. 56.

⁵⁹⁷ This proposal was released during the concluding days of this research and as a result, the summary provided is relatively brief, owing to time constraints. Given this, further study is needed.

⁵⁹⁸ European Commission, 'Proposal for a Regulation of the European Parliament and of the Council on Circularity Requirements for Vehicle Design and on Management of End-of-Life Vehicles, Amending Regulations (EU) 2018/858 and 2019/1020 and Repealing Directives 2000/53/EE and 2005/64/EE' (n 124) Recital 1.

advances several measures designed to ‘improve the quality of end-of-life treatment, incentivise reuse, and make the most efficient use of precious resources’ by targeting the entire lifecycle of vehicles.⁵⁹⁹ In seeking to achieve this, the proposal reaffirms and strengthens its use of the EPR principle by encouraging ‘better quality waste treatment’ and promoting manufacturer and dismantler cooperation; however, the Regulation continues to predominantly focus on the implementation of the EPR principle at a products end-of-life. It is notable that the producer bears financial responsibility for the ‘average’ costs of collection, recycling and treatment operations. However, the design effects of collectivity is mitigated through specific measures on fee modulation, aligning with Articles 8 and 8a of the Waste Framework Directive, which rewards producers for eco-design.⁶⁰⁰

In a welcome change, the Regulation proposes that lorries, busses and motorcycles are progressively brought within the scope of its measures, constituting a significant variation from that of the ELV Directive.⁶⁰¹ In doing this, it is estimated that up to 45 million extra vehicles will be subject to design and end-of-life management requirements, thus increasing vehicular circularity.⁶⁰² At the design stage, the proposal reasserts material prohibitions, informative responsibility and minimum reusability, recyclability and recoverability rates, the

⁵⁹⁹ European Commission, ‘End-of-Life Vehicles Regulations’ (*European Commission: Energy, Climate change, Environment*, 2023) <https://environment.ec.europa.eu/topics/waste-and-recycling/end-life-vehicles/end-life-vehicles-regulation_en> accessed 13 August 2023.

⁶⁰⁰ European Commission, ‘Proposal for a Regulation of the European Parliament and of the Council on Circularity Requirements for Vehicle Design and on Management of End-of-Life Vehicles, Amending Regulations (EU) 2018/858 and 2019/1020 and Repealing Directives 2000/53/EE and 2005/64/EE’ (n 124) S. 2; The Waste Framework Directive Art. 8 & 8a.

⁶⁰¹ European Commission, ‘Proposal for a Regulation of the European Parliament and of the Council on Circularity Requirements for Vehicle Design and on Management of End-of-Life Vehicles, Amending Regulations (EU) 2018/858 and 2019/1020 and Repealing Directives 2000/53/EE and 2005/64/EE’ (n 124) Art. 2.

⁶⁰² European Commission, ‘Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles’ (n 50) 13.

latter of which continues to be associated with vehicular approval within the Union.⁶⁰³ Significantly, however, producers will be required to design their vehicles with 25% recycled plastics and declare the extent to which they have incorporated recycled materials into the production of vehicles.⁶⁰⁴ Conformity will be regulated by introducing a 'vehicle circularity passport'.⁶⁰⁵

Concerning end-of-life management, the proposed Regulation particularly targets the collection and treatment of vehicles. The former aims to reduce the 'missing vehicles' rate in the Union, whereas the latter seeks to promote higher utility value practices to recover a more significant amount of secondary raw materials that can be fed back into the cylindrical consumption model.⁶⁰⁶ To reduce the number of missing vehicles and thus increase collection rates, the proposal forwards connected 'electronic databases', which allow for the exchange of vehicle identification numbers and vehicle registration or roadworthiness statuses amongst Member States.⁶⁰⁷ In addition, the proposal advances a framework for the export of vehicles, which includes a prohibition on the export of unroadworthy vehicles.⁶⁰⁸

As for treatment, the proposal details requirements for the removal of specified vehicle components prior to shredding so as to facilitate their efficient reuse and recycling, and their

⁶⁰³ European Commission, 'Proposal for a Regulation of the European Parliament and of the Council on Circularity Requirements for Vehicle Design and on Management of End-of-Life Vehicles, Amending Regulations (EU) 2018/858 and 2019/1020 and Repealing Directives 2000/53/EE and 2005/64/EE' (n 124) Art. 4, 5, 8, 9 & 11.

⁶⁰⁴ *ibid* Art. 6 & 10.

⁶⁰⁵ *ibid* Art. 13.

⁶⁰⁶ European Commission, 'End-of-Life Vehicles Regulations' (n 599).

⁶⁰⁷ European Commission, 'Proposal for a Regulation of the European Parliament and of the Council on Circularity Requirements for Vehicle Design and on Management of End-of-Life Vehicles, Amending Regulations (EU) 2018/858 and 2019/1020 and Repealing Directives 2000/53/EE and 2005/64/EE' (n 124) Art. 38 - 41 & 45.

⁶⁰⁸ *ibid* Art. 38 - 41 & 45.

sale is encouraged.⁶⁰⁹ Likewise, in accordance with Circular Economy goals, the proposals require Member States to take all necessary measures to ensure the ‘remanufacturing and refurbishment [including repair] of parts and components’, though no targets are attached to these requirements.⁶¹⁰ Owing to the perverse incentives arising from weight-based targets, the proposal forwards a minimum plastic recycling rate of 30%, further supporting the minimum content obligations stated above.⁶¹¹ Notably, reuse and recycling targets remain as detailed in the ELV Directive. Despite this, if adopted, the Regulation will align with the Circular Economy goals of waste prevention and keeping products, components and materials at their highest utility value to a greater degree, although, until the draft text has been agreed and adopted at the supranational level and subsequently applied and enforced at the national level, the extent to which it creates a vehicle Circular Economy will remain unclear.

10. Conclusion

ELVs pose a particular threat to the environment and human health upon negligent disposal. Nevertheless, their eclectic mix of materials means they represent a significant pool of resources that can be exploited in a Circular Economy if managed effectively. Accordingly, the ELV Directive, the first EU waste legislation to incorporate the EPR principle, sought to introduce specific design measures and requirements for the end-of-life management of vehicles. Here, the Directive targets vehicles, ELVs and their components, though concerning its scope does not encompass motorbikes, busses, or lorries, equivalent to 44

⁶⁰⁹ *ibid* Art. 30.

⁶¹⁰ *ibid* Art. 33.

⁶¹¹ *ibid* Art. 34.

million vehicles within the EU. The Directive's design measures sought to encourage waste prevention, reduce the use of hazardous substances, and increase reuse and recycling rates. It also introduced specific material prohibitions on some of the most hazardous and common heavy metals used in the production of vehicles, though these provisions are poorly drafted and therefore unspecific, unmeasurable, and limited in scope.

The Directive's end-of-life measures mandate the collection, treatment, reuse, and recycling of ELVs. Under normal market conditions, most ELVs will hold positive value, and as a result, profit-making collectors will facilitate their end-of-life collections. However, where a vehicle does not hold a positive value at the end of its life, the Directive requires its producers to bear financial responsibility for its collection. This chapter found that the Directive's collection mandate has operated reasonably effectively and undoubtedly raised rates of collection within Europe. Despite this, the Directive's de-registration and export provisions as well as a lack of national enforcement, have weakened progress since the EU is estimated to have 4 million 'missing' or 'unknown whereabouts' vehicles, constituting 35% of the available ELVs. Moreover, it is notable that the Directive effectuates financial responsibility sparingly, and as a result, ATF operators, rather than producers, bear much of the financial risk associated with the treatment, reuse and recycling of ELVs, given that they operate for profit under normal market conditions. This means that such operators will likely choose the least cost option for managing ELVs, and as a result, this does not always align with the Circular Economy goal of keeping products, components and materials at their highest utility value or the waste hierarchy, which places, for example, reuse above recycling. In a similar vein, the sparing use of financial responsibility means that producers do not have sufficient incentive to eco-design.

The Directive attempts to incentivise a high utility value end-of-life management process through a mixture of obligations necessitating reuse and recycling as well as employing targets. However, the chapter found that the Directive's reuse definitions were not always conducive to a Circular Economy, as they perversely disincentivised, for example, the repurposing of ELV components. It was found that although the Directive's reuse and recycling targets were relatively high, they were contrary to Circular Economy goals as they conflate reuse and recycling, thus signalling equal preference. This is particularly troubling, given that it directly contradicts the waste hierarchy, which, as noted above, favours reuse over recycling. In addition to this, the Directive's targets are based on the vehicle's weight, and as a result, this means that ATFs will likely target the most ubiquitous heavy components rather than those that represent the greatest environmental threat or resource value. It was also noted that weight-based efficiency targets do not align well with Circular Economy goals or the waste hierarchy, given that they *prima facie* accept that a portion of collected vehicles will not be reused or recycled. Compounding these issues, the Directive's reuse and recycling targets have remained static for over ten years, and they no longer sufficiently incentivise increasing levels of resource efficiency. This chapter concludes that despite the Directive's successes in increasing the collection, treatment, recycling and reuse of ELVs, a vehicular Circular Economy has not been achieved. The *European Commission's* proposals for replacing the ELV Directive with a Regulation better aligns with the waste hierarchy and the Circular Economy goals of keeping products, components and materials at their highest utility value. However, the extent to which it will induce a total vehicular Circular Economy remains unclear.

Chapter 5: Waste Electrical and Electronic Equipment (WEEE) Directive

1. Introduction

The uptake of Electrical and Electronic Equipment (EEE), which is widely construed to mean any product that houses a plug or battery, continues at pace owing to sustained demand, rapid technological advances and falling costs.⁶¹² This in turn, has led to increasing rates of Waste Electrical and Electronic Equipment (WEEE) generation, now Europe's and indeed the world's fastest-growing waste stream, with an estimated annual disposal rate of 9 million tonnes in the European Union (EU) alone in 2020.⁶¹³ WEEE consists of a diverse and eclectic mix of materials, and any one product can contain up to 60 metals, some deemed 'critical' and vulnerable to supply failures, whereas others are 'heavy' and environmentally problematic.⁶¹⁴

The diversity of materials housed in WEEE represents an equal threat and opportunity.⁶¹⁵ On the one hand, if WEEE is not managed effectively, it can be environmentally problematic because many of the materials found within the waste stream's products are highly toxic, and disposal can cause significant environmental harm if not pre-treated.⁶¹⁶ Improper

⁶¹² Moore, 'MPs Relaunch E-Waste and Circular Economy Inquiry' (n 321).

⁶¹³ *ibid*; Cole and others (n 53); House of Commons, Environmental Audit Committee, 'Electronic Waste and the Circular Economy' First Report of Session 2019-21, HC 220.

⁶¹⁴ Moore, 'MPs Relaunch E-Waste and Circular Economy Inquiry' (n 321); Deepali Sinha Khatriwal and others, 'One WEEE, Many Species: Lessons from the European Experience' (2011) 29 Waste Management & Research 954.

⁶¹⁵ Masahiro Oguchi, Hirofumi Sakanakura and Atsushi Terazono, 'Toxic Metals in WEEE: Characterization and Substance Flow Analysis in Waste Treatment Processes' (2013) 463–464 Science of The Total Environment 1124; The WEEE Directive (Recast).

⁶¹⁶ Wenzhi He and others, 'WEEE Recovery Strategies and the WEEE Treatment Status in China' (2006) 136 Journal of Hazardous Materials 502.

disposal can also result in the non-realisation of the WEEE's resource potential and lead to, amongst other effects, the extraction of additional raw materials, which is energy-intensive and can result in increasing pollution, habitat loss and soil degradation.⁶¹⁷ On the other hand, if managed correctly, WEEE is a considerable resource which can be exploited by reusing, repairing, remanufacturing and recycling its many materials.⁶¹⁸ These benefits are two-fold: firstly, environmentally hazardous waste is removed from landfill and incineration streams, and secondly, resource extraction is minimised.

Given the above, the EU designated 'e-waste' as a priority waste stream in 1999, which subsequently led to the introduction of the Waste Electrical and Electronic Equipment Directive (2002/96/EC) in 2002.⁶¹⁹ Owing to several significant amendments, the Directive was 'recast' and entered into force in 2012 under Directive 2012/19/EU.⁶²⁰ In a similar vein to the Batteries and End-of-life Vehicles Directives, the WEEE Directive sought to implement the Extended Producer Responsibility (EPR) principle and this, as is often the case, particularly focused on end-of-life management. The Restriction of Hazardous Substances Directive (2011/65/EU) complements the Directive by setting specific design requirements.⁶²¹ Though closely associated with the WEEE Directive, the Hazardous Substances Directive does not exclusively focus on EEE, nor does it implement the EPR

⁶¹⁷ Neal R Haddaway and others, 'Evidence of the Impacts of Metal Mining and the Effectiveness of Mining Mitigation Measures on Social–Ecological Systems in Arctic and Boreal Regions: A Systematic Map Protocol' (2019) 8 Environmental Evidence 9.

⁶¹⁸ Moore, 'MPs Relaunch E-Waste and Circular Economy Inquiry' (n 321).

⁶¹⁹ Khetriwal and others (n 614).

⁶²⁰ The WEEE Directive (Recast).

⁶²¹ Council Directive 2002/95/EC of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment [2002] OJ L 37; Council Directive 2011/65/EU of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) [2011] OJ L 174/88.

principle.⁶²² This chapter assesses the extent to which the WEEE Directive invokes circularity, and as part of that, the Restriction of Hazardous Substances Directive will be discussed. At the outset, it is essential to note that the EU is currently evaluating the effectiveness of the WEEE Directive, and its repeal and replacement is possible, though a proposal has not been forwarded.⁶²³

As noted in Chapter 2, the Circular Economy goals are to prevent waste, keep products, components and materials at their highest utility value at all times and protect the environment. The EPR principle extends producers' responsibility for their product to all life stages, though it is often only implemented at a products end-of-life.⁶²⁴ At first instance, this chapter provides a summary of the WEEE Directive before exploring its core measures, namely, design and end-of-life, which include financing, collection, treatment and recycling. It will then discuss the Directive's export, end-user information, further economic measures and enforcement provisions before concluding.

2. Overview of the Waste Electrical and Electronic Equipment Directive

Since WEEE's designation as a priority waste stream in 1999, the EU has sought to tackle rising rates of EEE waste.⁶²⁵ The Directive was first introduced in 2002 and later 'recast' in 2012 owing to several significant amendments, the latter Directive being the primary focus

⁶²² European Commission, 'Waste Electronic Equipment' (*European Commission*, 2020) <https://ec.europa.eu/environment/waste/weee/index_en.htm> accessed 26 February 2020.

⁶²³ European Commission, 'Commission Consults Citizens and Stakeholders on the Directive on Waste from Electrical and Electronic Equipment (WEEE)' (*European Commission: Energy, Climate change, Environment*) <https://environment.ec.europa.eu/news/commission-consults-citizens-and-stakeholders-directive-waste-electrical-and-electronic-equipment-2023-06-16_en> accessed 13 August 2023.

⁶²⁴ Watkins and others (n 191).

⁶²⁵ The WEEE Directive (Recast).

of this chapter.⁶²⁶ The Directive aims to 'preserve, protect and improve the quality of the environment, to protect human health and to utilise natural resources prudently and rationally'.⁶²⁷ The *European Commission* contends that the Directive 'aims to contribute to sustainable production and consumption by preventing the creation of WEEE as a first priority; contributing to the efficient use of resources and the retrieval of secondary raw materials through re-use, recycling and other forms of recovery' as well as 'improving the environmental performance of everyone involved in the life cycle of EEE'.⁶²⁸ It notes that the Directive achieves this by requiring 'the separate collection and proper treatment of WEEE and sets targets for their collection as well as for their recovery and recycling', helping 'European countries fight illegal waste exports more effectively by making it harder for exporters to disguise illegal shipments of WEEE' and reducing 'the administrative burden by calling for the harmonisation of national EEE registers and of the reporting format'.⁶²⁹

The 'recast' Directive, which was required to be nationally transposed by 14 February 2014, defines EEE as any:

'equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and fields and designed for use with a voltage rating not exceeding 1000 volts for alternating current and 1 500 volts for the direct current'.⁶³⁰

⁶²⁶ The WEEE Directive; The WEEE Directive (Recast).

⁶²⁷ The WEEE Directive (Recast) Recital 1.

⁶²⁸ European Commission – Directorate-General for Environment, 'Waste from Electrical and Electronic Equipment (WEEE)' (*European Commission*, 2021) <https://ec.europa.eu/environment/topics/waste-and-recycling/waste-electrical-and-electronic-equipment-weee_en> accessed 14 October 2021.

⁶²⁹ *ibid.*

⁶³⁰ The WEEE Directive (Recast) Art. 3 (1) (a).

Notably however, the Directive does not apply to essential security assets, filament lightbulbs, equipment designed to be sent to space, large-scale stationary industrial tools or fixed installations, means of transport, non-road mobile machinery, medical and *in vitro* diagnostic medical devices, as well as equipment designed for research and development.⁶³¹ Despite this, the Directive targets most electrical items that house a plug or battery and therefore covers a wide variety of products, from mobiles and computers to ovens and dishwashers. EEE is not considered waste until the end-user has physically discarded it or intends to, or is required to, discard the item.⁶³² Notwithstanding the Directive's design measures, the most significant of its provisions, namely those affecting the end-of-life management of the product, is initiated when the product becomes 'waste'. Given this, the Directive operates under an 'open scope' whereby all discarded EEE, their components, subassemblies and consumables are caught by the Directive unless explicitly excluded.⁶³³ WEEE falls into one of six categories, namely:

'1. temperature exchange equipment, 2. screens, mirrors and equipment containing screens, 3. lamps, 4. large equipment, 5. small equipment and 6. small IT and telecommunication equipment.'⁶³⁴

The accurate categorisation of WEEE is vital, particularly at the end-of-life stage, where recovery, recycling and reuse efficiencies are mandated; see Section 4.3 for a detailed discussion on the Directive's efficiency targets.

⁶³¹ *ibid* Art. 2.

⁶³² *ibid* Art. 3 (1) (e); The Waste Framework Directive Art. 3 (1).

⁶³³ The WEEE Directive (Recast) Art. 3 (1) (e).

⁶³⁴ *ibid* Annex IA.

The 'open scope' approach forwarded by the 2012 'recast' Directive contrasts significantly with that of the original 2002 WEEE Directive, which operated under a 'closed scope', meaning that WEEE provisions only applied to WEEE that fell into one of ten categories.⁶³⁵ Namely:

'1. Large household appliances, 2. Small household appliances, 3. IT and telecommunications equipment, 4. Consumer equipment, 5. Lighting equipment, 6. Electrical and electronic tools, 7. Toys, leisure and sports equipment, 8. Medical devices, 9. Monitoring and control instruments, and 10. Automatic dispensers'.⁶³⁶

Evidence suggests that this 'closed' scope approach often led to differing interpretations on whether the Directive's scope covered certain products or not.⁶³⁷ From a circular perspective, the transition from 'closed' to 'open' scope is welcome because, as *Bio Intelligence Service* notes, it helped clarify several previously exploited 'grey areas'.⁶³⁸ This view was reciprocated by *Jenni Ylä-Mella and others*, who argued that the amendment to the Directive's scope increased compliance, owing to its simplistic, 'catch-all' application.⁶³⁹

3. Design

⁶³⁵ The WEEE Directive Annex IA.

⁶³⁶ *ibid* Annex IA.

⁶³⁷ Bio Intelligence Service, 'Review of the Scope of the Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE)' (2013) Draft Final Report prepared for European Commission, DG ENV <https://ec.europa.eu/environment/pdf/waste/weee/approved_%20WEEE%20scope%20review.pdf> accessed 23 November 2021.

⁶³⁸ *ibid*.

⁶³⁹ Jenni Ylä-Mella and others, 'Implementation of Waste Electrical and Electronic Equipment Directive in Finland: Evaluation of the Collection Network and Challenges of the Effective WEEE Management' (2014) 86 Resources, Conservation and Recycling 38.

As noted throughout this thesis, the Circular Economy demands that goods are designed in an environmentally conscious manner to prevent waste, keep products, components and materials at their highest utility value at all times and protect the environment. Legislation implementing the EPR principle, such as the WEEE Directive, can affect product design explicitly or implicitly.⁶⁴⁰ As mentioned above, the design of EEE is influenced by the WEEE Directive and the Hazardous Substances Directive. The former Directive establishes general product design and labelling requirements, whereas the latter provides for material prohibitions, which are explored below. However, implicit eco-design incentives, which can evolve as a result of economic or physical implementation of the EPR principle is discussed throughout this chapter.

3.1. Product design and Labelling

Article 4 of the Directive sets out a general statement on the design of EEE, which requires Member States to improve product design by encouraging cooperation between producers and recyclers to facilitate reuse, dismantling and recovery, thus *prima facie* aligning with Circular Economy goals.⁶⁴¹ In doing so, Article 4 of the Directive requires Member States to ensure that eco-design of WEEE, including reuse and ‘treatment’, is not prevented by producers through the design of their products:

⁶⁴⁰ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility* (n 23).

⁶⁴¹ WEEE Directive (Recast) Art. 4 ; European Court of Auditors, ‘EU Actions and Existing Challenges on Electronic Waste’ (2021) Review 04
<https://www.eca.europa.eu/Lists/ECADocuments/RW21_04/RW_Electronic_Waste_EN.pdf> accessed 28 October 2021.

‘unless such specific design features or manufacturing processes present overriding advantages, for example, with regard to the protection of the environment and/or safety requirements’.⁶⁴²

Evidence presented by *Waugh and others* on behalf of the *European Commission* suggests that Article 4 has had little to no effect on the design of EEE products because ‘the interests of producers, users and recyclers are not aligned’, presumably because of Member State inaction.⁶⁴³

Furthermore, it is argued here that, as currently drafted, Article 4 of the Directive provides a minimal legislative incentive for producers to improve the design of their products as the provision merely seeks to ‘encourage’ rather than establish a specific or measurable framework that compels reuse. For example, the UK’s WEEE Regulations merely requires the Secretary of State ‘to encourage the design and production of EEE that takes into account and facilitates dismantling and recovery, in particular, the reuse and recycling of WEEE’, though how this is achieved in practice is discretionary, given that there is not a specific or measurable framework to, for example, ‘produce mandatory reuse standards within six months of commencement’.⁶⁴⁴ Indeed, to fill the gap between the vagueness of the Directive, its transpositions and industry implementation, the UK’s *Waste and Resources Action Programmes (WRAP)*, published an ‘Electrical and Electronic Equipment Sustainability Action Plan (ESAP)’, which sought to improve the design and durability of EEE

⁶⁴² The WEEE Directive (Recast) Art. 4.

⁶⁴³ Rachel Waugh and others, ‘Study on the Implementation of Product Design Requirements Set out in Art. 4 of the WEEE Directive: The Case of Re-Usability of Printer Cartridges’ (Publications Office of the European Union 2018) 17 <<https://op.europa.eu:443/en/publication-detail/-/publication/17b7b664-15f0-11e8-9253-01aa75ed71a1/language-en/format-PDF>> accessed 26 February 2020.

⁶⁴⁴ The Waste Electrical and Electronic Equipment Regulations 2013, SI 2013/3113 Reg. 79.

products.⁶⁴⁵ Though welcome, the voluntary plan has received a mere 81 signatories and is, therefore unlikely to affect EEE circularity.⁶⁴⁶

Article 4's drafting failure means that the Directive has little influence over the design of EEE, other than the design incentives derived from its financing provisions, see Section 4.1. Given this and the importance of eco-design in the development of a Circular Economy, owing to its ability to facilitate, for example, reuse, repair, remanufacture and recycling practices, it is argued that the drafting of the Directive does not sufficiently meet Circular Economy goals. This is because the Directive does not introduce specific or measurable minimum EEE design standards that take account of the Circular Economy goal of keeping products, components and materials at their highest utility value at all times, and as such, it does not sufficiently encourage the design and production of durable and repairable EEE.⁶⁴⁷

In addition to the measures outlined above, the Directive introduces informative responsibility by mandating the display of EEE product labelling.⁶⁴⁸ Here, the Directive's labelling requirements are similar to those detailed in Chapter 3, where producers must display a clear and legible 'crossed-out wheeled bin' symbol, see *Figure 3*.⁶⁴⁹ Barring exceptional cases, the symbol must be displayed on the EEE product itself, rather than its packaging.⁶⁵⁰ The purpose of this symbol is to indicate the separate collection of WEEE,

⁶⁴⁵ Eunomia Research & Consulting Ltd, 'Final Implementation Report for Directives 2002/96/EC and 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE): 2013 – 2015' (European Commission 2018) 25
<https://ec.europa.eu/environment/archives/waste/reporting/pdf/Final_Implementation_Report_2013_2015_WEEE.pdf> accessed 27 May 2020.

⁶⁴⁶ *ibid.*

⁶⁴⁷ Moore, 'MPs Relaunch E-Waste and Circular Economy Inquiry' (n 321); Cole and others (n 53); House of Commons, Environmental Audit Committee (n 613).

⁶⁴⁸ The WEEE Directive (Recast) Art. 14 & 15.

⁶⁴⁹ *ibid* Art. 14 & 15.

⁶⁵⁰ *ibid* Art. 14 & 15.

thus minimising disposal through municipal waste streams. It is unclear as to the effects of the symbol on consumer behaviour. However, as noted in Chapter 3, research on the display of the 'crossed-out wheeled bin' symbol on batteries found that such labels successfully diverted waste from landfill or incineration towards environmentally sound end-of-life practices, per Circular Economy goals.⁶⁵¹ The Directive's labelling requirements are complemented by additional informative responsibility measures, detailed in Section 6, though these do not affect EEE's design *per se*.

3.2. Material Prohibitions

As set out in this chapter's introduction, WEEE contains a broad mix of potentially environmentally hazardous material if disposed of incorrectly. The negligent disposal of WEEE, including headphones, mobile phones and tablets, is commonplace owing to their size and portability.⁶⁵² As a result, the Restriction of Hazardous Substances (RoHS) Directive, a daughter Directive of the WEEE Directive, sets out several prohibitive measures on using hazardous substances in the production of EEE.⁶⁵³ These restrictions, which complement the Directive's efforts to collect, treat and recover WEEE, aim to mitigate the potential for environmental harm.⁶⁵⁴ Accordingly, the RoHS Directive sets out prohibitions relating to some, but not all, of the most hazardous substances found in EEE production. These include lead (0,1%), mercury (0,1%), cadmium (0,01%), hexavalent chromium

⁶⁵¹ European Commission, 'Evaluation of the Directive 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators and Repealing Directive 91/157/EEC' (n 301).

⁶⁵² Emmanouil Dimitrakakis and others, 'Small WEEE: Determining Recyclables and Hazardous Substances in Plastics' (2009) 161 *Journal of Hazardous Materials* 913; Marianne Bigum and others, 'WEEE and Portable Batteries in Residual Household Waste: Quantification and Characterisation of Misplaced Waste' (2013) 33 *Waste Management* 2372.

⁶⁵³ Council Directive 2011/65/EU of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) [2011] OJ L 174/88 Art. 4.

⁶⁵⁴ Bigum and others (n 652).

(0,1%), polybrominated biphenyls (0,1%), polybrominated diphenyl ethers (0.1%), Bis(2-ethylhexyl) phthalate (0,1%), butyl benzyl phthalate (0,1%), dibutyl phthalate (0,1%), dissobutyl phthalate (0,1%).⁶⁵⁵

The Directive's prohibitions are more expansive than the ones detailed in the Batteries Directive and End-of-life Vehicles Directive, although they still merely cover a fraction of EEE's ubiquitous harmful substances.⁶⁵⁶ As a result, it is questionable whether the Directive is fully meeting its aims of protecting the environment and facilitating circularity. This becomes ever more apparent with the inclusion of maximum concentration levels, also found in the Batteries and End-of-Life Vehicles Directive. Here, the Directive permits the use of the above-mentioned hazardous substances in EEE's production, where they are used in small quantities, as depicted above in brackets as a percentage value by weight.⁶⁵⁷ The Commission periodically reviews this list to account for changing EEE materials due to technological advancement, which is welcome.⁶⁵⁸ Nevertheless, in a holistic sense, the availability of any hazardous materials is counterproductive to the aims of the Directive and Circular Economy goals, given that such substances will remain in use and may impact future recycle and the wider environment. Given this, the achievement of a Circular Economy likely requires a successful transition away from hazardous substances. Furthermore, it is concerning that in addition to tolerated levels of prohibited materials, the

⁶⁵⁵ Council Directive 2011/65/EU of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) [2011] OJ L 174/88 Annex II.

⁶⁵⁶ Violet N Pinto, 'E-Waste Hazard: The Impending Challenge' (2008) 12 Indian journal of occupational and environmental medicine 65.

⁶⁵⁷ Council Directive 2011/65/EU of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) [2011] OJ L 174/88 Art. 4 & Annex II.

⁶⁵⁸ *ibid* Art. 6.

Directive also contains 42 broad-ranging exemptions, though it is acknowledged that these are amendable and time-limited.⁶⁵⁹

Prohibiting hazardous substances contained within EEE is a vital tool in mitigating the potential for human health and environmental harm, the latter of which is a key goal of the Circular Economy.⁶⁶⁰ A *European Commission* study contended that the RoHS Directive reduced human- and eco- toxicity potential and decreased waste emissions.⁶⁶¹ Despite this, the literature suggests that the mass migration to alternative substances, particularly alternatives to lead, may have resulted in EEE reliability and quality concerns, which could ultimately work against the Circular Economy goals of preventing waste and keeping products, components and materials at their highest utility value at all times.⁶⁶² For example, it has been suggested that lead-free solder, which has a higher melting point and thus dries harder, may give rise to cracking and lower reliability.⁶⁶³ However, *Babayigit, Hans-Boyen and Conings* contend that failures are rare, although they cite one example of a 5% failure rate.⁶⁶⁴ Despite this, this chapter considers that the WEEE prohibitions are, on the whole, an effective deterrent, thus helping to mitigate a product's environmental harm at the end of its life. Nonetheless, it is acknowledged that higher failure rates due to mass migration to alternative materials may not, if further substantiated, fully align with Circular Economy goals

⁶⁵⁹ *ibid* Annex III.

⁶⁶⁰ Dawson (n 17).

⁶⁶¹ Sarah Bogaert and others, 'Study on RoHS and WEEE Directives' (Arcadis Ecolas, RPA 2008) 06/11925/AL II <https://ec.europa.eu/environment/pdf/waste/weee/rpa_study.pdf> accessed 9 November 2021.

⁶⁶² *ibid*; J Rajesh Kumar and others, 'Brief Study on Restriction of Hazardous Substances Directive (RoHS)' (2008) 17 *Journal of the Korean Institute of Resources Recycling* 3, 6; Aslihan Babayigit, Hans-Gerd Boyen and Bert Conings, 'Environment versus Sustainable Energy: The Case of Lead Halide Perovskite-Based Solar Cells' (2018) 5 *MRS Energy and Sustainability* E1.

⁶⁶³ Kumar and others (n 662) 7.

⁶⁶⁴ Babayigit, Boyen and Conings (n 662).

of preventing waste and keeping products, components and materials at their highest utility value at all times.

4. End-of-Life Management

As is often the case with legislation implementing the EPR principle, the majority of the WEEE Directive's measures are focused on the end-of-life management of EEE as a means of reducing the environmental effect of improper disposal and maximise resource efficiency. Henceforth, the WEEE Directive establishes several measures aimed at collecting, treating, reusing and recycling EEE. In this section, the chapter will discuss the Directive's financing, collection, treatment, reuse and recycling measures.

4.1. Financing

In a similar approach to the Batteries and End-of-life Vehicles Directives, the Directive requires producers to finance the costs of collection, treatment, reuse and recycling of WEEE.⁶⁶⁵ Producer financing is split into two categories with separate mechanisms, 'private household WEEE' and 'non-private household WEEE', which are discussed in turn below.⁶⁶⁶

4.1.1. Private Household WEEE

⁶⁶⁵ The WEEE Directive (Recast) Art. 5 - 13; European Commission, 'Making the Most of Waste Electrical and Electronic Equipment' (2019) Document 32012L0019 <<https://eur-lex.europa.eu/legal-content/EN/LSU/?uri=celex:32012L0019>> accessed 10 November 2021.

⁶⁶⁶ The WEEE Directive (Recast) Art. 5 - 13; European Commission, 'Making the Most of Waste Electrical and Electronic Equipment' (n 665).

As the name suggests, private household WEEE ‘comes from private households’, though it also includes other ‘commercial, industrial, institutional and other sources which, because of its nature and quantity, is similar to that from private households’.⁶⁶⁷ A producer’s financial responsibility for their product’s end-of-life management commences when the targeted product has been deposited at a designated collection facility.⁶⁶⁸ However, the Directive also requires Member States to ‘encourage’ producers to fund collection from the kerbside, though this is not mandatory and as such, provides little incentive for them to do so.⁶⁶⁹

The Directive’s private household WEEE financing provision is split into two categories, historic WEEE and non-historic WEEE. The former relates to EEE placed on the market pre-13 August 2005.⁶⁷⁰ Here, all producers must ‘contribute proportionately’ to the end-of-life management of private household WEEE, based on their ‘share of the market by type of equipment’.⁶⁷¹ This means that the historic WEEE financing mandate exhibits collective responsibility and closely aligns with the Batteries Directive scheme (detailed in Chapter 3), which, as explained in Chapter 2, does not harness the EPR principle’s full potential to incentivise the eco-design of products. This is because the producer does not bear full financial responsibility for their product’s end-of-life management, which diminishes their incentive to eco-design.⁶⁷²

⁶⁶⁷ The WEEE Directive (Recast) Art. 3 (h).

⁶⁶⁸ *ibid* Art. 12 (1) & (2).

⁶⁶⁹ *ibid* Art. 12 (1) & (2).

⁶⁷⁰ *ibid* Art. 12 (4).

⁶⁷¹ *ibid* Art. 12 (4).

⁶⁷² Atasu and Subramanian (n 151); Individual Producer Responsibility Working Group (n 195); Roller and Führ (n 194); Rotter, Chancerel and Schill (n 194); Kieren Mayers and others, ‘Implementing Individual Producer Responsibility for Waste Electrical and Electronic Equipment through Improved Financing’ (2013) 17 *Journal of Industrial Ecology* 186.

Given the above, the WEEE Directive requires producers placing EEE on the marketplace after 13 August 2005 to finance the end-of-life management of their 'own' product.⁶⁷³ Here, the Directive encourages individual responsibility, which incentivises producers to improve the design of their products.⁶⁷⁴ This is because an eco-designed product, per the Directive's measures, will be less costly to manage at its end-of-life because it will be easier to, for example, treat, dismantle, reuse and recycle.⁶⁷⁵ Despite this, the implementation of individual responsibility has been challenging, given the complexities involved with identifying individual brands of EEE and associating each product's end-of-life management costs with their respective producers.⁶⁷⁶

Several Member States, including the former member, the UK, have either not transposed the individual responsibility financing measures or have done so ambiguously.⁶⁷⁷ To some extent, this is to be expected given that the Directive does not clearly define individual responsibility, and in consequence of this, Member States have wide discretion in interpreting the Directive's financing requirements.⁶⁷⁸ By way of example, the UK's 'Explanatory Memorandum to The Waste Electrical and Electronic Equipment Regulations 2013' explains that:

⁶⁷³ The WEEE Directive (Recast) Art. 12 (3).

⁶⁷⁴ Knut Sander and others, 'The Producer Responsibility Principle of the WEEE Directive' (DG Environment Brussels 2007) IV <https://ec.europa.eu/environment/pdf/waste/weee/final_rep_okopol.pdf> accessed 12 November 2021; Atasu and Subramanian (n 151); Roller and Führ (n 194).

⁶⁷⁵ Sander and others (n 674) IV; Atasu and Subramanian (n 151); Roller and Führ (n 194).

⁶⁷⁶ Mayers and others (n 672).

⁶⁷⁷ Sander and others (n 674); Atasu and Subramanian (n 151).

⁶⁷⁸ Van Rossem, Chris, 'Individual Producer Responsibility in the WEEE Directive - From Theory to Practice?' (Lund University 2008) 305–312

<<https://lucris.lub.lu.se/ws/portalfiles/portal/5603015/1266800.pdf>> accessed 28 June 2021.

'the [UK] Government supports [...] [individual responsibility] in principle but takes the view that it is not technically feasible or economically viable at present in relation to WEEE from private households (a view supported by the great majority of producers and the waste industry). This is because the implementation of [...] [individual responsibility] would require systems to be in place to allow for the identification of each producer's own waste products. [...] Therefore, in transposing Article 12 of the Directive, these Regulations do not distinguish between 'new' and 'historical' WEEE. The financing of all WEEE from private households, which is deposited at collection facilities or taken back by distributors, is financed collectively by the producers who place EEE onto the market in the United Kingdom in a given compliance period.'⁶⁷⁹

To contextualise the above quote, the UK Regulations state that producers who place EEE on its marketplace must register with either the Environment Agency, Natural Resources Wales, Scottish Environmental Protection Agency or a Producer Responsibility Organisation (PRO), depending on the amount of WEEE they place on the market each year.⁶⁸⁰ If a producer places less than 5 tonnes of EEE on the marketplace annually, they must register as a 'small producer' with the relevant environmental agency to benefit from *de minimis* rules, meaning that specific provisions are disapplied.⁶⁸¹ However, producers who place more than 5 tonnes of EEE on the marketplace annually must register and fund one of the 34 competing UK PROs, which take on the producer's physical and financial responsibilities.⁶⁸² Financial obligations are thereafter calculated collectively as a proportion

⁶⁷⁹ 'Memorandum to The Waste Electrical and Electronic Equipment Regulations 2013, SI 2013/3113' para 3.4.

⁶⁸⁰ James Champ, 'De Minimis Threshold for WEEE Producers – What's Happening?' (*Ecosurety*, 2013) </news/de-minimis-threshold-for-weee-producers-what-s-happening/> accessed 2 June 2020.

⁶⁸¹ *ibid.*

⁶⁸² *ibid.*

of the producer's share of the PRO's designated collection target, regardless of whether it has collected historic or non-historic WEEE.⁶⁸³ This somewhat demonstrates the UK's inability to invoke individual responsibility, and, as a result, the UK's regime does not realise the full design advantages of the EPR principle.

Ireland has been a particular champion of individual responsibility and has enshrined the concept in its national law.⁶⁸⁴ However, the EU Member State has also faced challenges in attempting to transition from concept to implementation. This is because, like other Member States, the allocation of individual costs per item of WEEE has proved problematic, and this led to the Irish Government permitting producers to fulfil their obligations on either an individual or collective basis.⁶⁸⁵ Operationally, the Irish scheme is closely linked with that of Germany, where producers are allocated financial responsibility for their 'verified share of clearly identifiable WEEE', meaning that financial responsibility is based on the 'share of the total quantity of electrical and electronic equipment per type of equipment placed on the market in the previous calendar year'.⁶⁸⁶ Despite this, the scheme also provides for the fulfilment of financial responsibility on a collective basis.⁶⁸⁷ *Rotter, Chancerel and Schill* note that the latter option is preferred by producers because it is associated with a lower cost burden.⁶⁸⁸

Based on the above assessment, it can be concluded that the Directive's individual responsibility mandate has proved ineffective and has failed to directly associate EEE end-

⁶⁸³ *ibid.*

⁶⁸⁴ Sander and others (n 674) 111.

⁶⁸⁵ *ibid.*

⁶⁸⁶ Electrical and Electronic Equipment Act 2005 (Germany), 14 (5); Rotter, Chancerel and Schill (n 194).

⁶⁸⁷ Electrical and Electronic Equipment Act 2005 (Germany), 14 (5); Rotter, Chancerel and Schill (n 194).

⁶⁸⁸ Electrical and Electronic Equipment Act 2005 (Germany), 14 (5); Rotter, Chancerel and Schill (n 194).

of-life management costs with the original producer on a European-wide basis, thus weakening the EPR principle's incentive to eco-design. Ultimately, this may detract from the development of an EEE Circular Economy because producers are not incentivised to place repairable, reusable or recyclable products on the marketplace.

4.1.2. Non-Private Household WEEE

Producers of non-private household WEEE, which is all forms of WEEE that fall outside of the scope of private household WEEE, must finance the end-of-life management of their product. Unlike the provision above, the Directive does not confer responsibility for the management of the producers 'own' product, which means that producers are permitted to finance via collective or individual means.⁶⁸⁹ However, for EEE placed on the EU market before 13 August 2005, a producer must fund the end-of-life management of WEEE, where they supply a 'new equivalent product', irrespective of whether they placed the product on the market.⁶⁹⁰ This requirement is beneficial because it protects against the orphanage of products where the original producer is no longer operational.

As drafted, the Directive does not require producers to finance WEEE, where they are not supplying a 'new equivalent product'. This means that end-users are responsible for the resultant disposal costs, which somewhat deviates from the polluter pays principle. Likewise, the provision fails to align with Circular Economy goals of waste prevention and keeping products, components and materials at their highest utility value at all times, owing to the

⁶⁸⁹ The WEEE Directive (Recast) Article 13 .

⁶⁹⁰ *ibid* Article 13 .

fact that historic, non-private household WEEE is more likely to be disposed of negligently owing to the Directive's provisions. Despite this, the Directive does not preclude businesses from contracting between themselves (business-to-business contracts) to stipulate alternative financing methods, though the extent to which this occurs has not been assessed.

4.1.3. Free-riding

The Directive's financing provisions have been hindered by the practice of free-riding, 'where products placed on the market are not accompanied, or only partially accompanied, by the required EPR fees' at their end-of-life. This is said to affect 10% of all EEE products placed on the EU market.⁶⁹¹ WEEE free-riding can largely be attributed to the rise of online sales, meaning that consumers are able to access EEE products from producers around the globe, many of which do not contribute to their products end-of-life management cost.⁶⁹² A recent study conducted by *Recolight* found that out of 100 random checks on EEE supplied through *Amazon* in Germany, 57 were free riders, significantly more than the 10% average.⁶⁹³ The prevalence of WEEE free-riding is concerning given the EU's circular ambitions, as *Hilton* notes that the practice can lead to three inherent issues. Firstly, it can decrease the accrual

⁶⁹¹ Recolight, 'PR Club Debate Recommends New Legal Requirements in WEEE/Waste Legislation to Tackle Online Free Riders' (*In Blogs*, 27 July 2018) <<https://www.recolight.co.uk/epr-club-debate-recommends-new-legal-requirements-in-weee-waste-legislation-to-tackle-online-free-riders/>> accessed 24 November 2021; WEEE Forum, 'Successfully Countering Online Free-Riders: Response to the Consultation Regarding the Study to Support the Preparation of the Commission's Guidance for Extended Producer Responsibility Schemes' (WEEE Forum 2019) <https://weee-forum.org/wp-content/uploads/2019/06/countering_online_free-riders_consultation_issue_paper-2.pdf> accessed 24 November 2021; Mark Hilton and others, 'Extended Producer Responsibility (EPR) and the Impact of Online Sales' (Organisation for Economic Co-Operation and Development 2019) <<https://www.oecd-ilibrary.org/content/paper/cde28569-en>> accessed 18 November 2021.

⁶⁹² Hilton and others (n 691).

⁶⁹³ Recolight (n 691); WEEE Forum (n 691).

of EPR fees, which may stifle waste management activities and eco-design incentives.⁶⁹⁴ Secondly, free-riding producers will not contribute to take-back activities, and as a result, this may reduce resultant collection rates.⁶⁹⁵ Lastly, free-riding may result in the underestimation of the ‘number of products placed on the market’, which leads to the overestimation of Member State recycling rates.⁶⁹⁶

To combat WEEE free-riding, the Directive requires distance sellers to appoint authorised representatives in each of their sales territories, who are responsible for fulfilling the producer's responsibilities.⁶⁹⁷ However, evidence suggests that this measure has had little effect on reducing the sale of non-compliant EEE and as a result, it is argued here, given the large-scale avoidance of the measures, that free-riding may affect the advance to circularity.⁶⁹⁸ France, for example, has sought to mitigate against free-riding through the introduction of specific measures that require third-party sellers, such as Amazon and eBay, to undertake to carry-out the producers responsibilities whereby the original producer is non-compliant, and such an approach is likely, though not mandated by the Directive, more aligned with Circular Economy goals.⁶⁹⁹

4.2. Collection

⁶⁹⁴ Hilton and others (n 691).

⁶⁹⁵ *ibid.*

⁶⁹⁶ *ibid.*

⁶⁹⁷ *ibid.*

⁶⁹⁸ *ibid.*

⁶⁹⁹ Lidia Creech, ‘France to Force Online Retailers to Tackle Compliance Free-Riding’ (*Resource.co*, 27 January 2019) <<https://resource.co/article/france-force-online-retailers-tackle-compliance-free-riding-13061>> accessed 18 November 2021.

The Directive details that the separate collection of WEEE ‘is a precondition for ensuring specific treatment and recycling [...] and is necessary to achieve the chosen level of protection of human health and the environment in the Union’.⁷⁰⁰ To do so, Member States must ‘adopt appropriate measures to minimise the disposal of WEEE in the form of unsorted municipal waste’ by establishing collection systems that are free-of-charge and accessible to private households, having regard to population density.⁷⁰¹ This provision is often achieved through the establishment of collection systems at civic amenity sites and retail stores, meaning that producers are rarely burdened with the physical responsibility for the initial take-back of their products and, consequently, have little influence on return processes.⁷⁰² In a circular context, this collection method is particularly concerning as evidence suggests that WEEE is often mishandled, and its full repair and reuse potential is unlikely to be realised.⁷⁰³ Nevertheless, the Directive passes physical responsibility to producers for the onward collection and transport of WEEE that has been centrally collected.⁷⁰⁴ Oddly, Member States can derogate from the collection provision set out above, where returning WEEE is not ‘made more difficult to the final holder’ and remains free-of-charge.⁷⁰⁵

The Directive requires EEE distributors to collect WEEE on a free-of-charge basis, where a private household is returning it and purchasing new equipment.⁷⁰⁶ This means that distributors are merely required to collect WEEE on a ‘one-to-one’ basis, where the

⁷⁰⁰ The WEEE Directive (Recast) Recital 14.

⁷⁰¹ *ibid* Art. 5 (1) & (2) (a).

⁷⁰² Hilton and others (n 691); House of Commons, Environmental Audit Committee (n 613).

⁷⁰³ Cole and others (n 53).

⁷⁰⁴ The WEEE Directive (Recast) Art. 5 (2) (b).

⁷⁰⁵ *ibid* Art. 5 (2) (b).

⁷⁰⁶ *ibid* Art. 5 (2) (b).

consumer purchases ‘equivalent goods’.⁷⁰⁷ Accordingly, and despite the operationalisation of distributor collection facilities, consumers may be unable to return end-of-life EEE on a free-of-charge basis without making further purchases. Such a provision seems self-defeating in the advance to circularity and may act as an unnecessary barrier to consumers depositing WEEE through non-municipal waste streams. However, since 2012, ‘large retailers’ have also been mandated with collection responsibility for ‘very small WEEE’, which has no external dimension more than 25 cm, where they have an EEE sales area of at least 400 meters squared.⁷⁰⁸ Significantly, and in contrast to the provision above, the scheme operates on a free-of-charge basis, without requiring the purchase of ‘equivalent products’.⁷⁰⁹ Given this provision, it is unclear as to why all WEEE, regardless of size, is not returnable on a free-of-charge, non-obligatory basis as a means of increasing collection rates and facilitating circular adoption. The UK’s transposition of the above provisions is explored below as an exemplar.

In accordance with the Directive’s measures, the UK’s transposition splits the collection of WEEE into two stages.⁷¹⁰ The first stage requires EEE distributors or civic amenity sites to take-back WEEE, whereas the second requires producer-appointed PROs to transport the centrally collected WEEE to treatment centres, which facilitates treatment, recycling or preparation for reuse.⁷¹¹ Much of the UK’s transposition has been ‘copied out’, meaning that it directly incorporates the Directive’s take-back and collection mandates, and as a result, many of the arguments above remain applicable. For example, concerning the first stage

⁷⁰⁷ *ibid* Art. 5 (2) (b).

⁷⁰⁸ *ibid* Art. 5 (2) (c).

⁷⁰⁹ *ibid* Art. 5 (2) (c).

⁷¹⁰ The Waste Electrical and Electronic Equipment Regulations 2013 Reg 68 ; The Waste Electrical and Electronic Equipment Regulations 2006, SI 2006/3289.

⁷¹¹ House of Commons, Environmental Audit Committee (n 613) 16.

outlined above, the UK Regulations require distributors to take-back WEEE on a one-to-one, free-of-charge basis where the distributor supplies new EEE of 'equivalent type' that fulfils the same function as the returned product.⁷¹² Similarly, distributors supplying EEE from retail premises of at least 400 meters squared must take-back, in-store or in the stores' proximity, 'very small WEEE' on a free-of-charge basis, without any obligation to buy additional EEE.

It is notable however, that the UK's transposition has gone further than the Directive in tackling free-riders, noted in Section 4.1.3, who can undermine the take-back of WEEE and, thus, affect EEE circularity.⁷¹³ Here, the Regulation requires online sales distributors who do not have a physical presence in the UK to provide alternative 'take-back' routes.⁷¹⁴ Whilst such a scheme is *prima facie* encouraging, the UK has provided little guidance as to the nature and form of 'alternative' take-back routes and as a result, the literature suggests that many online retailers have sought to fulfil this requirement by offering free take-back at remote and inconvenient locations, such as warehouses and fulfilment centres which are largely inaccessible to consumers.⁷¹⁵ Others contend that, owing to lacking national monitoring enforcement rates, numerous online retailers do not offer alternative forms of take-back at all.⁷¹⁶ The rise of free-riding is particularly concerning for the development of an EEE Circular Economy because its realisation is dependent on the return of WEEE. Holland and Belgium have sought to find solutions to this issue, and in doing so require online retailers to offer free-of-charge postal collections.⁷¹⁷ However, at the supranational

⁷¹² The Waste Electrical and Electronic Equipment Regulations 2013 Reg 42 (1).

⁷¹³ Hilton and others (n 691).

⁷¹⁴ The Waste Electrical and Electronic Equipment Regulations 2013 Reg 13.

⁷¹⁵ House of Commons, Environmental Audit Committee (n 613) 30.

⁷¹⁶ Hilton and others (n 691); House of Commons, Environmental Audit Committee (n 613).

⁷¹⁷ Alex Forrest and Mark Hilton, 'Assessment of WEEE Collection Systems and Their Effectiveness in Other European Countries' (2019)

<<https://dts.valpak.co.uk/Content/Documents/Eunomia%20Valpak%20DTS%20Report%202019.pdf>>
accessed 8 April 2020.

level, the Directive is largely silent on the free-rider issues that are likely undermining WEEE collection within the EU, and it has instead fallen on national lawmakers to attempt to fill this gap to varying degrees, which somewhat undermines the advance to circularity.

As noted at the outset of this section, Member States are permitted to derogate from the Directive's collection mandate where returning WEEE is not 'made more difficult to the final holder' and remains free-of-charge.⁷¹⁸ Somewhat controversially, the UK has taken advantage of this derogation by establishing a 'distributor take-back scheme' that permits distributors to opt out of in-store take-back, where they pay a fee that funds other collection routes.⁷¹⁹ In other words, the scheme that is run by *Valpak Retail WEEE Services Ltd* allows retailers to legally circumvent the Regulations requirements for take-back, where a fee is paid to the scheme operators. The scheme has traditionally been available to all distributors, though in 2021 was curtailed, and as a result, those who supply over £100,000 of EEE products annually are no longer eligible for membership.⁷²⁰ Nevertheless, 70% of UK retailers are members of the scheme, which charges a minimum of £70 annually.⁷²¹ Member contributions are said to fund WEEE collection systems and civic amenity sites, and since its inception, £13 million has been raised and contributed to the upgrade of 1000 civic amenity sites.⁷²² Despite the scheme's positive effects, the UK has the lowest number of WEEE retailer collection points within Europe, though the effects of this on the advance to

⁷¹⁸ The WEEE Directive (Recast) Art. 5 (2) (b).

⁷¹⁹ The Waste Electrical and Electronic Equipment Regulations 2013 Reg. 68.

⁷²⁰ Valpak Retail WEEE Services, 'DTS Information' (*Valpak Retail WEEE Services*, 2021) <<https://dts.valpak.co.uk/DTS/Fees>> accessed 21 October 2021.

⁷²¹ *ibid.*

⁷²² *ibid.*

circularity remains unclear and needs further study.⁷²³ It is also unclear as to why the Directive permits derogation at the supranational level and whether it is necessary, though it is acknowledged that its use amongst Member States is low and may therefore have a limited effect on circular adoption within the EU as a whole.

The second collection stage requires producers to collect and transport WEEE to approved treatment facilities once civic amenity sites or distributors have taken-back the product from the consumer.⁷²⁴ To support this, the UK prohibits centrally collected WEEE from being disposed of before its treatment, meaning that once collected from consumers, the final holder cannot dispose of it before its treatment takes place.⁷²⁵ In a holistic sense, this provision is welcome, given that it will likely result in increased rates of circularity. However, on a theoretical level, the provision is poorly executed and contravenes Circular Economy goals and the polluter pays principle because producer-appointed PROs can charge distributors for the onward transportation of WEEE to treatment facilities.⁷²⁶ This misnomer is concerning, given that distributors are not polluters and will be disincentivised from taking back large quantities of WEEE because in doing so, they will be burdened with additional costs. This position is compounded by the fact that producer-funded PROs cannot charge civic amenity sites for equivalent collections, and as a result, it seems that distributors are somewhat unjustly targeted.⁷²⁷

⁷²³ Valpak Retail WEEE Services and The British Retail Consortium, 'Proposal to the Department for Environment, Food and Rural Affairs' (2019) 13–17
<<https://www.360environmental.co.uk/documents/DTS%20Phase%205%20Proposal%20-%20Defra%20-%2008.11.2019%20%20FINAL.pdf>> accessed 21 October 2021.

⁷²⁴ The Waste Electrical and Electronic Equipment Regulations 2013 Reg 34.

⁷²⁵ *ibid* Reg 48.

⁷²⁶ HM Government, 'Electrical Waste: Retailer and Distributor Responsibilities' (GOV.UK, 2020)
<<https://www.gov.uk/electricalwaste-producer-supplier-responsibilities/take-back-waste-in-store>> accessed 8 April 2020.

⁷²⁷ The Waste Electrical and Electronic Equipment Regulations 2013 Reg 34.

4.2.1. Collection Targets

Since its inception, the Directive has sought to incentivise the collection of WEEE through targets, which have evolved extensively. In the Directive's first iteration, Member States were required to collect a relatively low annual rate of four kilograms of WEEE for every private household resident.⁷²⁸ In 2016, this was revised upwards to incentivise greater WEEE collection rates, with Member States being required to collect 45% of the average rate of EEE placed on the market in its jurisdiction in the preceding three years. This was further uplifted in 2019 to the current collection target of '65% of the average weight of EEE placed on the market in the three preceding years' or '85% of WEEE generated on the territory of that Member State'.⁷²⁹ Whilst it is welcome that the Commission has sporadically sought to uplift targets, it is concerning that further amendment has not been forthcoming, given the EU's drive to circularity. Once a Member State has achieved the required collection figures, the incentive to increase collection is diminished, and rates will likely remain static. Given the assessment that an annual collection rate of 80 - 95% is needed to achieve sufficient resource efficiency and environmental protection, it is unclear why further uplifts have not been forthcoming in the wake of the increased drive to circularity.⁷³⁰ As a result, the current WEEE collection targets are unlikely to result in an EEE Circular Economy owing to the insufficient incentive for Member States and producers to operate high-functioning collection systems.

⁷²⁸ The WEEE Directive. Art. 5 (5).

⁷²⁹ The WEEE Directive (Recast). Art. 7. It is notable that Bulgaria, the Czech Republic, Latvia, Lithuania, Hungary, Malta, Poland, Romania, Slovenia and Slovakia are exempted from this collection rate until a date of their choosing which can be no later than 14th August 2021.

⁷³⁰ Lindhqvist (n 37).

Since the Directive's enactment, the collection rate of WEEE has improved.⁷³¹ Despite this, the Directive has yet to elicit high rates of WEEE collection, which may be one reason why the above-mentioned targeted collection rate has not been further uplifted.⁷³² At the time of writing, EU collection data relates to 2018 and, therefore, the collection target of '45% of the average rate of EEE placed on the market in the preceding three years'.⁷³³ Evidence suggests that 18 of 28 EU Member States, including the UK, which remained an EU Member State until 31 January 2020, met the required collection rate.⁷³⁴ However, seven Member States achieved rates of between 39.4% to 44.7%, whilst 2 achieved below 32%.⁷³⁵ Croatia and Bulgaria performed highest with 83.5% and 73.4%, respectively, thus achieving the 2019 higher collection rates of 65%.⁷³⁶ Malta and Romania collected the lowest amount of WEEE at 21.8% and 31.5%, and the UK achieved rates of 47.8%.⁷³⁷ Though not prohibited by the Directive, the UK, for example, has been criticised for its use of 'substantiated estimates', which is a practice that may artificially inflate collection figures.⁷³⁸

⁷³¹ European Court of Auditors, 'EU Actions and Existing Challenges on Electronic Waste' (2021) Review 04 15 <https://www.eca.europa.eu/Lists/ECADocuments/RW21_04/RW_Electronic_Waste_EN.pdf> accessed 28 October 2021.

⁷³² *ibid.*

⁷³³ The WEEE Directive (Recast). Art. 7. It is notable that Bulgaria, the Czech Republic, Latvia, Lithuania, Hungary, Malta, Poland, Romania, Slovenia and Slovakia are exempted from this collection rate until a date of their choosing which can be no later than 14th August 2021.

⁷³⁴ Eurostat, 'Waste Statistics: Electrical and Electronic Equipment - Statistics Explained' (*Eurostat*, May 2019) <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics_-_electrical_and_electronic_equipment&oldid=470242#Collection_of_WEEE_by_country> accessed 1 April 2020; House of Commons, Environmental Audit Committee (n 613). The full list of countries that met the targeted 45%, included: Bulgaria, Croatia, Estonia, Sweden, Hungary, the United Kingdom, Ireland, Portugal, Slovakia, Luxembourg, Czechia, Austria, Denmark, the Netherlands, Finland, Poland, France and Germany.

⁷³⁵ Eurostat, 'Waste Statistics: Electrical and Electronic Equipment - Statistics Explained' (n 734).

⁷³⁶ *ibid.*

⁷³⁷ *ibid.*

⁷³⁸ *ibid.*

The average EU-wide collection rate of WEEE was 46.8% in 2018, which means that over half of the available EEE that had reached the end of its life was not collected by Member States.⁷³⁹ This rate of collection is similar to that of portable batteries (see Chapter 3, Section 4.2.1.1), where it was concluded that the Batteries Directive did not promote ‘high levels of collection’ and circularity was unlikely to be achieved. However, in the case of EEE, the circumstances are rather different as the Commission have attempted to raise collection targets, though it seems that Member States and producers are unable to meet such uplifts. Whilst the average collection rate is slightly above the collection target of 45%, it is significantly below the 2019 target. A recent *European Court of Auditors* report suggested that just two Member States would likely achieve the uplifted collection rates.⁷⁴⁰ It contended that this is primarily due to the continued disposal of WEEE via municipal waste or as non-separated recyclable waste, illegal export and reporting failures.⁷⁴¹ Likewise, evidence suggests that consumers typically hoard small EEE, such as mobile phones, when they reach the end of their useful life.⁷⁴² For example, it is estimated that over 51% of UK residents have at least one unused electronic device stored at home, and 81% have no plans to reuse, recycle or sell those devices.⁷⁴³ A recent study by *YouGov* (a UK-based market research and data analytic organisation) and *GiffGaff Limited* (a mobile phone network operator) found that 72% of UK consumers do not understand the concept of e-waste.⁷⁴⁴ Additionally, despite the Directive, an estimated 155,000 tonnes of WEEE was

⁷³⁹ *ibid.*

⁷⁴⁰ European Court of Auditors (n 731) 31.

⁷⁴¹ *ibid.* 9.

⁷⁴² Darrel Moore, ‘Research by Giffgaff Suggest 72% of UK Adults Have “No Idea” What e-Waste Is’ (*Circular Online*, 20 October 2021) <<https://www.circularonline.co.uk/news/research-by-giffgaff-suggest-72-of-uk-adults-have-no-idea-what-e-waste-is/>> accessed 22 October 2021.

⁷⁴³ Royal Society of Chemistry, ‘Coronavirus Lockdowns Lead to UK Tech Sales Boom and Adds to E-Waste Problem’ (RSC, 4 January 2021) <<https://www.rsc.org/news-events/articles/2021/jan/precious-elements-lockdown/>> accessed 4 May 2023.

⁷⁴⁴ GiffGaff Limited, ‘An Urgent Call’ (*giffgaff*, 2023) <<https://www.giffgaff.com/hub/an-urgent-call/>> accessed 4 May 2023.

disposed of in the UK by 'general' municipal waste in 2019.⁷⁴⁵ A recent *House of Commons Select Committee* report identified that there were several factors affecting collection rates; these included: the presence of a Distributors Take-back Scheme, which exempts distributors from offering in-store take-back of WEEE whereby a compliance fee is paid, online free-riding and 'poor consumer awareness'.⁷⁴⁶ The above indicates that the Directives measures do not sufficiently incentivise the collection, and circularity of, EEE.

Given that the Directive sets minimum standards, some Member States have supported novel ways of increasing collection. For example, 13 UK local authorities have operated a WEEE kerbside collection service since 2012, thus making it easier for end-users to return their EEE.⁷⁴⁷ Here, over 400 tonnes of WEEE was collected over a four year period.⁷⁴⁸ At least 46 local authorities out of a possible 343 local authorities in England now operate such schemes.⁷⁴⁹ Elsewhere, Member States have sought to increase collection through the introduction of pay-as-you-throw schemes (Switzerland and Belgium) or the organisation of postal collections (Belgium and Holland) and pop-up collection events (Belgium, France, Holland, and Ireland).⁷⁵⁰ Others have sought to mandate the display of end-of-life management costs on EEE receipts, which have an informative effect on the purchaser (Switzerland, Belgium, Ireland and France).⁷⁵¹ The above demonstrates that the Directive focuses too heavily on take-back, and thus misses vital opportunities to increase the

⁷⁴⁵ 'UK the "second Largest Producer" of WEEE' (*letsrecycle.com*, 6 July 2020)

<<https://www.letsrecycle.com/news/uk-the-second-largest-producer-of-weee/>> accessed 4 May 2023.

⁷⁴⁶ House of Commons, Environmental Audit Committee (n 613) 21.

⁷⁴⁷ Biffa Waste Services Limited, 'Biffa Collects 400 Tonnes of Household WEEE' (*Biffa*)

<<https://www.biffa.co.uk/media-centre/news/biffa-collects-400-tonnes-of-household-weee>> accessed 9 April 2020. Sweden and the Republic of Ireland also offer such a service within the EU

⁷⁴⁸ *ibid.*

⁷⁴⁹ It is estimated that £21.2 million, a further £9.9 million per annum is required to establish collection networks across the UK.

⁷⁵⁰ Forrest and Hilton (n 717).

⁷⁵¹ *ibid.*

collection of EEE throughout the EU, which in turn, hinders the advance to a Circular Economy as waste is not always prevented, and as such, products, components and their materials are not always kept at their highest utility value.

4.3. Treatment, Reuse and Recycling

As detailed in Section 3 of this chapter, WEEE houses a diverse and eclectic mix of materials, which means that it can be environmentally problematic if not managed effectively. Nevertheless, given this mix of resources, WEEE is also a valuable asset which can be exploited. Therefore, once separately collected, the Directive warrants that all WEEE is treated and subsequently recovered, recycled or prepared for reuse to mitigate its effect on the environment and increase resource efficiency.⁷⁵²

In line with Circular Economy goals of preventing waste, the Directive prohibits separately collected WEEE from being disposed of prior to its 'proper treatment', meaning that all fluids must be removed other than where it is necessary to facilitate reuse or recycling.⁷⁵³ To achieve this, the Directive requires producers to establish a network of approved treatment facilities that use 'best available techniques'.⁷⁵⁴ This extends the producer's physical and financial responsibility to the post-collection phase. In a practical sense, producers simply contract out their treatment responsibilities to their appointed PROs, who establish a network of approved facilities by developing contractual relationships with multiple treatment facilities.⁷⁵⁵ However, some commentators have raised concerns regarding the WEEE

⁷⁵² The WEEE Directive (Recast) Art. 8.

⁷⁵³ *ibid* Art. 8 (2).

⁷⁵⁴ *ibid* Art. 8 (3).

⁷⁵⁵ Eunomia Research & Consulting Ltd (n 645) 23.

treatment standards at approved facilities and have linked these to poor national enforcement and export, see Sections 8 and 5.⁷⁵⁶

As noted above, once WEEE has been treated, the Directive mandates its recovery, recycling or preparation for reuse.⁷⁵⁷ Recovery includes 'recycling, reuse of waste, reclamation and the use of waste as a source of energy'.⁷⁵⁸ Recycling comprises 'any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes', but does not include energy recovery, reprocessing of materials for fuels or backfilling operations.⁷⁵⁹ Notably, 'preparing for reuse', which was omitted from the original Directive, incorporates the 'checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be reused without any other pre-processing'.⁷⁶⁰ To support the recovery, recycling and 'preparing for reuse' mandate, the Directive sets minimum efficiency targets that respective producers must achieve.⁷⁶¹ In essence, efficiency targets dictate the percentage of a product's weight that needs to be recovered, recycled or 'prepared for reuse' to comply with the Directive's environmental protection and resource

⁷⁵⁶ Robert Stewart, '2 - EU Legislation Relating to Electronic Waste: The WEEE and RoHS Directives and the REACH Regulations' in Vanessa Goodship and Ab Stevels (eds), *Waste Electrical and Electronic Equipment (WEEE) Handbook* (Woodhead Publishing 2012) 960
<<https://www.sciencedirect.com/science/article/pii/B9780857090898500027>>; Khetriwal and others (n 614).

⁷⁵⁷ The WEEE Directive (Recast).

⁷⁵⁸ The Waste Framework Directive Art. 3 (15) & Annex II; Department for Environment, Food & Rural Affairs, 'Guidance on the Legal Definition of Waste and Its Application' (HM Government 2012) 8
<https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69590/pb13813-waste-legal-def-guide.pdf> accessed 3 November 2021.

⁷⁵⁹ The Waste Framework Directive Art. 3 (17).

⁷⁶⁰ *ibid* Art. 3 (16); Nicole Seyring and others, 'Study on WEEE Recovery Targets, Preparation for Re-Use Targets and on the Method for Calculation of the Recovery Targets' (European Commission 2015) Final
<https://ec.europa.eu/environment/waste/weee/pdf/16.%20Final%20report_approved.pdf> accessed 1 June 2020.

⁷⁶¹ Seyring and others (n 760) 31–61.

efficiency objectives. The targets in *Table 1* below relate to each of the six product categories outlined in Section 2 of this chapter.

Table 1: Minimum recycling, ‘preparing for reuse’ and recovery efficiency targets⁷⁶²

Product Category	Minimum recycling and ‘preparing for reuse’ efficiency, including recovery	Minimum recycling and ‘preparing for reuse’ efficiency, excluding recovery
Temperature exchange equipment	85%	80%
Large equipment	85%	80%
Screens, monitors, and equipment containing screens having a surface greater than 100 cm ²	80%	70%
Small IT and telecommunication equipment	75%	55%
Small equipment	75%	55%
Lamps	-	80%

⁷⁶² The WEEE Directive (Recast) Annex III & V.

In a similar manner to the End-of-Life Vehicles Directive, the Directive's efficiency targets relate to the total percentage weight of individual WEEE products. In a circular context, weight-based targets are problematic because treatment facilities can target the most ubiquitous heavy metals housed within WEEE without considering the resource potential or environmental threat of specific materials.⁷⁶³ The alternative to weight-based targets is material-specific targets, which it is argued here, are more aligned with the Circular Economy goal of keeping products, components and materials at their highest utility value at all times.

Additionally, it is notable that the Directive's efficiency targets conflate recycling and 'preparation for reuse', and as a result, both are seemingly given equal preference. This means that a producer is equally incentivised to recycle a product as it is to prepare it for reuse. This is of concern because 'preparing for reuse' ranks above recycling in the waste hierarchy, and as a result, the WEEE Directive is not fulfilling the Circular Economy goal of keeping products, components and materials at their highest utility value at all times. Notwithstanding the discussion below, it is argued that this could have been overcome through the provision of separate 'preparing for reuse' and recycling targets, which rank 'preparing for reuse' over recycling, as per the waste hierarchy. Moreover, it is notable that the aforementioned targets incentivise 'recovery', which is somewhat troubling given that 'other recovery' includes incineration where waste is used as a fuel, and ranks poorly on the waste hierarchy, being one removed from 'disposal'.

⁷⁶³ Seyring and others (n 760) 8.

Recycling, placed on an equal footing with reuse, is not always the most resource-efficient way of handling end-of-life EEE and within a Circular Economy, it should not be treated as such.⁷⁶⁴ End-of-life management processes typically involve 'shredding', which reduces the size of WEEE before they are sieved to collect separate materials, such as ferrous, non-ferrous metals, plastics, and glass.⁷⁶⁵ Such practices mean that opportunities to reuse, 'prepare for reuse' or repurpose WEEE's components are often missed, and lightweight critical or rare earth materials can be lost to incineration for energy.⁷⁶⁶ Accordingly, the Directive does not sufficiently incentivise higher utility value practices and indeed, as presently drafted, it may be perversely acting as a disincentive for producers to explore such options.

5. Export

The Directive permits the export of WEEE, where consignments comply with the Shipment of Waste Regulations, which implemented the Basel Convention and the *Organisation for Economic Cooperation and Developments (OECD)* decision 'on the Control of Transboundary Movements of Wastes Destined for Recovery Operations'.⁷⁶⁷ Due to the diversity of EEE placed on the market and the catch-all scope of the Directive, the export is complex as WEEE can be either hazardous or non-hazardous. Here, the Waste Shipment Regulations prohibit the exportation of hazardous wastes or waste destined for disposal to

⁷⁶⁴ Cole and others (n 53).

⁷⁶⁵ Franziska Maisel and others, 'Preparing WEEE Plastics for Recycling – How Optimal Particle Sizes in Pre-Processing Can Improve the Separation Efficiency of High Quality Plastics' (2020) 154 *Resources, Conservation and Recycling* 104619.

⁷⁶⁶ House of Commons, Environmental Audit Committee (n 613) 47.

⁷⁶⁷ Decision of the Council on the Control of Transboundary Movements of Wastes Destined for Recovery Operations; The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; Waste Shipment Regulations.

non-OECD countries.⁷⁶⁸ This prohibition does not extend to OECD members, though such shipments are subject to a prior notification and consent procedure.⁷⁶⁹ Likewise, the shipment of non-hazardous waste to non-OECD and OECD members is permissible, though, in the case of non-OECD countries, the country of export must allow such imports. For example, a notable prohibitor of the import of non-hazardous WEEE is China.⁷⁷⁰ In addition to the Shipment of Waste Regulations, the Directive requires WEEE exporters to ensure that their end-of-life management is carried out under 'conditions that are equivalent to the requirements of the [WEEE] Directive'.⁷⁷¹

Despite export being permissible under the Shipment of Wastes Regulation, the illegal shipment of WEEE to developing countries, which often lack high-functioning waste management processes, is common.⁷⁷² The *Basel Action Network* estimates that 352,474 tonnes of WEEE are exported to developing countries annually, with the UK being the worst offender.⁷⁷³ A *European Court of Auditors* report suggested that illegal export is usually associated with actors wrongfully declaring that shipments are for reuse or repair, which is permissible.⁷⁷⁴ Indeed, when recasting the Directive, the EU sought to reduce illegal exports through the application of 'Minimum Requirements for Shipments', which was designed as a tool to 'distinguish between EEE and WEEE'.⁷⁷⁵ Despite this, evidence suggests that the

⁷⁶⁸ Waste Shipment Regulations Art. 36.

⁷⁶⁹ *ibid* Art. 36.

⁷⁷⁰ Shailendra Mudgal and others, 'Equivalent Conditions for Waste Electrical and Electronic Equipment (WEEE) Recycling Operations Taking Place Outside the European Union' (European Commission 2013) 25.

⁷⁷¹ The WEEE Directive (Recast) Art. 10 (2); Waste Shipment Regulations Art. 49; Mudgal and others (n 770) para 3.3.2. A similar provision exists within the Waste Shipment Regulations.

⁷⁷² Rolf Widmer and others, 'Global Perspectives on E-Waste' (2005) 25 *Environmental Impact Assessment Review* 436; Jim Puckett, Chris Brandt and Hayley Palmer, 'Holes in the Circular Economy: WEEE Leakage from Europe' (Basel Action Network 2018).

⁷⁷³ Puckett, Brandt and Palmer (n 772) 3.

⁷⁷⁴ European Court of Auditors (n 731) 27.

⁷⁷⁵ The WEEE Directive (Recast) Annex VI.

exportation of illegal WEEE is a persistent issue, and some commentators have argued for more vigorous action.⁷⁷⁶ Both illegal and legal exportation undermines the effectiveness of the Directive and hinders the advance to an EEE Circular Economy because exported materials represent a loss of resource, which could ultimately be fed back into a Circular Economy that keeps products and materials at their highest utility value at all times.

6. End-User Information

The Directive passes limited informative responsibility to producers.⁷⁷⁷ At a minimum, it requires that at the point of sale, private household EEE consumers are supplied with, via consumer campaigns or within instruction manuals, information on WEEE's disposal through unsorted municipal waste streams and the meaning of the 'crossed-out wheeled bin' symbol, mentioned at Section 3.1.⁷⁷⁸ Similarly, information should identify the consumer's role in the reuse and recycling of WEEE and the potential effects of non-compliance on the environment and human health.⁷⁷⁹ Most significantly, consumers must be made aware of WEEE's return and collection systems.⁷⁸⁰ However, the UK's *House of Commons Environmental Audit Committee* notes that these measures are not fully aligned with the Circular Economy, given that they do not provide information on an EEE's projected life expectancy rates, material makeup, or repairability.⁷⁸¹

⁷⁷⁶ E Román, '22 - WEEE Management in Europe: Learning from Best Practice' in Vannessa Goodship and Ab Stevels (eds), *Waste Electrical and Electronic Equipment (WEEE) Handbook* (Woodhead Publishing 2012) <<https://www.sciencedirect.com/science/article/pii/B9780857090898500222>>.

⁷⁷⁷ The WEEE Directive (Recast) Art. 14 (5).

⁷⁷⁸ *ibid* Art. 14.

⁷⁷⁹ *ibid* Art. 14.

⁷⁸⁰ *ibid* Art. 14.

⁷⁸¹ House of Commons, Environmental Audit Committee (n 613) 36; Christine Cole, Tim Cooper and Alex Gnanapragasam, 'Extending Product Lifetimes through WEEE Reuse and Repair: Opportunities and Challenges in the UK', *2016 Electronics Goes Green 2016+ (EGG)* (IEEE 2016).

Despite the Directive's measures that seek to induce informative responsibility, a recent study conducted in the UK noted that 72% of inhabitants did not understand the concept of EEE waste.⁷⁸² This figure is compounded by the fact that 35% of the study participants were hoarding used mobile phones.⁷⁸³ Of this, 35% did not know how to recycle their device, and 70% noted that they would like to do so, citing environmental benefits.⁷⁸⁴ In the same study, 68% of survey respondents thought that more should be done to raise awareness of EEE waste.⁷⁸⁵ Given this, the extent to which the Directive's information provisions have been effective is questionable as it indicates that consumers are not always aware of their responsibility and the availability of collection schemes. This is problematic, given that *Nowakowski* notes that the education of consumers is one of the most critical factors in increasing the collection and circularity of EEE.⁷⁸⁶ The UK, for example, has sought to overcome this by increasing the use of information campaigns on social media and television (a recent WEEE television campaign debuted in the UK in March 2023, funded by the WEEE compliance fee (see Section 4.2)).⁷⁸⁷ However, as currently drafted, it is argued that the Directive does not fully incentivise the use of such campaigns, as producers can comply with its provisions by providing the required information in instruction manuals.

7. Further Economic Measures

⁷⁸² Moore, 'Research by Giffgaff Suggest 72% of UK Adults Have "No Idea" What e-Waste Is' (n 742).

⁷⁸³ GiffGaff Limited (n 744).

⁷⁸⁴ *ibid.*

⁷⁸⁵ Moore, 'Research by Giffgaff Suggest 72% of UK Adults Have "No Idea" What e-Waste Is' (n 742).

⁷⁸⁶ Nowakowski (n 186).

⁷⁸⁷ Doherty (n 189).

The Directive permits Member States to enact further economic instruments or other measures to provide an incentive for the 'application of the waste hierarchy', thus linking to the Circular Economy goal of keeping products, components and materials at their highest utility value at all times.⁷⁸⁸ The Waste Framework Directive sets out a non-exhaustive range of economic instruments and other measures, such as pay-as-you-throw, deposit-refund schemes, and fiscal measures to promote recycling and reuse.⁷⁸⁹ However, given its ability to increase the sound management of WEEE, the Directive is far too relaxed in its approach to additional economic measures, which lacks prescription. For example, it is unclear why the Directive focuses solely on the take-back of goods through civic amenity sites and retailers, which despite increasing the collection of WEEE, has not resulted in EEE's circularity. Some Member States have explored measures to reduce reliance on take-back and, instead, complement it with additional economic measures by introducing landfill and/or incineration taxes to incentivise product repair, remanufacture, reuse and recycling. Recognising the role that incentives can play in achieving a Circular Economy, the UK has explored, via the *House of Commons Environmental Audit Committee*, reducing value-added tax for organisations offering repair or reuse services, although to date this has not been implemented.⁷⁹⁰

8. Enforcement

As discussed in the proceeding chapter, the Commission, at the supranational level, can instigate infringement proceedings for non-transposition, incorrect or incomplete

⁷⁸⁸ The WEEE Directive (Recast) Art. 16a.

⁷⁸⁹ The Waste Framework Directive Annex IVa.

⁷⁹⁰ House of Commons, Environmental Audit Committee (n 613).

implementation or inadequate (or no) application and enforcement of the transposed Directive's measures under Article 258 and 260 of the Treaty on the Functioning of the European Union.⁷⁹¹ For a wider discussion on supranational enforcement, refer to Chapter 2, Section 3.5. At the national level, Member States are required to apply 'effective, proportionate and dissuasive' penalties for contraventions of the Directive's measures.⁷⁹² The UK, for example, has transposed the aforementioned measure by establishing numerous monitoring, enforcement, offences, and penalty provisions.⁷⁹³ Any contravention of the UK's transposition can, where it is properly enforced, result in a time-limited 'enforcement notice' being issued, which requires action to make good the contravention.⁷⁹⁴ Where this is not complied with, a summary or indictable offence is committed, and those found guilty are subject to a statutory maximum fine.⁷⁹⁵ However, the extent to which these provisions are 'effective' and 'dissuasive' is something of a moot point.

Notwithstanding the above, evidence suggests that national transpositions are not always adequately monitored and enforced by Member States, and this has, for example, led to persistent free-riding (see Section 4.1.3) and the illegal export of WEEE (see Section 5). It is argued here that under enforcement at the national level is likely to have an adverse effect on the transition from a linear economy to a Circular Economy.⁷⁹⁶ Despite this, *Sander and Others* identified that in recent years some Member States, such as Ireland and Germany,

⁷⁹¹ TFEU Art. 258 - 260.

⁷⁹² The WEEE Directive (Recast) Art. 22 .

⁷⁹³ The Waste Electrical and Electronic Equipment Regulations 2013 Pts 13 & 14.

⁷⁹⁴ *ibid* Reg 88.

⁷⁹⁵ *ibid* Reg 91.

⁷⁹⁶ *Cole and others* (n 53); *European Court of Auditors* (n 731); *House of Commons, Environmental Audit Committee* (n 613); *Stewart* (n 756); *Bogaert and others* (n 661); *Khetriwal and others* (n 614).

have taken a more proactive approach to enforcement of the Directive's measures by increasing surveillance and unannounced inspections, with some success.⁷⁹⁷

9. Conclusion

Continued consumer demand, technological advances and falling costs have contributed to the growing amounts of WEEE, and it is now Europe's fastest-growing waste stream. Given its rich yet environmentally problematic makeup, the EU has been managing the waste stream by Directive, which seeks to reduce the effect of EEE products on the environment and improve resource efficiency. As with the two previously analysed Directives, the WEEE Directive seeks to implement the EPR principle, particularly at the end-of-life stage. However, unlike those Directives, the Directive's primary financing mechanism for private household WEEE is based on individual responsibility rather than collective responsibility. This means that the Directive seeks to encourage producers to bear sole responsibility for the products they place on the market, which in theory is likely to incentivise greater 'eco-design' given that the producer is directly responsible for the end-of-life management of their product. However, implementing individual responsibility within Member State's territories' has proved challenging, owing to the logistics of associating each product's disposal costs with individual producers. This has led to Member States invoking collective rather than individual responsibility schemes, reducing eco-design incentives. Nonetheless, the Directive does attempt to introduce prescriptive design measures on general design provisions, labelling requirements and material prohibitions, though these are unlikely to significantly contribute to the development of a EEE Circular Economy.

⁷⁹⁷ Sander and others (n 674).

At the collection stage, physical responsibility to establish WEEE returns systems is not entirely borne by the producers, and instead, much of the burden of responsibility falls on civic amenity sites and distributors. It is argued that this, coupled with the Directive's requirement for distributors to merely collect WEEE on a one-to-one basis, where they are selling equivalent products, maybe a contributing factor to the current stagnation of collection rates. Current collection targets are also a likely contributor, given that they have remained static since 2019, and likely no longer act as a sufficient incentive for collection. Similarly, collection figures may also be hindered by the existence of free-riders and perverse collection disincentives, as well as the Directive being too reliant on traditional take-back mechanisms, rather than employing enhanced mechanisms such as, for example, producer-operated postal or kerbside WEEE collections. Equally, further economic measures, such as the operationalisation of deposit return schemes, and further informative responsibility have not been fully explored. Likewise, the circular value of collected products, including reuse, is not always protected by those who collect WEEE. Given the above, it is argued that the current WEEE collection regime does not sufficiently prevent waste and keep products, components and materials at their highest utility value at all times.

Post-collection, the Directive mandates the treatment, recovery, recycling and reuse of WEEE, supported by efficiency targets. However, this chapter found that these provisions are not aligned with Circular Economy goals. The Directive does not sufficiently incentivise high utility value practices nor does it sufficiently apply the EU's waste hierarchy. Here, the Directive's recycling efficiencies conflate reuse with recycling and incentivise recovery. Given that reuse is above recycling in the waste hierarchy, it is not clear why these targets

are not separated. In a similar vein, it is unclear why recovery plays a prominent role in the Directive's efficiency targets, given that it is, other than disposal, considered the least preferable means of managing waste under the waste hierarchy. This chapter also found that the Directive's efficiency targets are based on the weight of collected WEEE, which may lead to producers targeting ubiquitous, heavier WEEE components rather than those that are environmentally problematic or deemed critical. It is also posited that weight-based targets do not sit well within a Circular Economy, given that they *prima facie* accept that the full product will not be reused or recycled. Nonetheless, the Directive's end-of-life measures, including collection, treatment, and final disposal mandates, have undoubtedly increased the environmentally sound management of WEEE. However, it is argued that the Directive has not fully invoked an EEE Circular Economy.

Chapter 6: Waste Packaging Directive

1. Introduction

The design of packaging aims to protect products from damage, increase their marketability, preserve shelf-life, and enable effective logistics.⁷⁹⁸ Spanning a variety of materials, such as plastic, cardboard, paper and glass, packaging is often only used once before being discarded by its end-user.⁷⁹⁹ As a result, estimates now suggest that between 15-20% of global municipal solid waste relates to packaging, and in the European Union (EU) alone, it is estimated that up to 50% of paper and 40% of plastic consumption derives from product packaging.⁸⁰⁰ Most of this is attributed to the packaging of food and beverages, which accounts for two-thirds of the EU packaging market.⁸⁰¹ High single-use plastic packaging consumption rates are especially concerning given its propensity to cause environmental harm, particularly to terrestrial and aquatic ecosystems.⁸⁰² This is because plastics typically contain polymers which do not degrade naturally and, if not managed correctly, can exist in some form for more than 1000 years.⁸⁰³ To contextualise the scale of the problem, of the 6300 million metric tons of plastic packaging consumed between 1950 and 2015, just 9%

⁷⁹⁸ Anna Azzi and others, 'Packaging Design: General Framework and Research Agenda' (2012) 25 *Packaging Technology and Science* 435.

⁷⁹⁹ Alice Brock and Ian Williams, 'Life Cycle Assessment and Beverage Packaging' (2020) 13 *Detritus* 47; Patricia Megale Coelho and others, 'Sustainability of Reusable Packaging—Current Situation and Trends' (2020) 6 *Resources, Conservation & Recycling*: X 100037.

⁸⁰⁰ Coelho and others (n 799).

⁸⁰¹ Eunomia Research & Consulting Ltd, 'Effectiveness of the Essential Requirements for Packaging and Packaging Waste and Proposals for Reinforcement.' (European Commission 2020) Final para E.1.0.

⁸⁰² Martin C Krueger, Hauke Harms and Dietmar Schlosser, 'Prospects for Microbiological Solutions to Environmental Pollution with Plastics' (2015) 99 *Applied Microbiology and Biotechnology* 8857.

⁸⁰³ Nkwachukwu and others (n 54); Swapnil Kisanrao Kale and others, 'Microbial Degradation of Plastic: A Review' (2015) 6 *Journal of Biochemical Technology* 952.

have been recycled, 12% incinerated, and 79% landfilled.⁸⁰⁴ Compounding these statistics, 4.8 to 12.7 million tonnes of plastics are disposed of annually in the earth's oceans, posing a particular concern for marine organisms, which can quickly ingest or become entangled in waste plastic packaging, causing injury or death.⁸⁰⁵

Considering the above, many businesses are now switching from single-use plastics to more sustainable and bio-degradable packaging, such as cardboard and paper.⁸⁰⁶ Although bio-degradable, these alternative forms of packaging are not produced without consequence to the environment as they are both resource and energy intensive.⁸⁰⁷ For example, their formation relies on extracting raw materials, such as wood.⁸⁰⁸ The *United States Environmental Protection Agency* estimates that one ton of paper is the equivalent of 15 to 17 mature trees.⁸⁰⁹ Paper production can be particularly damaging where its raw material is sourced as a consequence of deforestation, which can lead to adverse effects on the climate and ecosystems.⁸¹⁰ Given this, it remains vitally important that waste packaging, be it sustainably sourced or bio-degradable, is managed in a resource-efficient and environmentally conscious manner. Despite legislation being adopted in Europe to improve

⁸⁰⁴ Ferenc Ronkay and others, 'Plastic Waste from Marine Environment: Demonstration of Possible Routes for Recycling by Different Manufacturing Technologies' (2021) 119 *Waste Management* 101.

⁸⁰⁵ Government Office for Science, 'Foresight Future of the Sea: A Report from the Government Chief Scientific Adviser' (HM Government 2018) para 3.1.4 <<https://www.gov.uk/government/publications/future-of-the-sea-2>> accessed 6 December 2021.

⁸⁰⁶ Anna (Any) Phelan and others, 'Plastic Pollution and Packaging: Corporate Commitments and Actions from the Food and Beverage Sector' (2022) 331 *Journal of Cleaner Production* 129827.

⁸⁰⁷ WasteWise Program, 'Environmental Factoids' (*U.S Environmental Protection Agency*, 30 March 2016) <<https://archive.epa.gov/epawaste/conservation/smm/wastewise/web/html/factoid.html>>; Mohammad Abdollahbeigi, 'An Overview of the Paper Recycling Process in Iran' (2021) 3 *Journal of Chemical Reviews* 1.No Reference

⁸⁰⁸ A Riley, '10 - Paper and Paperboard Packaging' in Anne Emblem and Henry Emblem (eds), *Packaging Technology* (Woodhead Publishing 2012) <<https://www.sciencedirect.com/science/article/pii/B978184569665850010X>>.

⁸⁰⁹ WasteWise Program (n 807).

⁸¹⁰ Manfred Domroes, 'The Tropical Forest Ecosystem: Reviewing the Effects of Deforestation on Climate and Environment', *The Global Environment* (Springer 1991) <https://link.springer.com/chapter/10.1007/978-3-662-01085-3_5> accessed 7 December 2021.

the design, collection and recycling of packaging, it is still estimated that up to 20% of all packaging could be created with reusable alternatives and large quantities of unnecessary packaging could be removed altogether.⁸¹¹

Directive 85/338/EEC was the first piece of EU legislation to focus on packaging, though it was limited in scope and solely related to ‘containers of liquids for human consumption’.⁸¹² It sought to regulate beverage container production, marketing, refilling and recycling to reduce their environmental impact.⁸¹³ Research suggests that despite the introduction of the Directive, it failed to significantly reduce the negative environmental impacts and consumption rates of such containers, nor did it improve their design.⁸¹⁴ *Grilli* notes that many failures stemmed from the Directive either being ignored or not fully implemented by Member States.⁸¹⁵ Considering this, Germany controversially introduced broader waste packaging measures encompassing the Extended Producer Responsibility (EPR) principle in 1991, which later led to a new, expanded waste packaging regime in the EU.⁸¹⁶ The German Packaging Ordinance comprised a producer collection and recycling mandate alongside governed targets. The Ordinance, which concentrated on packaging within Germany, positively incentivised producers to optimise their packaging and reduced

⁸¹¹ Frank Grilli, ‘To Be or Not To Be Recyclable? An Examination of the Proposal for an EC Directive on Packaging and Packaging Waste’ (1993) 95 *British Food Journal* 25; Coelho and others (n 799); The UK Plastics Pact, ‘Blazing a Trail on Plastics: Annual Report 2019/20’ (WRAP 2020) <<https://wrap.org.uk/sites/default/files/2020-12/The-UK-Plastics-Pact-Annual-Report-19-20.pdf>> accessed 7 December 2021.

⁸¹² Council Directive 1985/339/EEC of 27 June 1985 on containers of liquids for human consumption [1985] OJ L 176/18.

⁸¹³ Grilli (n 811).

⁸¹⁴ European Commission, ‘Packaging Waste’ (*European Commission*, 2021)

<https://ec.europa.eu/environment/topics/waste-and-recycling/packaging-waste_en> accessed 7 December 2021.

⁸¹⁵ Grilli (n 811).

⁸¹⁶ Packaging Ordinance 1991, Federal Law Gazette I, page 1434.

German packaging consumption by over 1 million tonnes.⁸¹⁷ Despite this, it was controversial because it led Germany to increase the export of waste packaging to other Member States, which acted as a disincentive for their domestic collection systems, thus distorting the market.⁸¹⁸

Despite the above, owing to the Ordinance's success and the ensuing imbalances amongst Member State collection and recycling networks, the EU enacted the Waste Packaging Directive (94/62/EC) in 1994.⁸¹⁹ Most notably, the Waste Packaging Directive establishes specific design and information requirements to prevent packaging waste before encouraging its reuse and recycling. The Directive has been amended on six occasions, and contains many of the EPR principle's hallmarks. However, given the fact that the EPR principle was relatively new in 1994, the Directive, until 2018, merely incorporated a non-mandatory soft-law provision on the implementation of the EPR principle and, as such, Member States were not required to pass physical or financial responsibility for, by way of example, packaging's end-of-life management to producers.⁸²⁰ Despite this, most but not all, Member States incorporated the EPR principle to varying degrees when transposing the Directive, thus emulating the German Packaging Ordinance.⁸²¹ Given that the Waste Packaging Directive provides a relatively light-touch framework for the design and end-of-life management of packaging in the EU, there is a high degree of variance in the design of national transpositions amongst Member States. This is because Member States have often chosen to surpass the Directives minimum-standards (see 3.5 for a wider discussion on the

⁸¹⁷ Dawson, Ahuja and Lee (n 39).

⁸¹⁸ *ibid.*

⁸¹⁹ The Waste Packaging Directive.

⁸²⁰ Council Directive 2018/852/EC of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste [2018] OJ L 150/141 Recital 20 .

⁸²¹ European Commission, 'Ex-Post Evaluation of Five Waste Stream Directives' (n 15).

use of Directives). Nonetheless, from 2024 the soft law provision noted above will be replaced by a mandatory obligation to incorporate the EPR principle.⁸²² In doing so, greater harmonisation will likely be achieved across the Union and the effects of this change on the advance to a Circular Economy will be explored throughout this chapter.

In 2018, the Waste Packaging Directive was amended to take account of the EU's Circular Economy Action Plan.⁸²³ This amendment sought to increase circularity by strengthening the Directive's reuse and recycling obligations.⁸²⁴ Against the backdrop of increasing plastic packaging waste, the *European Commission* also adopted its 'Strategy for Plastics in a Circular Economy' in 2018, which aims for all plastic packaging to be reusable by 2030.⁸²⁵ In 2020, the EU indicated its intention to revise the Waste Packaging Directive to 'reinforce essential requirements for packaging to ensure their reuse and recycling, uptake of recycled content and improve enforceability' as well as tackle 'over-packaging and reduce waste'.⁸²⁶ A legislative proposal to replace the Directive with a newly devised Regulation, which would increase uniformity amongst Member States, was released in November 2022, though this has yet to be adopted and is subject to amendment, meaning that it is outside of this

⁸²² The Waste Packaging Directive Art. 4 (1).

⁸²³ Council Directive 2018/852/EC of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste [2018] OJ L 150/141; European Commission, 'Circular Economy Action Plan' (n 17).

⁸²⁴ Council Directive 2018/852/EC of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste [2018] OJ L 150/141; European Commission, 'Packaging Waste' (n 814).

⁸²⁵ European Commission, 'A European Strategy For Plastics in a Circular Economy' (European Commission 2018) <<https://www.europarc.org/wp-content/uploads/2018/01/Eu-plastics-strategy-brochure.pdf>> accessed 13 December 2021; Eleonora Foschi and Alessandra Bonoli, 'The Commitment of Packaging Industry in the Framework of the European Strategy for Plastics in a Circular Economy' (2019) 9 Administrative Sciences 18.

⁸²⁶ Vivienne Halleux and European Parliament, 'A European Green Deal: Revision of Directive 94/62/EC on Packaging and Waste Packaging' (*Legislative Train Schedule: European Parliament*, 17 December 2021) <[https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-revision-of-packaging-and-packaging-waste-directive-\(refit\)](https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-revision-of-packaging-and-packaging-waste-directive-(refit))> accessed 5 January 2022.

chapter's scope.⁸²⁷ However, owing to its significance, a summary of the proposed Regulation is provided in Section 9.

This chapter will examine the Waste Packaging Directive to assess the extent to which it invokes circularity. As noted throughout this thesis, the Circular Economy goals are to prevent waste, keep products, components and materials at their highest utility value at all times and protect the environment. The EPR principle extends producers' responsibility for their product to all life stages, though it is often only implemented at a product's end-of-life.⁸²⁸ At first instance, this chapter summarises the Waste Packaging Directive before exploring its design and end-of-life measures, including financing, collection, treatment, recycling and reuse. Additionally, the chapter will discuss export, end-user information, further economic measures and enforcement before briefly summarising the newly proposed Waste Packaging Regulations and concluding.

2. Overview of the Waste Packaging Directive

The EU enacted the Waste Packaging Directive in 1994 with a core aim to harmonise national measures across the Union and to prevent or reduce the environmental impact of packaging and waste packaging.⁸²⁹ Member States were initially required to nationally transpose the Directive, which contains a series of 'essential requirements', by June 1996.⁸³⁰

⁸²⁷ European Commission, 'Proposal for a Directive of the European Parliament and of the Council Reviewing the Targets in Directives 2008/98/EC on Waste, 94/62/EC on Packaging and Packaging Waste, and 1999/31/EC on the Landfill of Waste, Amending Directives 2000/53/EC on End-of-Life Vehicles, 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators, and 2012/19/EC on Waste Electrical and Electronic Equipment' (n 315).

⁸²⁸ Watkins and others (n 191).

⁸²⁹ The Waste Packaging Directive.

⁸³⁰ *ibid.*

By way of example, the UK was initially late in transposing the Directive, though did so through the Producer Responsibility Obligations (Packaging Waste) Regulations 1997 and the Packaging (Essential Requirements) Regulations 1998, both of which have been subsequently amended to reflect successive amendments to the Directive.⁸³¹ In light of the EU's Circular Economy Action Plan, the Directive's objectives were expanded in 2018.⁸³² Consequently, the Directive aims to contribute to the transition towards a Circular Economy by reusing, recycling, and recovering packaging waste to reduce final disposal rates.⁸³³

Accordingly, the Directive introduces provisions that target most lifecycle stages of packaging, including design, reuse, and recycling obligations. The definition of packaging incorporates 'all products made of any materials of any nature to be used for the containment, protection, handling, delivery, and presentation of goods'.⁸³⁴ This is irrespective of whether the packaging has been used or not. Also included within the wide-ranging definition are items, disposable or otherwise, intended to be 'filled' at the point of sale and 'ancillary elements' attached to the packaging.⁸³⁵ Packaging can therefore encompass sales (primary) packaging, grouped (secondary) packaging and transport (tertiary) packaging.⁸³⁶ The Directive lists several examples of packaging, including sweet boxes, matchboxes and coffee pods.⁸³⁷ Consequently, packaging that fulfils the definition

⁸³¹ Producer Responsibility Obligations (Packaging Waste) Regulations 1997, SI 1997/648; The Packaging (Essential Requirements) Regulations 1998, SI 1998/1165; Producer Responsibility Obligations (Packaging Waste) Regulations 2007, SI 2007/871 (as amended); Packaging (Essential Requirements) Regulations 2015, SI 2015/1640 (as amended).

⁸³² European Commission, 'Circular Economy Action Plan' (n 17); Ellen MacArthur Foundation, 'The EU's Circular Economy Action Plan' (n 17); Council Directive 2018/852/EC of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste [2018] OJ L 150/141.

⁸³³ The Waste Packaging Directive Art. 1 (2) ; Council Directive 2018/852/EC of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste [2018] OJ L 150/141.

⁸³⁴ The Waste Packaging Directive Art. 3 (1).

⁸³⁵ *ibid* Art. 3 (1).

⁸³⁶ *ibid* Art. 3 (1) (i) - (iii).

⁸³⁷ *ibid* Art. 3 (1) (i) - (iii).

above and is discarded, intended, or required to be discarded constitutes packaging waste.⁸³⁸ However, where packaging is an ‘integral part of a product’ and ‘it is necessary to contain, support or preserve that product throughout its lifetime’, then providing ‘all elements are intended to be used, consumed or disposed of together’, it falls outside of the Directive’s scope.⁸³⁹ Examples include tea bags, tool boxes and video game cases.⁸⁴⁰ As seen in the previous chapters, such exemptions are concerning, given that a Circular Economy demands that all products, components and materials are kept at their highest utility value at all times. Packaging, being integral to the product or not, will reach its end of life at some point in time, and as such, it is imperative to circular ambitions that these are managed effectively at that point.

3. Design

The Circular Economy demands that goods are eco-designed, thus reducing their environmental impact, reducing waste and ensuring that they can be managed at their highest utility value at their end-of-life. As seen throughout this thesis, the EPR principle can, if applied effectively, support this aim explicitly or implicitly. As noted above, the Directive does not require the mandatory implementation of the EPR principle, as defined in Article 8 of the Waste Framework Directive, until 2024.⁸⁴¹ Nevertheless, the Waste Packaging Directive does contain many of the EPR principle’s hallmarks and, as such, establishes several explicit design measures, focusing on packaging prevention, the establishment of ‘essential requirements’ and material prohibitions, each of which will be discussed below.

⁸³⁸ *ibid* Art. 3 (2); The Waste Framework Directive Art. 3 (1).

⁸³⁹ The Waste Packaging Directive Art. 3 (1) (i).

⁸⁴⁰ *ibid* Annex I.

⁸⁴¹ *ibid* Art. 4 (1); The Waste Framework Directive Art. 8.

Implicit design incentives, which can arise from economic or physical responsibility being passed to producers, will be discussed throughout this chapter, though again, note that the application of such responsibilities is not mandatory until 2024.⁸⁴²

3.1. Packaging Prevention

The Directive sets a general obligation for Member States to prevent the generation of packaging waste and minimise its environmental impact.⁸⁴³ To achieve this goal, the Directive permits the implementation of the EPR principle (currently a soft-law requirement) and further states that any application of economic instruments, such as tax incentives or deposit return schemes, should support the application of the waste hierarchy.⁸⁴⁴ Successive amendments have seen the Directive progressively introduce further prevention obligations, which have primarily been directed at the consumption of plastic carrier bags. Owing to their intrinsic environmentally damaging properties, Member States have been required to 'take measures to achieve a sustained reduction in the consumption of lightweight plastic carrier bags'.⁸⁴⁵ Transposed measures should restrict annual consumption levels of lightweight plastic carrier bags to 40 per person by 31 December 2025.⁸⁴⁶ Additionally, or as an alternative, Member States may adopt instruments restricting free-of-charge carrier bag availability.⁸⁴⁷ In the UK, for example, Wales was the first country to introduce a charge on single-use plastic carrier bags, where a levy of 5p was charged to

⁸⁴² The Waste Packaging Directive Art. 4 (1).

⁸⁴³ *ibid* Art. 4 (1).

⁸⁴⁴ *ibid* Art. 4 (1).

⁸⁴⁵ *ibid* Art. 4 (1a) (a) & (b).

⁸⁴⁶ *ibid* Art. 4 (1a) (a) & (b).

⁸⁴⁷ *ibid* Art. 4 (1a) (a) & (b).

the consumer and analysis of this initiative indicates that it has been successful, with some sectors reporting over 90% reductions in single-use plastic carrier bags.⁸⁴⁸

A recent *European Commission* study highlighted that the Waste Packaging Directive ‘follows the waste hierarchy’ by ‘putting priority on waste prevention’.⁸⁴⁹ Despite this, the EU as a whole has continued to observe rising rates of waste packaging generation, which points to failing preventative measures.⁸⁵⁰ For example, the generation of waste packaging within the EU grew by 8.5% between 2007 and 2017 to 173kg per capita.⁸⁵¹ A *European Commission* ‘Inception Impact Assessment’ highlighted that this was due to a ‘shift from reusable towards single-use and disposable packaging, growing online sales as well as the sometimes still ‘excessive’ quantities of packaging for goods.’⁸⁵² Given this, the *European Environment Agency* argued in 2013 that ‘neither decoupling waste generation from economic growth nor the EU policy objective of waste prevention has as yet been accomplished’.⁸⁵³ *Tencati and others* argue that the EU ‘prevention strategy’ is failing because prevention is much more difficult and complex to effectuate than recycling and recovery.⁸⁵⁴

⁸⁴⁸ Welsh Government, ‘Environment (Wales) Act 2016 Factsheet: Carrier Bag Charging Scheme’ (2016) <<https://gov.wales/sites/default/files/publications/2019-05/environment-wales-act-2016-carrier-bag-charging-scheme.pdf>> accessed 13 August 2022.

⁸⁴⁹ European Commission, ‘Ex-Post Evaluation of Five Waste Stream Directives’ (n 15) 8.

⁸⁵⁰ European Commission, ‘Inception Impact Assessment’ (European Commission 2020) <https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12263-Reducing-packaging-waste-review-of-rules_en> accessed 16 December 2021.

⁸⁵¹ *ibid*; European Commission, ‘Report from the Commission to the European Parliament, the Council, European Economic and Social Committee and the Committee of the Regions on the Implementation of EU Waste Legislation, Including the Early Warning Report for Member States at Risk of Missing the 2020 Preparation for Re-Use/Recycling Target on Municipal Waste’ COM (2018) 656 final.

⁸⁵² European Commission, ‘Inception Impact Assessment’ (n 850).

⁸⁵³ European Commission, ‘A European Strategy For Plastics in a Circular Economy’ (n 825). European Commission, ‘A European Strategy For Plastics in a Circular Economy’ (n 34).

⁸⁵⁴ Antonio Tencati and others, ‘Prevention Policies Addressing Packaging and Packaging Waste: Some Emerging Trends’ (2016) 56 *Waste Management* 35.

Though the Directive generally encourages the adoption of preventative measures, it does not sufficiently set out a suitable framework or technicalities for doing so. As a result, this limits its effectiveness in meeting the Circular Economy goal of waste prevention, as was established in Chapter 2. Nevertheless, the EU is currently arguing for ‘clearer, more enforceable EU level requirements’ that ‘drive design for reuse and recyclability of packaging and prevent the continued growth in the generation of packaging’.⁸⁵⁵ Indeed, to facilitate this, the EU adopted a Directive ‘on the reduction of the impact of certain plastic products on the environment’ in 2019.⁸⁵⁶ This Directive primarily sought to prohibit the placing on the market of several single-use plastic items, including cutlery, plates, straws, stirrers, sticks for balloons and cotton buds.⁸⁵⁷ However, it also included measures targeting packaging, with one measure requiring the continuous connection of ‘caps to bottles’ to facilitate their recovery, thus preventing waste.⁸⁵⁸ More widely, however, the EU released a proposal for the repeal and replacement of the current waste packaging regime in November 2022, see Section 9 of this chapter for a summary of this proposal.⁸⁵⁹

3.2. Essential Requirements and Standardisation

The Waste Packaging Directive sets a series of essential requirements that affect the design of packaging and its ability to be sold on the EU marketplace.⁸⁶⁰ Firstly, the essential

⁸⁵⁵ European Commission, ‘Inception Impact Assessment’ (n 43).

⁸⁵⁶ Council Directive 2019/904/EC of 5 June 2019 on the reduction of the impact of certain plastic products on the environment [2019] OJ L 155.

⁸⁵⁷ *ibid* Art. 5 and Annex Part B.

⁸⁵⁸ *ibid* Art. 6 (1).

⁸⁵⁹ European Commission, ‘Proposal for a Regulation of the European Parliament and of the Council on Packaging and Packaging Waste, Amending Regulation (EU) 2019/1020 and Directive (EU) 2019/904, and Repealing Directive 94/62/EC’ (n 125).

⁸⁶⁰ The Waste Packaging Directive Art. 9 & Annex II; European Commission, ‘Summary of Directive 94/62/EC on Packaging and Packaging Waste’ (*European Commission*) <<https://eur-lex.europa.eu/legal->

requirements established a non-measurable obligation aimed at reducing the value and weight of packaging, known as ‘light weighting’. Here, the essential requirements merely required that ‘packaging volume and weight be limited to the minimum adequate amount to maintain the necessary level of safety, hygiene and acceptance for the packed product and for the consumer’.⁸⁶¹ Notably, this obligation does not contain quantifiable or measurable objectives or targets, and as a result, it is unclear how producers or regulators can comply with such requirements, given their unspecific nature. Additionally, it is argued that light weighting objectives may encourage the use of flexible plastic films or pouches, which by their very nature are difficult to recycle and are often not collected on the curbside, which undermines the advance to circularity.⁸⁶² Secondly, the Directive’s essential requirements also outlined a non-quantifiable obligation that sought to reduce the number of hazardous substances or materials used in packaging production, and lastly, they encouraged producers to develop reusable, recyclable and recoverable packaging; though again, no specific numbers or targets are attached to these requirements which raises the same questions around measurability, as those advanced above.⁸⁶³ That said, the Directive notes that producers can comply with the abovementioned essential requirements by applying the EU’s harmonised packaging standards issued by the *European Committee for Standardisation*.⁸⁶⁴ These standards are outside of the scope of this study, although for

content/EN/TXT/?qid=1595838206165&uri=LEGISSUM:I21207> accessed 1 October 2020; Eunomia Research & Consulting Ltd (n 801).

⁸⁶¹ The Waste Packaging Directive Art. 9 & Annex II; European Commission, ‘Summary of Directive 94/62/EC on Packaging and Packaging Waste’ (n 860); Eunomia Research & Consulting Ltd (n 801).

⁸⁶² The Waste Packaging Directive Art. 9 & Annex II; European Commission, ‘Summary of Directive 94/62/EC on Packaging and Packaging Waste’ (n 860); Eunomia Research & Consulting Ltd (n 801).

⁸⁶³ The Waste Packaging Directive Art. 9 & Annex II; European Commission, ‘Summary of Directive 94/62/EC on Packaging and Packaging Waste’ (n 860); Eunomia Research & Consulting Ltd (n 801).

⁸⁶⁴ The Waste Packaging Directive Art. 9 (2) & Art. 10 ; The European Organisation for Packaging and the Environment, ‘Understanding the CEN Standards on Packaging and the Environment: Some Questions and Answers’ (2006) <<https://www.euopen-packaging.eu/wp-content/uploads/2021/03/CEN-QA-February-2006.pdf>> accessed 14 December 2021.

completeness, they relate to prevention, reuse, recycling, energy recovery, biodegradation, and the composting of packaging; a future study of such standards may be of benefit, given their proclivity to induce greater circularity.⁸⁶⁵ Packaging produced under these standards is presumed to comply with the essential requirements of the Directive, although it should be noted that they are voluntary, and as a result, producers can opt to design their products in alternative ways (in other means than those advanced by the standards). However, in such cases, there is not a presumption of conformity.

It is notable that the Waste Packaging Directive's essential requirements are self-regulated by packaging producers, as there is a presumption of conformity until proven otherwise by a competent authority.⁸⁶⁶ Evidence suggests that compliance is not routinely monitored, meaning that there is a distinct lack of data on producer conformity.⁸⁶⁷ This issue is compounded by the fact that out of the 28 Member States (now 27), including the former Member the UK, just three Members have transposed enforcement provisions relating to the Directive's essential requirements.⁸⁶⁸ It has also been noted that only the UK and the Czech Republic have conducted active investigations into non-conformity.⁸⁶⁹ The lack of monitoring and national enforcement amongst EU Member States somewhat undermines the effectiveness of the Directive's essential requirements, as does the fact that existing voluntary standards have not been incorporated into the Directive itself, which means that there is insufficient measurability to support monitoring and national enforcement practices.

⁸⁶⁵ Relevant harmonised European Standards are: EN 13427_2004 ('umbrella standard'), EN 13428_2004 (prevention by source reduction), EN 13429_2004 (reuse), EN 13430_2004 (recycling), EN 13431_2004 (energy recovery) and EN 13432_2004 (biodegradation and composting).

⁸⁶⁶ The Waste Packaging Directive Art. 9.

⁸⁶⁷ *ibid* Art. 9.

⁸⁶⁸ Eunomia Research & Consulting Ltd (n 801) 31–32; Mariësse AE van Sluisveld and Ernst Worrell, 'The Paradox of Packaging Optimization – a Characterization of Packaging Source Reduction in the Netherlands' (2013) 73 *Resources, Conservation and Recycling* 133.

⁸⁶⁹ Eunomia Research & Consulting Ltd (n 801) 31–32; Sluisveld and Worrell (n 868).

3.3. Material Prohibitions

In a similar manner to the Directives assessed in the previous three chapters, the Waste Packaging Directive also contains material prohibitions on the use of hazardous substances, targeting lead, cadmium, mercury, and hexavalent chromium.⁸⁷⁰ Notwithstanding the arguments detailed in the previous three chapters, it is notable that the Directive merely targets four heavy metals out of the many harmful materials and substances used in packaging production processes.⁸⁷¹ A study conducted by *Groh and others* identified 148 materials and substances in the production of packaging.⁸⁷² Indeed, most of these were classified as being particularly hazardous to the environment, and as a result, it is unclear why the Directive merely targets four materials.⁸⁷³ That being said, it is widely recognised that lead, cadmium, mercury, and hexavalent chromium are some of the most toxic and environmentally damaging, and given this, the Directive likely attempts to balance risk with feasibility.⁸⁷⁴ However, when juxtaposed against the Directive's recital, which notes that the four prohibitions were a 'first step towards reducing the toxicity of packaging waste', it

⁸⁷⁰ The Waste Packaging Directive Art. 11 .

⁸⁷¹ Ksenia Groh and others, 'Overview of Known Plastic Packaging-Associated Chemicals and Their Hazards' (2019) 651 *Science of The Total Environment* 3253.

⁸⁷² *ibid.* It is noted by this chapter that substances are also regulated by the Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC.

⁸⁷³ *ibid.* It is noted by this Chapter that substances are also regulated by the Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC.

⁸⁷⁴ It must be remembered that although one of the Directive's aim is to 'prevent any impact thereof on the environment', it is also an aim to 'avoid obstacles to trade'.

remains concerning that additional material and substance controls have not been introduced.⁸⁷⁵ Nonetheless, as with the three other analysed Directives, the material prohibitions are undermined by tolerance of their use in small quantities, though these quantities have been successively revised down from 600 parts per million in 1998 to 100 parts per million by weight in 2001.⁸⁷⁶

4. End-of-Life Management

As explained in the previous sections of this chapter, the Directive has not traditionally mandated the implementation of the EPR principle to effectuate its provisions. However, owing to amendment, the Directive requires its Member States to establish and implement the EPR principle by 31 December 2024 to harmonise the Directive's application and increase circularity.⁸⁷⁷ Updated transpositions must adhere to Article 8 and Article 8a of the Waste Framework Directive, which sets minimum standards for the EPR principle's implementation within the Union; see Section 3.3 of Chapter 2 for a detailed discussion on the Waste Framework Directive and the minimum standards of EPR schemes.⁸⁷⁸ Despite this, most EU Member States incorporated the EPR principle when initially transposing the Directive. This is because the Directive merely establishes minimum or baseline standards in which Member States can surpass; for a wider discussion on the use of Directives in EU environmental law, refer to Chapter 2, Section 3.5. Likewise, the Directive provides a framework to incorporate the EPR principle by obligating the collection and subsequent

⁸⁷⁵ The Waste Packaging Directive.

⁸⁷⁶ The Waste Packaging Directive Art. 11 & 22.

⁸⁷⁷ *ibid* Art. 7 (2); Council Directive 2018/852/EC of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste [2018] OJ L 150/141.

⁸⁷⁸ The Waste Framework Directive.

management of packaging, including reuse, recycling, and recovery, each of which can be associated with the implementation of the EPR principle.

4.1. Financing

As demonstrated within the previous chapters of this thesis, EU Directives encompassing the EPR principle typically require producers to fund the end-of-life management of their product on an individual or collective basis. Given that the Waste Packaging Directive does not yet mandate the application of the EPR principle according to its definition in Article 8 of the Waste Framework Directive, no such requirements are found within its text.⁸⁷⁹ Indeed, at the time of writing, no financial provisions have been outlined within the Directive for the post-2024 era.⁸⁸⁰ Instead, the Directive will, until at least the EU's newly devised Waste Packaging Regulation takes effect, rely on Article 8a of the Waste Framework Directive, which obligates the use of financial responsibility.⁸⁸¹ In employing such responsibility, Member States must take the necessary measures to ensure that the financial responsibility covers the full costs of the product's end-of-life management, including its separate collection and treatment, as well as end-user information campaigns and any 'data gathering and reporting' requirements.⁸⁸²

⁸⁷⁹ *ibid.*

⁸⁸⁰ *ibid* Art. 8.

⁸⁸¹ *ibid* Art. 8a.

⁸⁸² *ibid* Art. 8a (4). These measures are on a net-cost basis, and as a result, producers may offset their burden of responsibility through the sale of secondary raw materials or, where employed, unclaimed deposit return scheme deposits. The former, acts as an additional circular incentive, as a stimulant for the incorporation of secondary raw materials in production cycles.

Notably, however, the Waste Framework Directive is silent on the use of individual responsibility, and though not prohibited, it merely notes that where collective schemes are implemented, fees should be ‘modulated, where possible’ by taking account of the ‘durability, repairability, reusability and recyclability’ of a product as well as the presence of hazardous substances.⁸⁸³ Whilst the modulation of fees is welcome, considering that they provoke a greater eco-design incentive than schemes without modulation, the Waste Framework Directive does not establish a specific structure for the operation of fee modulation. As explained in Chapter 3, to stimulate eco-design effectively, the modulation of fees should be as closely associated with the product's end-of-life management costs as is reasonably possible, and without a specific fee structure, this is unlikely to occur in practice.⁸⁸⁴ In addition to this, it is unclear why the Waste Framework Directive does not seek to incentivise individual responsibility, given that such responsibility gives rise to the greatest eco-design incentive, thus helping to keep products, components and materials at their highest utility value.⁸⁸⁵

As previously discussed, many countries have used the Waste Packaging Directive as a basis to invoke the EPR principle in their respective national systems of managing waste packaging. For example, the Producer Responsibility Obligations (Packaging Waste) Regulations establish such a scheme within the UK and aims to recover and recycle packaging waste to achieve the minimum obligations set by the Directive.⁸⁸⁶ By way of overview, the Regulation requires packaging producers that handle more than 50 tonnes of packaging and have a turnover of £2 million per annum to register with a regulator, with fees

⁸⁸³ *ibid* Art. 8a (4).

⁸⁸⁴ Sachdeva, Araujo and Hirschnitz-Garbers (n 352) 8.

⁸⁸⁵ Individual Producer Responsibility Working Group (n 195).

⁸⁸⁶ Waste Packaging Regulations 2007.

ranging between £345 - £776.⁸⁸⁷ *De minimis* rules apply for those companies with a turnover of between £2 – 5 million, known as ‘small packaging producers’. Producers must prove they have complied with their recovery and recycling obligations by completing a ‘certificate of compliance’.⁸⁸⁸ Recovery and recycling obligations can be met via a novel funding mechanism, where producers purchase ‘evidence notes’, or ‘packaging recovery notes’. One ‘note’, purchased from reprocessing plants or exporters, evidences one tonne of recovered and recycled packaging.⁸⁸⁹ However, producers may and often do offset their burden of responsibility by joining a Producer Responsible Organisation (PRO) or compliance scheme, denoting collectivity.⁸⁹⁰

The UK's scheme collects packaging waste via municipal or commercial curbside waste collection. This waste is sorted and sold to reprocessing plants and exporters, pending reuse or recycling.⁸⁹¹ Significantly, producers merely contribute to the costs of the end-of-life management of packaging waste instead of covering the full end-of-life management costs of packaging. The *UK Government's* ‘Our Waste, Our Resources: A Strategy for England’, notes that ‘producers cover less than a tenth of the costs of managing household packaging waste’ and a recent *National Audit Office* report identified that producers contributed, by purchasing evidence notes, £73 million towards the end-of-life management costs of packaging in 2017.⁸⁹² This was significantly lower than the estimated £700 million spent on

⁸⁸⁷ Environment Agency, ‘Packaging Waste: Producer Responsibilities’ (GOV.UK, 15 December 2020) <<https://www.gov.uk/guidance/packaging-producer-responsibilities>> accessed 18 January 2022.

⁸⁸⁸ *ibid.*

⁸⁸⁹ *ibid.*

⁸⁹⁰ Christopher Wilson, Ian David Williams and Simon Kemp, ‘Compliance with Producer Responsibility Legislation: Experiences from UK Small and Medium-Sized Enterprises’ (2011) 20 *Business strategy and the environment*. 310.

⁸⁹¹ Comptroller and Auditor General, ‘The Packaging Recycling Obligations’ (National Audit Office 2018) HC 1386 Session 2017-19 <<https://www.nao.org.uk/wp-content/uploads/2018/07/The-packaging-recycling-obligations.pdf>> accessed 7 January 2022.

⁸⁹² *ibid* 5; HM Government, ‘Our Waste, Our Resources: A Strategy for England’ (n 14); Dawson (n 17).

the end-of-life management by local authorities, meaning that limited financial responsibility is bestowed on producers under the scheme.⁸⁹³ It also contrasts significantly with other European countries, such as Holland, Germany and Belgium, which require producers to bear the total end-of-life management costs of their packaging, thus stimulating more significant eco-design incentives.⁸⁹⁴

Based on the above assessment, the Directive has not fully invoked financial responsibility for the end-of-life management of packaging, and owing to its voluntary nature, it has been initiated to varying degrees throughout the EU. This is problematic because where full end-of-life management costs are not attributed to producers, eco-design incentives associated with the EPR principle are stifled. Considering this, the move to align the Waste Packaging Directive with Articles 8 and 8a of the Waste Framework Directive is welcome, pending the transition to a bespoke packaging framework as proposed by the Waste Packaging Regulations.⁸⁹⁵ Nonetheless, it remains a concern that there has not been greater clarity on the Waste Framework Directive's requirement for fee modulation, and in turn, this may affect the Directive's ability to incentivise greater eco-design and keep products, components and materials at their highest utility value at all times.

4.2. Collection

⁸⁹³ Comptroller and Auditor General (n 891) 28. These figures relate to the collection and sorting of packaging only.

⁸⁹⁴ *ibid* 27.

⁸⁹⁵ European Commission, 'Proposal for a Regulation of the European Parliament and of the Council on Packaging and Packaging Waste, Amending Regulation (EU) 2019/1020 and Directive (EU) 2019/904, and Repealing Directive 94/62/EC' (n 125).

The Waste Packaging Directive requires Member States to establish collections systems to manage end-of-life packaging.⁸⁹⁶ In doing so, consumers or other final users must be able to return or have their ‘used packaging and/or packaging waste’ collected to ‘channel it to the most appropriate waste management alternative’.⁸⁹⁷ Unlike the Batteries Directive’s ‘portable battery’ collection mandate, the Directive is not prescriptive about the forms of collection that Member States invoke. Instead, it merely specifies that such systems should apply to ‘imported products under non-discriminatory conditions’ and be open to the sector’s economic operators and public authorities.⁸⁹⁸ These obligations are established in tandem with the Waste Framework Directive, which dictates that Member States should establish separate collection schemes for paper, cardboard, glass, metal and plastic.⁸⁹⁹ Despite this, the separate collection of packaging varies considerably across the EU.⁹⁰⁰ This is reflected in the recycling rates achieved by Member States in 2019, which ranged from the highest rate of 84.2% in Belgium to the lowest at 35.7% in Malta.⁹⁰¹ This can be further contextualised by examining, as an exemplar, the UK’s scheme. This analysis will be helpful because the UK’s collection regime is relatively typical of other EU Member States, which also exhibit wide-ranging national, devolved and regional level disparities on how and what packaging is and is not collected.

⁸⁹⁶ The Waste Packaging Directive Art. 7 (1).

⁸⁹⁷ *ibid* Art. 7 (1) (a).

⁸⁹⁸ *ibid* Art. 7 (3).

⁸⁹⁹ The Waste Framework Directive Art. 15; European Commission, ‘Ex-Post Evaluation of Five Waste Stream Directives’ (n 15) 36.

⁹⁰⁰ European Commission, ‘Ex-Post Evaluation of Five Waste Stream Directives’ (n 15) 36.

⁹⁰¹ Eurostat, ‘Packaging Waste Statistics’ (*Eurostat*, 18 October 2021)

<https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Packaging_waste_statistics#Recycling_and_recovery_targets_and_rates> accessed 18 January 2022.

The UK achieved a national waste packaging recycling rate of 62.3% in 2019, where municipal kerbside operators collect waste packaging from households.⁹⁰² Despite this, the scheme has been hindered by inconsistencies amongst local authorities regarding the acceptable form and quantity of waste packaging, which makes it harder for consumers to recycle such waste.⁹⁰³ Although no longer a Member State, the UK continues to align with the Waste Framework Directive's separate collection requirements through the recently enacted Environment Act 2021, which provides a statutory duty for local authorities to collect a consistent set of recyclate.⁹⁰⁴ Nonetheless, the scheme does not mandate the collection of harder-to-recycle items, such as soft plastic packaging, and as a result, it is not routinely collected by local authorities.⁹⁰⁵ In Wales, Swansea Council contend that 'this is because many soft plastic items are not easily recycled and when mixed with rigid items [...] they are extremely difficult to separate which is necessary to recycle them'.⁹⁰⁶ This is concerning given that the *Waste and Resources Action Programme (WRAP)* estimates that soft plastics make up 'nearly a quarter of consumer packaging and 'only 6% is recycled'.⁹⁰⁷ Given plastic packaging's propensity to cause environmental harm, particularly to terrestrial and aquatic ecosystems, it is concerning that producers are not required to separately collect and manage such packaging according to their highest utility value.⁹⁰⁸

⁹⁰² Comptroller and Auditor General (n 891) 8; Department for Environment, Food & Rural Affairs and Government Statistical Service, 'UK Statistics on Waste' (HM Government 2021) <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1002246/UK_stats_on_waste_statistical_notice_July2021_accessible_FINAL.pdf> accessed 31 January 2022.

⁹⁰³ HM Government, 'Our Waste, Our Resources: A Strategy for England' (n 14) 35.

⁹⁰⁴ Environment Act 2021 S.57.

⁹⁰⁵ Swansea Council, 'Frequently Asked Questions about Recycling and Rubbish' (*Swansea Council*, 2022) <<https://www.swansea.gov.uk/article/5366/Frequently-asked-questions-about-recycling-and-rubbish>> accessed 11 January 2022.

⁹⁰⁶ *ibid.*

⁹⁰⁷ Waste and Resources Action Programme, 'Plastic Bags and Wrapping' (*WRAP*, 2023) <<https://wrap.org.uk/taking-action/plastic-packaging/actions/plastic-bags-and-wrapping>> accessed 28 July 2023.

⁹⁰⁸ Krueger, Harms and Schlosser (n 802).

In conflict with the EPR principle and the polluter pays principle, the abovementioned difficulties in collecting soft plastics have voluntarily led some large retailers to introduce take-back schemes. *Tesco Plc*, for example, expects to recycle 1000 tonnes of soft plastic per annum due to its take-back scheme, where consumers can deposit soft plastics at designated collection points within its stores.⁹⁰⁹ Nonetheless, there are also welcome examples of producers taking voluntary action on soft plastics on an individual basis. For example, *Walkers Snacks Ltd*, a sizeable crisp manufacturer, have established a take-back network run by *Terracycle US Inc.*, where ‘80% of households are within just four miles’ of such collection points.⁹¹⁰

Evidence suggests that the UK’s experience of collecting and recycling soft or harder-to-recycle packaging is also seen throughout the EU and this is largely due to its unprofitability.⁹¹¹ Given the increasingly ubiquitous nature of packaging and its proclivity to cause environmental damage if not disposed of correctly, it is unclear as to why the Directive has not been amended to include financial responsibility for the mandatory collection of single-use plastic packaging.⁹¹² However, with greater financial responsibility being transferred to producers in the near future under Articles 8 and 8a of the Waste Framework

⁹⁰⁹ Tesco Plc, ‘Shoppers Can Now Return All Their Soft Plastic Packaging to Recycling Points at Every Large Tesco Store in the UK’ (*Tesco*, 21 August 2021) <<https://www.tescopl.com/news/2021/shoppers-can-now-return-all-their-soft-plastic-packaging-to-recycling-points-at-every-large-tesco-store-in-the-uk/>> accessed 11 January 2022.

⁹¹⁰ Walkers Snacks Limited, ‘A Free and Simple Way to Recycle Walkers Crisp Packets’ (*Walkers*) <<https://walkers.co.uk/recycle>> accessed 12 January 2022.

⁹¹¹ Susanna Andreasi Bassi and others, ‘Extended Producer Responsibility: How to Unlock the Environmental and Economic Potential of Plastic Packaging Waste?’ (2020) 162 *Resources, Conservation and Recycling* 105030.

⁹¹² Groh and others (n 871).

Directive, it is hoped that harder-to-recycle packaging will be discouraged as producers will bear the full costs of their management, although this must be monitored.

In addition to take-back, other methods of increasing collection rates have been explored across the EU and the UK. For example, Germany effectuated the Directive's collection requirements through a mixture of policy instruments introduced in 2003, including the operationalisation of a deposit return scheme for drinks containers, which has since achieved return rates of 96%, and the co-mingled municipal collection of plastic, paper, metals and composite materials.⁹¹³ Similarly, Scotland was the first UK country to present plans to introduce a 'Deposit and Return Scheme' targeting drinks containers in 2020.⁹¹⁴ Initially set to launch on 1 July 2022, though now delayed to 2025, the scheme charges consumers an extra 20p for each single-use drinks container purchased, which is refunded at the point the item is returned to a designated collection point. Positively, England and Wales are also expected to introduce a similar scheme in 2025, though the collection of glass bottles is expected to be excluded.⁹¹⁵

In addition to the above, the *Welsh Government* has sought to raise collection rates by increasing the frequency of kerbside recycling collections whilst decreasing general municipal waste collection rates.⁹¹⁶ Since doing so in 2011, the *Welsh Government* argued

⁹¹³ Rita Kol and others, 'Recent Advances in Pre-Treatment of Plastic Packaging Waste', *Current topics in recycling* (IntechOpen 2021); Sebastian Rhein and Katharina Friederike Sträter, 'Intended and Unintended Effects of Statutory Deposit Return Schemes for Single-Use Plastic Bottles: Lessons Learned from the German Experience' (2021) 30 GAIA - Ecological Perspectives for Science and Society 250.

⁹¹⁴ The Deposit and Return Scheme for Scotland (Scotland) Regulations 2020, SI 2020/154 (Draft); Zero Waste Scotland (n 167); Scottish Environment Protection Agency (n 167). The UK government is also consulting on the introduction of a drinks container Deposit Return Scheme in England, Wales and Northern Ireland.

⁹¹⁵ Department for Levelling Up, Housing & Communities (n 168).

⁹¹⁶ Welsh Government, 'How Wales Became a World Leader in Recycling' (*Welsh Government*, 18 March 2020) <<https://gov.wales/how-wales-became-world-leader-recycling>> accessed 13 January 2022.

that they had observed consumer behavioural changes and quantitative increases in collection rates.⁹¹⁷ Elsewhere, economic instruments, such as ‘environmental taxes’ in, for example, Sweden, Denmark, and ‘Pay-as-you-throw’ schemes in Ireland and areas of Germany, have been found to *de facto* incentivise recycling, whilst also discouraging the disposal of packaging waste through municipal waste streams.⁹¹⁸ The above-mentioned findings are significant as they demonstrate the benefits of alternative collection mechanisms that have not developed in other, more prescriptive waste regimes. Therefore, although this thesis does not advocate a non-prescriptive approach to collection, it does recognise that the Directive’s light-touch framework has led to the development of novel collection techniques.

In addition to the quantity and form of collected packaging, the quality of such recyclate may also affect the development of a Circular Economy. A recent *European Environmental Bureau and Zero Waste Europe* report identified significant increases in the rejection rate of packaging at EU sorting facilities, mainly due to the low quality or contaminated material that has been collected.⁹¹⁹ Aside from the general obligations set by the Waste Framework Directive to establish separate collections of paper, cardboard, glass, metal and plastic, the Directive does not address the quality of such collections.⁹²⁰ This is despite the EU’s evaluation of the Directive, which states that ‘there is evidence that, particularly as a result of inadequate, separate collection, the quality of material collected for recycling often still

⁹¹⁷ *ibid.*

⁹¹⁸ Chiara Magrini, Filippo D’Addato and Alessandra Bonoli, ‘Municipal Solid Waste Prevention: A Review of Market-Based Instruments in Six European Union Countries’ (2020) 38 *Waste Management & Research* 3.

⁹¹⁹ European Environmental Bureau and Zero Waste Europe, ‘Harmonisation of Waste Separate Collection across Europe’ (2020) <https://zerowasteurope.eu/wp-content/uploads/2020/07/2020_07_14_zwe_eeb_position-paper_harmonisation-of-waste-separate-collection_en.pdf> accessed 12 January 2022.

⁹²⁰ The Waste Framework Directive.

leaves [much] to be desired'.⁹²¹ Therefore, the increased circular management of waste packaging depends upon the extent to which small and contaminated packaging can be separately collected, sorted and recycled.⁹²² The *European Environmental Bureau and Zero Waste Europe* contend that:

'High purity thresholds for collected materials are not defined at the EU level, but they could be a driver of harmonised separate collection and an enabler of high quality recycling and preparation for reuse at the local and regional levels. Setting those thresholds by the EC [European Commission] should be a part of the harmonisation process, as a way to increase the quality of separately collected waste while keeping the system cost-efficient in a total bill.'⁹²³

It is also contended that additional producer-funded communication campaigns may increase consumer awareness and thus increase the quality of collected packaging recycle.⁹²⁴ The *UK Government* has also suggested that it may be beneficial, as a means of aiding consumer understanding and compliance, to provide consistent coloured recycling collection bins.⁹²⁵

4.3. Recycling, Recovery and Reuse

⁹²¹ European Commission, 'Ex-Post Evaluation of Five Waste Stream Directives' (n 15) 50.

⁹²² *ibid.*

⁹²³ European Environmental Bureau and Zero Waste Europe (n 919) 2.

⁹²⁴ *ibid.*

⁹²⁵ Darrel Moore, 'Simply Changing the Colour of Bins Can Increase Recycling' (*Circular Online*, 2019) <<https://www.circularonline.co.uk/news/simply-changing-the-colour-of-bins-can-increase-recycling/>>; HM Government, 'Our Waste, Our Resources: A Strategy for England' (n 14).

4.3.1. Recycling and Recovery

In contrast to the three previously analysed waste streams, the Waste Packaging Directive is considerably less prescriptive and as depicted above this has led to unharmonised end-of-life management processes amongst Member States. Nevertheless, in a similar manner to the aforementioned Directives, the recycling and recovery of waste packaging is mandated, and Member States must implement 'necessary' measures to meet general, EU-wide quantitative end-of-life targets.⁹²⁶ One notable omission, however, is that the Directive does not require the pre-treatment of packaging prior to facilitating its onward end-of-life management, which may increase contamination rates, thus affecting waste packaging's recycling or reuse potential and increasing associated management costs.⁹²⁷ The omission of pre-treatment does not relate to feasibility or cost-effectiveness; instead, it aligns with the Directive's overall approach to managing end-of-life packaging, which provides a relatively light-touch framework.⁹²⁸

As a means of incentivising the recovery and recycling of packaging, the Directive contains efficiency targets which are based on the weight of collected waste.⁹²⁹ These targets have incrementally risen since their introduction in 2001, where 50% of collected packaging was required to be recovered and 25% recycled.⁹³⁰ Initially, the Directive also established 'maximum' recovery and recycling levels of 65% and 45%, respectively, which were advanced to avoid market distortions, which had occurred upon the commencement and

⁹²⁶ The Waste Packaging Directive Art. 6 (1).

⁹²⁷ Kol and others (n 913).

⁹²⁸ *ibid.*

⁹²⁹ The Waste Packaging Directive Art. 6 (1).

⁹³⁰ *ibid* Art. 6 (1) (a) & (c).

success of the German Packaging Ordinance, as outlined in Section 1 of this chapter.⁹³¹ In 2008, the efficiency rates increased to 60% recovery and 55% recycling, with a maximum of 80%.⁹³² Owing to an amendment in 2018, the Directive efficiency targets are set to rise further in 2025 and 2030 to 65% and 70%, respectively, presumably to reflect the EU's advance to circularity and the mandatory implementation of the EPR principle.⁹³³ Both of these figures relate to recycling and, as a result, the Directive no longer exhibits recovery targets, which, other than disposal, is the least preferred form of managing waste as depicted on the Waste Framework Directive's 'waste hierarchy'.⁹³⁴ This is encouraging given that the *European Commission* has removed the circular restrictive 'maximum' targets, citing obsolescence and that it lacked 'reasonable explanation'.⁹³⁵ Though increases in the targeted packaging recycling rate are welcome, they need to be realised to support the transition to a Circular Economy. A recent 'early warning report' by the *European Commission* troublingly noted that most Member States were unlikely to achieve the Directive's 2025 or 2030 targets without amendment.⁹³⁶ In a similar study, *Antonopoulos, Faraca and Tonini* noted that to realise such targets, packaging design improvement and post-collection sorting practices needed to improve.⁹³⁷

⁹³¹ *ibid* Art. 7 (1); European Commission, 'Ex-Post Evaluation of Five Waste Stream Directives' (n 15) 64–65; Chartered Institute for Waste Management, 'Packaging Waste Recovery: A European Comparison' (2016) <<https://www.ciwm.co.uk/Custom/BSIDocumentSelector/Pages/DocumentViewer.aspx?id=QoR7FzWBtisamYEcWSfL6SxAJRLAPT9vBc%252bTYqJHvnIIMlqCsWkEmaE8Zjg6eL94FxU9JUBUd8Rj%252byAOnDWYXkztrE1PEmyUBCW7arrTnHmOfLZ8G0g%252bbwjKsJLkGTK1iIgTYIZwYcfX%252fLeeXbKFmSYINJ1eC0w32gFIQphsYg%253d>> accessed 30 October 2022.

⁹³² The Waste Packaging Directive Art. 6 (b) & (d).

⁹³³ *ibid* Art. 6 (f) & (h).

⁹³⁴ *ibid* Art. 6 (f) & (h).

⁹³⁵ European Commission, 'Ex-Post Evaluation of Five Waste Stream Directives' (n 15).

⁹³⁶ European Commission, 'Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Identifying Member States at Risk of Not Meeting the 2025 Preparing for Re-Use and Recycling Target for Municipal Waste, the 2025 Recycling Target for Packaging Waste and the 2035 Municipal Waste Landfilling Reduction Target' (n 6).

⁹³⁷ Ioannis Antonopoulos, Giorgia Faraca and Davide Tonini, 'Recycling of Post-Consumer Plastic Packaging Waste in the EU: Recovery Rates, Material Flows, and Barriers' (2021) 126 *Waste Management* 694.

In addition to the generalised targets above, the Directive encouragingly introduced material-specific recycling efficiencies in 2008, which will increase in 2025 and 2035, as depicted in *Table 2*. As opposed to the generalised targets exhibited in, for example, the Waste Electrical and Electronic Equipment Directive, material-specific recycling efficiencies likely induce greater rates of circularity, given that they drive consistent inputs of recyclate in a cylindrical consumption model, as well as targeting environmentally problematic or scarce materials.⁹³⁸ Moreover, material-specific targets realise the resource potential of a range of materials rather than merely the most ubiquitous or heavy materials, which may have been perversely incentivised under other waste stream Directives. However, it is contended that these targets are not complicit in keeping products, components and materials at their highest utility value at all times because they do not mandate the recycling of the whole product and, instead, require a targeted percentage, according to weight, to be recycled.

Table 2: Material-Specific Recycling Targets

Product Category	Year		
	2008 ⁹³⁹	2025 ⁹⁴⁰	2030 ⁹⁴¹
Glass	60%	70%	75%
Paper	60%	75%	85%
Cardboard	60%	75%	85%

⁹³⁸ European Environment Agency, 'The Case for Increasing Recycling: Estimating the Potential for Recycling in Europe' <<https://www.eea.europa.eu/publications/the-case-for-increasing-recycling>> accessed 31 July 2023.

⁹³⁹ The Waste Packaging Directive Art. 6 (1) (e).

⁹⁴⁰ *ibid* Art. 6 (1) (g).

⁹⁴¹ *ibid* Art. 6 (1) (i).

Metals	50%	-	-
Ferrous Metals	-	70%	80%
Aluminium	-	50%	60%
Plastics	22.5%	50%	55%
Wood	15%	25%	30%

Though not mandatory until 2024, most Member States have employed the EPR principle to effectuate the Directive's recovery and recycling mandate.⁹⁴² In doing so, Member States typically apportion the Directive's targets to producers, or their PROs, to ensure compliance with the supranational targets.⁹⁴³ The UK's scheme provides a good example of this in practice. Here, targets are apportioned through a 'National Packaging Waste Database', based on the producer's declared tonnage of 'handled' packaging during the compliance period.⁹⁴⁴ The term 'handled' includes packaging supplied to 'the next stage of the packaging chain' as well as any packaging which has been sold to end-users or has been imported or exported.⁹⁴⁵ Subsequently, producers meet their respective targets by purchasing either 'Packaging Recovery Notes' or 'Packaging Export Recovery Notes' from accredited reprocessors or exporters who facilitate the sound disposal of collected packaging, thus *de*

⁹⁴² The European Organisation for Packaging and the Environment, 'Extended Producer Responsibility' (*European-packaging*, 2015) <<https://www.euopen-packaging.eu/policy-area/extended-producer-responsibility/>> accessed 1 February 2022; The Waste Packaging Directive Art. 7 (2).

⁹⁴³ The European Organisation for Packaging and the Environment (n 942).

⁹⁴⁴ Environment Agency, 'Packaging Recycling Targets 2021 & 2022 Confirmed' (*Environment Agency*, 18 January 2022) <<http://npwd.environment-agency.gov.uk>> accessed 18 January 2022; Environment Agency, 'Packaging Waste: Producer Responsibilities' (n 887). Environment Agency, 'Packaging Recycling Targets 2021 & 2022 Confirmed' (*National Packaging Waste Database*, 18 January 2022) <<http://npwd.environment-agency.gov.uk>> accessed 18 January 2022; Environment Agency (n 121).

⁹⁴⁵ Environment Agency, 'Packaging Waste: Producer Responsibilities' (n 887).

facto confirming that the efficiency targets set out above have been adhered to.⁹⁴⁶ These evidence notes are then submitted to the 'National Packaging Waste Database', mentioned above, which then issues a certificate of compliance, confirming that the producer's obligations have been met.⁹⁴⁷ As detailed in Section 4.1, producers do not cover the full end-of-life management costs of packaging, with estimated cost coverage of 10% of the total management of the waste stream, 'which means that most of the cost is borne by local authorities, other public authorities and businesses who consume packaged goods'.⁹⁴⁸

Through the scheme detailed above, the UK has consistently achieved the targeted recycling and recovery rates detailed within the Directive.⁹⁴⁹ Indeed, by 2019, most Member States, except for Croatia, Hungary and Malta, had achieved the required recycling rate of 55%.⁹⁵⁰ Similarly, with the exception of Poland, Hungary, Croatia, and Malta, all Member States achieved the required recovery rate of 60%.⁹⁵¹ This indicates that the Directive's targets have proved effective in incentivising recycling and recovery.⁹⁵² Despite this, the Directive has not incentivised circularity, given that its targets have remained static since 2008 and therefore *prima facie* accepting of the fact that Member States and their producers can dispose of up to 45% of collected packaging via practices such as landfill and incineration, and this does not align well with the Circular Economy goal of waste prevention.

⁹⁴⁶ *ibid.*

⁹⁴⁷ *ibid.*

⁹⁴⁸ Scottish Government, 'Reforming the UK Packaging Producer Responsibility System: Partial Business and Regulatory Impact Assessment (BRIA)' (GOV.SCOT, 19 January 2023) para 13 <<https://www.gov.scot/publications/reforming-uk-packaging-producer-responsibility-system-partial-business-regulatory-impact-assessment-bria/pages/2/>> accessed 20 July 2023.

⁹⁴⁹ Department for Environment, Food & Rural Affairs, 'Consultation on Recovery and Recycling Targets for Packaging Waste for 2013- 2017' (HM Government 2011) <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/82440/packaging-consult-doc.pdf> accessed 18 January 2022.

⁹⁵⁰ Eurostat, 'Packaging Waste Statistics' (n 901).

⁹⁵¹ *ibid.*

⁹⁵² European Commission, 'Ex-Post Evaluation of Five Waste Stream Directives' (n 15) 16–18.

However, it is encouraging that the Directive's targets will increase in 2025 and 2030 and remove the incentivisation of recovery, as a lower utility value practice depicted on the waste hierarchy.⁹⁵³ Increased targets are likely to incentivise packaging recycling rates, though the *European Commission's* 'early warning report' serves as a stark reminder that this is not a foregone conclusion, particularly as, *Antonopoulos, Faraca and Tonini* cite issues with the design and post-collection sorting of waste packaging.⁹⁵⁴ Nonetheless, it is anticipated that attributing the full costs of the end-of-life management of packaging to producers will likely have a transformative effect, though this may be limited by the absence of a consistent framework for such management. However, overall, it is considered here that the Directive's recycling and recovery measures do not, as currently drafted, meet the Circular Economy goals of preventing waste, keeping products, materials and components at their highest utility value at all times and thus, ensuring environmental protection.

4.3.2. Reuse

As argued by *Coelho and others*, the reuse of packaging was once the norm in Europe.⁹⁵⁵ By way of example, the UK has previously boasted voluntary deposit return schemes, which gave rise to the reuse of packaging, including milk and beer bottles.⁹⁵⁶ In the case of milk, glass bottles were returned to the doorstep and reused up to 40 times before other disposal

⁹⁵³ The Waste Framework Directive Art. 4.

⁹⁵⁴ European Commission, 'Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Identifying Member States at Risk of Not Meeting the 2025 Preparing for Re-Use and Recycling Target for Municipal Waste, the 2025 Recycling Target for Packaging Waste and the 2035 Municipal Waste Landfilling Reduction Target' (n 6); *Antonopoulos, Faraca and Tonini* (n 937).

⁹⁵⁵ *Coelho and others* (n 799).

⁹⁵⁶ Tom Licence, 'Normalising Bottle Return and Reuse: Lessons from the Victorians on the Limits of Voluntary Schemes' (*History & Policy*, 30 January 2020) <<https://www.historyandpolicy.org/policy-papers/papers/normalising-bottle-return-and-reuse-lessons-from-the-victorians-on-the-limits-of-voluntary-schemes>> accessed 19 January 2022.

mechanisms were instigated, though it is acknowledged that in today's world, such delivery means would attract higher costs and may not be affordable to the broader population.⁹⁵⁷ As a result of cost savings, such schemes have gradually given way to single-use packaging, and now most packaging, especially plastic packaging, is used once before being discarded.⁹⁵⁸ This has led to packaging consumption being the primary user of virgin raw materials.⁹⁵⁹

In consequence of the above, the adoption of the EU's Circular Economy Action Plan saw the Directive amended in 2018, particularly to realise the value of packaging by further strengthening the Directive's reuse provisions.⁹⁶⁰ Subsequently, the Directive seeks 'to encourage the increase in the share of reusable packaging placed on the market' and the introduction of 'systems to reuse packaging' without compromising food hygiene or the safety of consumers.⁹⁶¹ Highlighting potential options, the Directive sets out a non-exhaustive list of incentives that 'may' be implemented to gain higher reuse rates.⁹⁶² These include deposit-return schemes, qualitative and quantitative targets, economic incentives and 'minimum percentages of reusable packaging placed on the market every year for each packaging stream'.⁹⁶³ It is notable, however, that the Directive merely encourages reuse, and although it gives flexibility to Member States to choose instruments best suited to their respective waste packaging regimes, it also means that the uptake of the measure's is likely reduced as they are not mandatory.

⁹⁵⁷ *ibid.*

⁹⁵⁸ Coelho and others (n 799); Licence (n 956).

⁹⁵⁹ Coelho and others (n 799); Licence (n 956).

⁹⁶⁰ European Commission, 'Circular Economy Action Plan' (n 17); Council Directive 2018/852/EC of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste [2018] OJ L 150/141.

⁹⁶¹ The Waste Packaging Directive Art. 5 (1).

⁹⁶² *ibid* Art. 5 (1) (a) - (d).

⁹⁶³ *ibid* Art. 5 (1).

It is contended that the provisions above are unlikely to lead to high levels of reuse owing to their unspecific and unmeasurable nature, and in consequence, the Directive is not well aligned with Circular Economy goals. This is especially the case given the distinct lack of supranational mandated quantitative targets that incentivise reuse over other higher utility value practices.⁹⁶⁴ As currently drafted, the Directive may act as a perverse incentive for producers to prefer recycling over reuse, as the former will contribute to the fulfilment of the Directive's recycling targets. This incentive can be reduced at the discretion of Member States, who 'may' decide but are not required to adjust their recycling targets to take account of reuse. Here, recital 5 of the 2018 amendment states:

'As reuse entails the avoidance of placing new packaging on the market and increasing the volumes of packaging waste generated, reusable sales packaging that is placed on the market for the first time and wooden packaging that is repaired for reuse should be taken into account for the purposes of attaining the respective packaging recycling targets.'⁹⁶⁵

When implemented, it is contended that the provision above may reduce the perverse incentive for producers to prioritise recycling over reuse. However, it is argued that the uptake of reusable packaging may ultimately be a question of cost, and whilst it is acknowledged that there is an existing economic advantage to reusable packaging given

⁹⁶⁴ The lack of supranational mandated targets here is reflective of the Directive's age. However, it also, when compared to the other Directives analysed by this thesis, signals that the EU has not achieved consistency in its approach to the management of products after their first-life.

⁹⁶⁵ Council Directive 2018/852/EC of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste [2018] OJ L 150/141 Recital 5 .

that it likely reduces costs in the long term, economic incentives could have been mandated as a means of ensuring producers and consumers alike opted for reusable packaging at the outset over single-use alternatives.⁹⁶⁶ This could have, for example, included the mandatory use of economic EPR policy instruments, including tax incentives, to ensure that reusable packaging is cheaper or equal to single-use alternatives at the point of purchase.

5. Export

As demonstrated in the previous three chapters, Member States often meet their targeted recycling obligations by exporting waste to ‘third’ countries. This is also the case with packaging, providing that Member States establish an ‘effective system of quality control and traceability’ and ‘the exporter can prove that the shipment of waste complies with’ the Waste Shipment Regulations.⁹⁶⁷ This means the end-of-life management of packaging outside of the EU should occur under ‘broadly similar’ conditions.⁹⁶⁸ Since waste packaging is defined as non-hazardous, its export to Organisation of Economic Co-operation and Development (OECD) and Non-OECD members has historically been permitted under the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal and, *the OECD’s* ‘Control of Transboundary Movements of Wastes Destined for Recovery Operations’.⁹⁶⁹ However, in 2020, the EU adopted new rules prohibiting the

⁹⁶⁶ Increased informative responsibility could have also been advanced as a means of promoting existing economic advantages to consumers.

⁹⁶⁷ The Waste Packaging Directive Art. 6a (8); Waste Shipment Regulations.

⁹⁶⁸ The Waste Packaging Directive Art. 6a (8).

⁹⁶⁹ The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; Decision of the Council on the Control of Transboundary Movements of Wastes Destined for Recovery Operations.

export of plastic waste to all non-OECD countries, except in cases of clean plastic exported for recycling, though the export of other forms of waste packaging has continued.⁹⁷⁰

The continuation of waste packaging exports is largely a result of Europe's limited waste management infrastructure, which does not, particularly in relation to plastics, have sufficient capacity to manage waste packaging according to their highest utility value.⁹⁷¹ This is concerning given that the *European Commission's* evaluation of the Waste Packaging Directive previously warned that it is 'not always clear how much of that waste is actually recycled' upon being exported to third countries.⁹⁷² Similarly, the UK's *National Audit Office* noted that there is typically 'low visibility and control over the waste that is sold for recycling abroad and there is a risk that some of it is not recycled under equivalent standards, and is instead sent to landfill'.⁹⁷³

The export of waste packaging undermines the Directive's, and indeed the Circular Economy's, goal of environmental protection. However, the practice also acts as a barrier to developing a packaging Circular Economy given that the resources are exported out of Europe and cannot be fed back into a cylindrical consumption model, which keeps products, components and materials at their highest utility value at all times. Accordingly, the repair, reuse and recycling potential of waste packaging cannot be realised, which may lead to the extraction of raw materials and the increased production of new packaging. Given this, the

⁹⁷⁰ Commission Delegated Regulation 2020/2174/EU of 19 October 2020 amending Annexes IC, III, IIIA, IV, V, VII and VIII to Regulation (EC) No 1013/2006 of the European Parliament and of the Council on shipments of waste [2020] OJ L 433.

⁹⁷¹ European Environment Agency, 'The Plastic Waste Trade in the Circular Economy' (2019) <<https://www.eea.europa.eu/publications/the-plastic-waste-trade-in>> accessed 1 August 2023.

⁹⁷² European Commission, 'Ex-Post Evaluation of Five Waste Stream Directives' (n 15) 17.

⁹⁷³ Comptroller and Auditor General (n 891) 8.

Directive's export provisions are not effective and likely hinder the transition to a Circular Economy, particularly as the EU does not effectively manage the waste packaging that it produces.⁹⁷⁴

6. End-User Information

As outlined in Chapter 5, the education of consumers is one of the most critical factors in increasing the circularity of goods.⁹⁷⁵ Recognising this, the Waste Packaging Directive establishes a general requirement for Member States to ensure that packaging end-users can obtain information on the return, collection or other recovery systems that are available to them and in doing so, consumers must be able to understand the meaning of packaging markings and how they can contribute to the reuse, recycling and recovery of waste packaging.⁹⁷⁶ Though notably, the Directive fails to take into account holistic circular practices, such as providing information on life expectancy, reusability, or the packaging's ability to be repaired and reused, which means that consumers cannot make informed choices on packaging.

To disseminate information, the Directive sets a non-specific, non-measurable obligation for Member States to 'promote consumer information campaigns'.⁹⁷⁷ The Directive does not require the mandatory implementation of the EPR principle (see Section 4.1) until 2024, and until that point, it is silent on the extent to which producers bear responsibility for such campaigns. However, evidence suggests that most Member States, including Spain,

⁹⁷⁴ European Environment Agency (n 971).

⁹⁷⁵ Nowakowski (n 186).

⁹⁷⁶ The Waste Packaging Directive Art. 13.

⁹⁷⁷ *ibid* Art. 13.

Portugal and France, have invoked informative responsibility to varying degrees.⁹⁷⁸ France, for example, has linked consumer awareness campaigns with financial contributions to packaging EPR schemes. The scheme rewards producers for good practices and penalises them for bad practices.⁹⁷⁹ Where producers fund one or more information campaigns, they receive a 2% cost reduction in their contribution to the scheme, which acts as an incentive.⁹⁸⁰ Despite this, the Directive does not sufficiently incentivise, nor establish a sufficient framework for the standardised dissemination of information. However, it is notable that producers will be required to bear the full net cost of consumer campaigns upon the mandatory introduction of the EPR principle, in accordance with Article 8a of the Waste Framework Directive, from 2024.⁹⁸¹

7. Further Economic Measures

In addition to the measures outlined above, the Directive grants permission to Member States to employ further economic measures to facilitate the Directive's goals, and indeed, the use of these measures to prevent the use of lightweight plastic bags is actively encouraged.⁹⁸² To do so, the Directive refers to the Waste Framework Directive, which contains a non-exhaustive list of potential economic instruments, including pay-as-you-throw, deposit return schemes and the adoption of other fiscal measures.⁹⁸³ Fiscal measures

⁹⁷⁸ Sergio Rubio and others, 'Effectiveness of Extended Producer Responsibility Policies Implementation: The Case of Portuguese and Spanish Packaging Waste Systems' (2019) 210 *Journal of Cleaner Production* 217.

⁹⁷⁹ *ibid.*

⁹⁸⁰ *ibid.*

⁹⁸¹ The Waste Framework Directive Art. 8a.

⁹⁸² The Waste Packaging Directive Art. 4 (1), 4 (1a) & 15.

⁹⁸³ The Waste Framework Directive Annex IVa. Full list of example instruments and measures: charges and restrictions for the landfilling and incineration of waste, pay-as-you-throw schemes, fiscal incentives, EPR, deposit refund schemes, sound planning of investment in waste management infrastructure, sustainable

have proved particularly effective in reducing the use of single-use plastic carrier bags and channelling consumers to reusable alternatives. For example, the Welsh Government's introduction of a charge on single-use plastic carrier bags reduced their consumption by 90%.⁹⁸⁴

Although the Directive is predominantly concerned with introducing further economic measures to manage lightweight plastic carrier bags, Member States are not discouraged from employing such measures more widely. For example, the collection of packaging in Germany is encouraged through a deposit return scheme, whilst pay-as-you-throw schemes have been forwarded in Ireland.⁹⁸⁵ Deposit return schemes have proved particularly effective at increasing the collection and, thus, the end-of-life management of drinks containers. Nordic EU Members have employed such schemes extensively, increasing collection rates by 85-95%.⁹⁸⁶ Indeed, given such successes, the *European Parliament* assessed the viability of an EU-wide deposit return scheme to increase the collection of packaging; however despite circular ambitions, the scheme has not come to regulatory fruition.⁹⁸⁷

In addition to landfill and incineration taxes and advanced recycling fees, some Member States have explored the use of material taxes to incentivise the collection and recycling of

public procurement, phasing out of subsidies that do not promote the waste hierarchy, support to research and innovation in advanced recycling technology and remanufacturing, use of best available techniques for waste treatment economic incentives for regional and local authorities, public awareness campaigns, 'system for coordination, including by digital means, between all competent public authorities involved in the waste management' and promoting continuous dialogue and coordination between relevant stakeholders.

⁹⁸⁴ Welsh Government (n 848).

⁹⁸⁵ Magrini, D'Addato and Bonoli (n 918); Kol and others (n 913).

⁹⁸⁶ Magnus Hennlock and others, 'Economic Policy Instruments for Plastic Waste – A Review with Nordic Perspectives' (Nordic Council of Ministers 2014) <<https://norden.diva-portal.org/smash/get/diva2:791794/FULLTEXT02.pdf>> accessed 20 January 2022.

⁹⁸⁷ Jürgen Schneider and others, 'A European Refunding Scheme for Drinks Containers' (European Parliament 2011) <[https://www.europarl.europa.eu/RegData/etudes/note/join/2011/457065/IPOL-AFET_NT\(2011\)457065_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/note/join/2011/457065/IPOL-AFET_NT(2011)457065_EN.pdf)> accessed 20 January 2022.

waste packaging.⁹⁸⁸ One example of this is the UK's 'Plastic Packaging Tax', which was first operationalised in April 2022.⁹⁸⁹ The scheme aims to stimulate the use of plastic recycle in plastic bottles by charging producers £200 per ton, where 30% of recycled materials have not been used.⁹⁹⁰ The tax is expected to result in a 40% increase in the use of recycled plastics, thus increasing the desirability of plastic bottle collection.⁹⁹¹ However, though the measure is welcome, the tax may have the unintended consequence of perversely incentivising the recycling of plastic bottles over higher utility value practices, such as reuse. Despite this, the above assessment of further economic incentive use is compelling, and demonstrates that it can successfully stimulate greater packaging circularity. However, in a similar manner to this chapter's discussion in Section 6 on end-user information, it can be concluded that the Directive, as drafted, does not establish a sufficient, nor mandatory framework for the deployment of such measures.

8. Enforcement

As discussed in the proceeding chapters, the Commission, at the supranational level, can instigate infringement proceedings for non-transposition, incorrect or incomplete implementation or inadequate (or no) application and enforcement of the transposed Directive's measures under Article 258 and 260 of the Treaty on the Functioning of the European Union.⁹⁹² Nonetheless, the Directive is silent on national enforcement, although as discussed in Chapter 2, by extension of the Court of Justice of the European Union,

⁹⁸⁸ Guangli Zhou and others, 'A Systematic Review of the Deposit-Refund System for Beverage Packaging: Operating Mode, Key Parameter and Development Trend' (2020) 251 *Journal of Cleaner Production* 119660.

⁹⁸⁹ HM Revenue & Customs (n 176).

⁹⁹⁰ *ibid.*

⁹⁹¹ HM Revenue & Customs (n 177); HM Revenue & Customs (n 176).

⁹⁹² TFEU Art. 258 - 260.

Member States are required to nationally apply and enforce its measures and provide for ‘effective, proportionate and dissuasive’ penalties.⁹⁹³ Member States are therefore afforded wide-ranging discretion on the design of monitoring, enforcement and penalty provisions. The UK and specifically England, provides a good illustrative example of this discretion given that they have moved away from criminally prosecuting legal persons and instead use civil sanctions.⁹⁹⁴ In 2016, *Costcutter Supermarkets Group* referred itself to the regulator upon discovering potential breaches of the UK Packaging Regulations, and it was agreed that the company would make a charitable donation instead of being prosecuted.⁹⁹⁵ Since introducing civil sanctions, the Environment Agency has considered 285 ‘enforcement undertakings’ amounting to charitable donations of more than £6 million.⁹⁹⁶ However, this enforcement action typically relies on the goodwill of companies to self-regulate.⁹⁹⁷ Though *UK Government* considers the introduction a success, it is argued that civil sanctions are not a dissuasive means of nationally enforcing the end-of-life management of packaging, owing to their self-regulatory nature.⁹⁹⁸ For a wider discussion on supranational, and indeed, national enforcement, refer to Chapter 2, Section 3.5

9. Proposed Packaging Regulation

⁹⁹³ Macrory, ‘European Moves on Environmental Enforcement (2014) European Moves on Environmental Enforcement’ (n 255).

⁹⁹⁴ Department for Environment, Food & Rural Affairs (n 949) para 12.21-12.26.

⁹⁹⁵ Comptroller and Auditor General (n 891) 42.

⁹⁹⁶ Darrel Moore, ‘EA to Packaging Firms: Comply with Recovery and Recycling Directives, or Face “Enforcement Action”’ (*Circular Online*, 2020) <<https://www.circularonline.co.uk/news/ea-to-packaging-firms-comply-with-recovery-and-recycling-directives-or-face-enforcement-action/>>.

⁹⁹⁷ Department for Environment, Food & Rural Affairs (n 949) para 12.21.

⁹⁹⁸ *ibid.*

The *European Commission* proposed a new packaging regime in the guise of a Regulation in November 2022.⁹⁹⁹ First mooted in the European Green Deal and Circular Economy Action Plan, the proposed Regulation is in the early stages of enactment, and the Waste Packaging Directive remains in force and is expected to do so for 12 months after formal adoption takes place, which is unlikely to be before 2024.¹⁰⁰⁰ Therefore, the proposed Regulation is outside this research's scope, though owing to its significance, a summary is provided below.

The newly proposed Regulation aims to 'ensure that all packaging is reusable or recyclable in an economically feasible way by 2030'.¹⁰⁰¹ It aims to do this by reframing the Waste Packaging Directive's essential requirements, promoting reuse, increasing the uptake of recycled content, improving enforcement, and tackling overpackaging and overconsumption, thus reducing waste.¹⁰⁰² The proposal bears many of the hallmarks of the Waste Packaging Directive, and as a result, it sets design standards as well as end-of-life management responsibilities. In doing so, it promotes the EPR principle as a collection, treatment, reuse and recycling driver, thus merely reaffirming existing commitments.¹⁰⁰³

The proposal aims to ensure that all packaging is recyclable by introducing measures on the design, collection, sorting and recycling of all packaging, including that of soft

⁹⁹⁹ European Commission, 'Proposal for a Regulation of the European Parliament and of the Council on Packaging and Packaging Waste, Amending Regulation (EU) 2019/1020 and Directive (EU) 2019/904, and Repealing Directive 94/62/EC' (n 125) Art. 64.

¹⁰⁰⁰ *ibid* Art. 64; European Commission, 'The European Green Deal' (n 118); European Commission, 'A New Circular Economy Action Plan' (n 17).

¹⁰⁰¹ European Parliament, 'Revision of the Packaging and Packaging Waste Directive' (2023) Briefing Paper <[https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/745707/EPRS_BRI\(2023\)745707_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/745707/EPRS_BRI(2023)745707_EN.pdf)> accessed 6 July 2023.

¹⁰⁰² *ibid*.

¹⁰⁰³ The Waste Packaging Directive Art. 7 (2).

plastics.¹⁰⁰⁴ Taking a product life-cycle approach, the proposal sets out substance prohibitions, termed ‘substances of concern’, whereby lead, cadmium, mercury, and hexavalent chromium cannot be used in the design and production of packaging where it exceeds 100 milligrams per kilogram.¹⁰⁰⁵ This is said to protect against pollution and safeguard the use of secondary raw materials that are recovered during the recycling process, though again, is not dissimilar to the existing waste packaging regime.¹⁰⁰⁶

In addition to the above, the proposed Regulation explicitly introduces ‘minimum recycled content’ obligations, which require packaging to be designed with at least 10% recycled content by 2030 and ranging up to 35% depending on the type of packaging.¹⁰⁰⁷ By 2040, the Regulation suggests that rates will be increased to between 50% and 65%.¹⁰⁰⁸ Other design measures include waste minimisation requirements, which target size and weight reductions, as well as overpackaging, which limits unused packaging space to 40%.¹⁰⁰⁹ Moreover, expanded labelling requirements are advanced, requiring the physical or digital display of information on the reusability of packaging and its material composition.¹⁰¹⁰

In relation to the end-of-life management of waste packaging, the proposed Regulation specifies waste reduction targets, which aim to reduce the rate of packaging by 5%, 10%

¹⁰⁰⁴ European Commission, ‘Proposal for a Directive of the European Parliament and of the Council Reviewing the Targets in Directives 2008/98/EC on Waste, 94/62/EC on Packaging and Packaging Waste, and 1999/31/EC on the Landfill of Waste, Amending Directives 2000/53/EC on End-of-Life Vehicles, 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators, and 2012/19/EC on Waste Electrical and Electronic Equipment’ (n 315) Art. 6.

¹⁰⁰⁵ European Commission, ‘Proposal for a Regulation of the European Parliament and of the Council on Packaging and Packaging Waste, Amending Regulation (EU) 2019/1020 and Directive (EU) 2019/904, and Repealing Directive 94/62/EC’ (n 125) Art. 5.

¹⁰⁰⁶ *ibid* Art. 5.

¹⁰⁰⁷ *ibid* Art. 7.

¹⁰⁰⁸ *ibid* Art. 7.

¹⁰⁰⁹ *ibid* Art. 9 & 10.

¹⁰¹⁰ *ibid* Art. 11.

and 15%, when compared to 2018 levels, by 2030, 2035 and 2040.¹⁰¹¹ In similarity with the UK's Waste Packaging Regulations 2009, the proposed Regulation also introduces a mandatory register of packaging producers, which aims to reduce free-riding and increase monitoring and compliance.¹⁰¹² This register supports the implementation of the EPR principle by requiring each producer or their third-party PRO's to fund return and collection systems and facilitate the recycling or reuse of packaging.¹⁰¹³ These schemes must align with Articles 8 and 8a of the Waste Framework Directive, which means that the modulation of fees, which rewards the producer's eco-design and penalises them for bad practice, becomes mandatory.¹⁰¹⁴ However, it is anticipated that the mandatory enactment of the EPR principle, and its requirements to adhere to Articles 8 and 8a of the Waste Framework Directive will not increase packaging circularity in itself. This is because most European countries already manage packaging waste through the implementation of EPR policy instruments owing to the Waste Packaging Directive's requirements for Member States to align with the Waste Framework Directive's minimum EPR standards by 2024.¹⁰¹⁵

The proposed Regulation establishes a series of targets to support the end-of-life management of waste packaging. These targets are based around the recycling and reuse of packaging and somewhat oddly, do not extend to the collection phase. This is presumably because, if enacted, Member States would be required to establish plastic and metal beverage container deposit and return schemes.¹⁰¹⁶ Considering this, the proposal does not

¹⁰¹¹ *ibid* Art. 38.

¹⁰¹² *ibid* Art. 39.

¹⁰¹³ *ibid* Art. 40.

¹⁰¹⁴ *ibid* Art. 40; The Waste Framework Directive Art. 8 & 8a.

¹⁰¹⁵ The Waste Packaging Directive Art. 7 (3); The Waste Framework Directive Art. 8a & 8.

¹⁰¹⁶ European Commission, 'Proposal for a Regulation of the European Parliament and of the Council on Packaging and Packaging Waste, Amending Regulation (EU) 2019/1020 and Directive (EU) 2019/904, and Repealing Directive 94/62/EC' (n 125) Art. 44.

merely rely on take-back but also employs other economic measures, such as deposit return schemes, as drivers for increasing collection rates, which is encouraging. In regards to recycling, existing targets are reproduced in the proposal.¹⁰¹⁷ This is of no surprise, given that the *European Commission* warned in 2023 that most Member States were at risk of missing their targeted recycling rate of 65%.¹⁰¹⁸ Owing to this, the proposal contains provisions for the postponement of existing targets for up to five years, which is likely to undermine the advance towards a packaging Circular Economy in the near term.¹⁰¹⁹ Conversely, in a departure from the existing regime, the proposal specifies a ‘reuse and refill’ target.¹⁰²⁰ For example, 90% of packaging for large household appliances (such as fridge freezers) must be reusable or refillable by 2030.¹⁰²¹ However, though welcome, this target merely applies to specific sectors and as a result, the proposal does not sufficiently incentivise higher utility end-of-life management practices over that of recycling.¹⁰²²

10. Conclusion

¹⁰¹⁷ *ibid* Art. 44.

¹⁰¹⁸ European Commission, ‘Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Identifying Member States at Risk of Not Meeting the 2025 Preparing for Re-Use and Recycling Target for Municipal Waste, the 2025 Recycling Target for Packaging Waste and the 2035 Municipal Waste Landfilling Reduction Target’ (n 6).

¹⁰¹⁹ European Commission, ‘Proposal for a Regulation of the European Parliament and of the Council on Packaging and Packaging Waste, Amending Regulation (EU) 2019/1020 and Directive (EU) 2019/904, and Repealing Directive 94/62/EC’ (n 125) Art. 40.

¹⁰²⁰ *ibid* Art. 45.

¹⁰²¹ European Commission, ‘Proposal for a Directive of the European Parliament and of the Council Reviewing the Targets in Directives 2008/98/EC on Waste, 94/62/EC on Packaging and Packaging Waste, and 1999/31/EC on the Landfill of Waste, Amending Directives 2000/53/EC on End-of-Life Vehicles, 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators, and 2012/19/EC on Waste Electrical and Electronic Equipment’ (n 315) Art. 26.

¹⁰²² European Commission, ‘Proposal for a Regulation of the European Parliament and of the Council on Packaging and Packaging Waste, Amending Regulation (EU) 2019/1020 and Directive (EU) 2019/904, and Repealing Directive 94/62/EC’ (n 125) Art. 45.

The generation of waste packaging, which is environmentally problematic upon negligent disposal, has continued on an upwards trend in recent years, and now up to 20% of global municipal waste can be associated with the waste stream. This trend has continued in the EU, despite its management through the Waste Packaging Directive, which has been amended on several occasions. Here, the Directive establishes design and end-of-life management measures, which mainly relate to the collection, recycling and recovery of waste packaging. Compared to the Batteries, End-of-life Vehicles and Waste Electrical and Electronic Equipment Directives, it is notable that the Waste Packaging Directive provides a relatively light-touch framework for managing end-of-life packaging, which has led to its divergent management in the EU.

The above-mentioned light-touch approach has afforded EU Member States broad discretion to manage packaging waste within their respective territories. On the one hand, this is positive because the Directive has enabled Member States to innovate by encouraging wide-ranging economic measures, such as deposit return schemes and material taxes, as a means of supporting the collection and subsequent end-of-life management of packaging. On the other hand, many of the Directive's provisions were found to be neither specific nor measurable and do not align well with Circular Economy goals. Owing to the voluntary nature of the EPR principle until 2024, the Directive spurns many of the advantages associated with the EPR principle, and whilst there have been increases in waste packaging collection and recycling, the Directive has not resulted in a packaging Circular Economy. This is because it has not effectively tackled the increasing rates of packaging consumption, nor has it successfully incentivised the reuse, longevity, durability, and repair of packaging. The Directive does not adequately prevent waste

packaging, nor does it keep it at its highest utility value at all times and as a result, the Directive does not realise packaging's circular potential or fully mitigate its negative environmental effects. The newly proposed Waste Packaging Regulation may, if enacted, go some way to rectifying these issues, though as currently drafted it does not forward solutions that will prevent packaging waste and ensure that it is kept at its highest utility value at all times, thus protecting the environment, as per Circular Economy goals.

Chapter 7: Conclusion

1. Introduction

This thesis assesses whether existing Extended Producer Responsibility (EPR) regulatory frameworks within the European Union (EU), consisting of the Batteries, End-of-Life Vehicles, Waste Electrical and Electronic and Waste Packaging Directives, support the drive towards a Circular Economy. This chapter will first provide an overview of the thesis before noting a series of conclusions, answering the research questions set out in Chapter 1.

2. Thesis Overview

This thesis has evaluated existing EPR regulatory frameworks in the EU to assess whether they support circularity. As noted in Chapter 2, the EU has an ambition to transition from a linear, ‘make, take, use and throw’ economy to one that is circular by design. In conceptualising the Circular Economy, Chapter 2 noted that it has yet to achieve its authoritative or accepted definitional form, although it found that its goals, as per the Ellen MacArthur Foundation’s definition of the Circular Economy adopted by this thesis, are to (1) reduce waste by designing and disposing of products, components and materials in an environmentally conscious manner; (2) keep products, components and materials at their highest utility value at all times; and, (3) protect the environment to allow nature to regenerate.¹⁰²³ Given this, a Circular Economy requires the decoupling of economic growth

¹⁰²³ Ellen MacArthur Foundation, ‘Towards a Circular Economy: Business Rationale for an Accelerated Transition’ (n 60).

from consumption and environmental degradation. Therefore, the Circular Economy can reduce waste, drive greater resource productivity, redress resource scarcity, and reduce the environmental impacts of production and consumption. European countries have touted the implementation of the EPR principle as a driver for the Circular Economy, given its potential to incentivise design changes and manage end-of-life products, thus increasing resource efficiency and protecting the environment.

As highlighted in Chapter 2, the EPR principle aims to extend a producer's responsibility for their products to its whole life cycle. Despite this, in practice, the EPR principle is often only applied at a products end-of-life. The key aim in doing so is to first reduce the product's immediate impact by mitigating environmental harm at the end of its life, and then incentivise eco-design that results in resource-efficient, less environmentally impactful products that are easy to manage in an environmentally conscious manner at their end-of-life. The EPR principle acts as a guiding principle that lawmakers can implement by selecting one or more EPR policy instruments, set within one or multiple statutes. EPR policy instruments consist of product take-back; economic and market-based instruments; standards or industry-based instruments; and information-based responsibilities.¹⁰²⁴

Given the above, producers will, in most cases, bear physical or financial responsibility for collecting, treating, reusing, and recycling their products once they have reached their end-of-life. This, in turn, creates a financial incentive for producers to eco-design. The incentive in doing so is to reduce the cost burden of a product's end-of-life management by ensuring

¹⁰²⁴ Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (n 23) 22.

that they are easy to, for example, dismantle, reuse, repair, remanufacture and recycle. Lawmakers usually couple these implicit financial incentives with explicit design measures, notably concerning substance controls and standardisation through labelling or design standards.

The primary research question linked to this thesis was:

Do existing EPR regulatory frameworks within the EU support circularity?

To further guide the study, several subsidiary research questions were developed to align with Circular Economy goals and the EPR principle, namely:

1. Has the EU's EPR frameworks resulted in the eco-design of products?
2. Has the EU's EPR frameworks increased product collection?
3. Once collected, has the EU's EPR frameworks kept products and their materials at their highest utility value?

To answer the primary and subsidiary research questions, the study looked at four EU Directives: the Batteries Directive, End-of-Life Vehicles Directive, Waste Electrical and Electronic Directive, and the Waste Packaging Directive. As these Directives contain similar hallmarks, the chapters followed a comparable analysis pathway, which included an assessment of the Directive's design and end-of-life measures to evaluate whether they drive circularity. The study's conclusions are set out below.

3. Conclusions

The following section provides the main conclusions concerning the research questions above and as set within Chapter 1. At first instance, conclusions will be made for the subsidiary research questions before proceeding to the primary research question.

Subsidiary Research Question 1: Has the EU's EPR framework resulted in the eco-design of products?

The implementation of the EPR principle, particularly by way of financial responsibility, can stimulate the eco-design of products. This is because where a producer is responsible for the whole life cycle and particularly the end-of-life management of its products, it is incentivised to reduce its resultant costs by designing products that generate less waste, last longer, and are easier to manage at its end-of-life. This could include placing products on the market that can be repaired, remanufactured and reused or repurposed. Therefore, if applied successfully, the eco-design incentives derived from the EPR principle can assist in preventing waste, keeping products, components and materials at their highest utility value and protecting the environment. In theory, eco-design incentives are particularly strong where a producer is solely responsible for the management costs of the products placed on the market. This incentive is diminished where collective schemes are employed because the producer's costs will be based on their market share rather than the design of their product, meaning that there is a minimal incentive for the producer to eco-design, as it will not reap the rewards for doing so.

As a result of the above, it is troubling that the analysed Directives in this thesis do not sufficiently promote individual responsibility over that of collective responsibility, and it was found that the implicit design incentives within the Batteries, End-of-Life Vehicles, and Waste Packaging Directives were particularly low. It is notable however that Article 8a of the Waste Framework Directive required Member States to update their transpositions to include fee modulation by January 2023, thus increasing the link between a product's design and its end-of-life management costs. However, the Waste Framework Directive does not provide a sufficient framework for the adoption of fee modulation, merely specifying that fees should be reflective of a product's 'durability, repairability, reusability and recyclability' and, accordingly, the strength of the link between design and cost is questionable.¹⁰²⁵ This is troubling because, in the absence of a specific fee modulation framework, Member States may not closely associate a product's end-of-life management costs with its design, thus leading to less significant eco-design incentives.

This thesis found that the Waste Electrical and Electronic Equipment Directive sought to make producers responsible for the end-of-life management of their own products, thus invoking notions of individual responsibility, which in theory should result in an increased incentive for producers to eco-design. However, it was found that several Member States, have either not transposed the individual responsibility financing measures or have done so ambiguously, and as a result, the full design advantages associated with individual responsibility has not been realised. This was the result of Member States having broad discretion in interpreting individual responsibility requirements as the Directive does not

¹⁰²⁵ The Waste Framework Directive Art. 8a.

provide a precise definition. Nonetheless, given the above, it can be concluded that the analysed Directives have not incentivised a high level of implicit eco-design.

Furthermore, each of the assessed Directives advances explicit design measures. The most ubiquitous of these drivers were those affecting the material makeup of products through the introduction of prohibitions. However, other measures included the supply of information through labelling and standardisation or prevention measures. Whilst these measures have undoubtedly influenced the design of products, their impact on keeping products, components and materials at their highest utility value is limited, as they are not explicitly employed as a circular stimulant. Additionally, the measures are not sufficiently well drafted, meaning that they are often unspecific and unmeasurable or have wide-ranging exemptions attached to them. Although the Directive's explicit measures have resulted in design changes, they could better align with the Circular Economy goals of waste prevention, keeping products, components and materials at their highest utility value at all times and protecting the environment.

Subsidiary Research Question 2: Has the EU's EPR framework increased product collection?

To keep products, components and materials in use and at their highest utility value at all times, the Circular Economy demands that citizens consciously dispose of products at the end of their first life. This means that collection rates should be as close to 100% as possible,

though it has been argued that at least 80-95% of targeted products should be collected to ensure high levels of resource efficiency and environmental protection.¹⁰²⁶

Each of the analysed Directives in this thesis obligates the collection or take-back of products by passing varying degrees of financial or physical responsibility to producers. In doing so, this thesis has found that collection rates have increased across all of the Directives analysed. It found that collection has been particularly stimulated where targeted products hold positive value at their end-of-life, and owing to this, regulation has not played a particularly prevalent role in the success of such schemes. For example, the collection of automotive batteries has an estimated collection rate of 98% and is a 'textbook' example of a Circular Economy. However, strikingly, producers play an insignificant role in their collection owing to their positive value at their end-of-life. Given this, it can be concluded that products with positive end-of-life value, which demonstrate higher collection rates than those with low, moderate, or no value (see below), should not be the focus of regulation. Nonetheless, products that hold positive value at their end-of-life should not be entirely neglected given that they act as a backstop in cases of market failure, where economic incentives are reduced. This is particularly the case for products that are ubiquitous (for example, automotive batteries) or pose a significant threat to the environment (for example, industrial batteries, including electric vehicle batteries).

This thesis found that where a product holds low, moderate or no value at the end of its life or is small in size or susceptible to illegal exploitation, collection rate rises have been modest. Taking WEEE and portable batteries as an example, collection rates are still

¹⁰²⁶ Lindhqvist (n 37).

relatively low at an EU average of 46.8% and 47.5%, respectively. In the case of portable batteries, their collection rates increased by just 12.8% from 2009 to 2018.¹⁰²⁷ One reason for these modest increases could be because of a lack of necessary incentivisation, be it economic or regulatory. For instance, both the Batteries Directive and the WEEE Directive contain collection targets that seek to support respective collection mandates, although these targets are often set low and remain static for long periods. The Batteries Directive requires the collection of just 45% of portable batteries, whilst the WEEE Directive requires a rate of 65% of WEEE, which means they are accepting that 65% of batteries and 45% of WEEE can be disposed of through municipal waste streams, which somewhat undermines the drive to a Circular Economy and particularly the goal of waste prevention.

Similarly, this thesis has found that the analysed Directives have not sufficiently embraced economic incentives or novel techniques to aid the collection of negative value products and instead, the Directives are too reliant on take-back mandates alone. This means that producers are not always fully economically incentivised by, for example, tax incentives, to collect products above and beyond their targeted collection rate or in the most accessible ways for consumers. Similarly, it is argued that consumers are not always economically incentivised to dispose of their end-of-life products, or it is too hard for them to do so, which may lead to negligent disposal or hoarding. Given this, it is a notable omission that the Directives have not embraced a full range of incentives to increase product collection and circularity, including producer-funded curbside collections, servitisation or deposit return schemes. This is significant because, for example, although not mandated by the Waste Packaging Directive, drafting ambiguity has led to the increased use of economic incentives

¹⁰²⁷ Eurostat, 'Waste Statistics: Recycling of Batteries and Accumulators' (n 378).

to aid waste packaging collection. Indeed, Germany's deposit return scheme, which targets drinks containers, has achieved collection rates of 96%, thus demonstrating effectiveness in encouraging high rates of collection, which are necessary to achieve circularity.¹⁰²⁸

This thesis also found that regulatory failures often undermined collection rates, particularly regarding export, national enforcement and the dissemination of information. By way of illustration, though vehicles typically maintain a positive value at their end-of-life, their rates of collection have been weakened by a mixture of regulatory failures, including a flawed de-registration system and the lack of export and national enforcement provisions, culminating in 4 million 'missing' or 'unknown whereabouts' vehicles, many of which are presumed to have been illegally exported, thus representing a loss of resources and an environmental hazard.¹⁰²⁹ Likewise, the Directives do not sufficiently incentivise nor establish an adequate framework for the dissemination of information to consumers. This may act as a barrier to product collection because consumers may not be sufficiently clear on how, when or where to dispose of their unwanted, or spent products. Given the above, though the EU's EPR regulatory frameworks have increased the collection of products on the whole, they have not sufficiently stimulated the necessary collection levels needed to transition from a linear economy to one that is circular by design.

Subsidiary Research Question 3: Once collected, has the EU's EPR framework kept products and their materials at their highest utility value?

¹⁰²⁸ Kol and others (n 913); Rhein and Sträter (n 913).

¹⁰²⁹ European Commission and others (n 515); Williams (n 530).

Analysis of the EU's EPR regulatory frameworks has found that batteries, vehicles, electrical and electronic equipment, packaging, and their components and materials are not always kept at their highest utility value. However, it is notable that although recycling is encouraged in all four of the Directives and rates have increased, it has merely been incentivised by efficiency targets, which are not complicit in keeping products, components and materials at their highest utility value at all times. This is because such targets do not mandate the recycling of the whole product and, instead, require a targeted percentage, according to weight, to be recycled (or reused and recovered). This is troublesome for the development of a Circular Economy, given that these targets intrinsically accept that resources will be lost, even after the product has been collected. Likewise, the EU's EPR regulatory frameworks use of targets solely related to a product's total weight, as noted above, is concerning as it gives rise to a perverse incentive for merely the most ubiquitous heavy materials to be targeted during the recycling process. This then means that light-weight and potentially environmentally hazardous or resource important materials are discarded. To overcome such issues, the Waste Packaging Directive contains material specific targets. However, as seen with material prohibitions (see Chapter 5, 3.2), it is acknowledged that a transition towards material specific targets may lead to producers searching for alternative materials, thus circumventing the provision and possibly leading to adverse environmental effects.

This thesis has observed that the EU's EPR regulatory frameworks disproportionately focus on the recycling of products rather than other practices that hold higher utility value.¹⁰³⁰

¹⁰³⁰ This is likely because of the age of the Directives, which primarily pre-date the EU's advance to a Circular Economy.

Despite all four of the Directives provisioning recycling mandates, three (the End-of-Life Vehicles, Waste Electrical and Electronic Equipment and Waste Packaging Directives) contain provisions seeking to effectuate product reuse, which is of higher utility value than that of recycling as depicted by the EU's waste hierarchy. Furthermore, just two of these Directives, the End-of-Life Vehicles and Waste Electrical and Electronic Equipment Directives, incentivise reuse with targets. Likewise, where targets incentivise reuse, these are conflated with that of recycling, which wrongly suggests that they are tantamount. This thesis found that none of the analysed Directives sufficiently encourage other higher utility value practices, such as repair or remanufacture, and in the limited cases where such practices are briefly mentioned, accompanying provisions are not specific and measurable. Likewise, just two Directives (the End-of-Life Vehicles and Packaging Directives) explicitly mentioned waste prevention, though these are not sufficiently incentivised in both cases. On account of the above, the EU's EPR regulatory frameworks are not consistent with the Circular Economy goals of preventing waste and keeping products, components and materials at their highest utility value at all times or the waste hierarchy.

Primary Research Question: Do existing EPR regulatory frameworks within the EU support circularity?

This thesis has analysed the EU's EPR regulatory frameworks to ascertain its support for circularity. It has found that the four analysed Directives do not fully incentivise the eco-design of products, be it implicitly or explicitly, and as a result, the Directives do not satisfactorily incentivise products that generate less waste, are easier to manage at their highest utility value at their end-of-life and thus protect the environment. Notably, it was

found that the EU's EPR regulatory frameworks do not sufficiently support the strong association of end-of-life management costs with producers, thus resulting in reduced eco-design. Although the EU's EPR regulatory frameworks have increased the collection of products, they have not effectively stimulated the necessary collection levels to prevent waste and ensure that products and their materials are kept at their highest utility value at all times. This is because the analysed Directives have low collection targets, do not sufficiently embrace novel collection mechanisms or economic incentives and exhibit regulatory failures that undermine their effectiveness. Lastly, this thesis has observed that the EU's EPR regulatory frameworks end-of-life management practices perversely incentivise recycling over other higher utility value practices, such as reuse, contrary to Circular Economy goals. Considering this, the thesis concludes that although the EU's EPR regulatory frameworks have increased the collection and recycling of targeted products, they do not effectively support the advance to a Circular Economy.

List of References

- Abdollahbeigi M, 'An Overview of the Paper Recycling Process in Iran' (2021) 3 Journal of Chemical Reviews 1
- Adams KT and others, 'Circular Economy in Construction: Current Awareness, Challenges and Enablers' (2017) 170 Proceedings of the Institution of Civil Engineers - Waste and Resource Management 15
- Ahuja J, Dawson L and Lee R, 'A Circular Economy for Electric Vehicle Batteries: Driving the Change' (2020) 12 Journal of Property, Planning and Environmental Law 235
- Antonopoulos I, Faraca G and Tonini D, 'Recycling of Post-Consumer Plastic Packaging Waste in the EU: Recovery Rates, Material Flows, and Barriers' (2021) 126 Waste Management 694
- Atasu A and Subramanian R, 'Extended Producer Responsibility for E-Waste: Individual or Collective Producer Responsibility?' (2012) 21 Production and Operations Management 1042
- Atasu A, Van Wassenhove LN and Sarvary M, 'Efficient Take-Back Legislation' (2009) 18 Production and Operations Management 243
- Azzi A and others, 'Packaging Design: General Framework and Research Agenda' (2012) 25 Packaging Technology and Science 435
- Babayigit A, Boyen H-G and Conings B, 'Environment versus Sustainable Energy: The Case of Lead Halide Perovskite-Based Solar Cells' (2018) 5 MRS Energy and Sustainability E1
- Baron, Yifaat and others, 'Study to Support the Impact Assessment for the Review of Directive 2000/53/EC on End-of-Life Vehicles' (European Commission 2023)
- Bassi SA and others, 'Extended Producer Responsibility: How to Unlock the Environmental and Economic Potential of Plastic Packaging Waste?' (2020) 162 Resources, Conservation and Recycling 105030
- Bell S and others, *Environmental Law* (9th edn, Oxford University Press 2017)
- Beverly Thorpe and Alexandra McPherson, 'Extended Producer Responsibility' (Clean Production Action 2004)
<https://www.cleanproduction.org/static/ee_images/uploads/resources/EPRtoolkitColourFinal.pdf> accessed 8 January 2023
- Biffa Waste Services Limited, 'Biffa Collects 400 Tonnes of Household WEEE' (*Biffa*)
<<https://www.biffa.co.uk/media-centre/news/biffa-collects-400-tonnes-of-household-weee>> accessed 9 April 2020

Bigum M and others, 'WEEE and Portable Batteries in Residual Household Waste: Quantification and Characterisation of Misplaced Waste' (2013) 33 Waste Management 2372

Bio Intelligence Service, 'Review of the Scope of the Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE)' (2013) Draft Final Report prepared for European Commission, DG ENV
<https://ec.europa.eu/environment/pdf/waste/weee/approved_%20WEEE%20scope%20review.pdf> accessed 23 November 2021

——, 'Guidance on Extended Producer Responsibility: Case Study on WEEE in the UK' (2014) <<http://epr.eu-smr.eu/>> accessed 6 April 2020

Bobba S, Mathieux F and Blengini GA, 'How Will Second-Use of Batteries Affect Stocks and Flows in the EU? A Model for Traction Li-Ion Batteries' (2019) 145 Resources, Conservation and Recycling 279

Bogaert S and others, 'Study on RoHS and WEEE Directives' (Arcadis Ecolas, RPA 2008) 06/11925/AL <https://ec.europa.eu/environment/pdf/waste/weee/rpa_study.pdf> accessed 9 November 2021

Boulding K, 'The Economics of the Coming Spaceship Earth' in Henry Jarrett (ed), *Environmental Quality in a Growing Economy: Essays from the Sixth RFF Forum* (Resources for the Future 1966)

Brock A and Williams I, 'Life Cycle Assessment and Beverage Packaging' (2020) 13 Detritus 47

Brouillat E and Oltra V, 'Extended Producer Responsibility Instruments and Innovation in Eco-Design: An Exploration through a Simulation Model' (2012) 83 Ecological Economics 236

Brown V, 'The End of Waste under EU Law' (2013) 28 Natural Resources & Environment 41

Bruvoll A, 'Taxing Virgin Materials: An Approach to Waste Problems' (1998) 22 Resources, Conservation and Recycling 15

Cairney P and Kwiatkowski R, 'How to Communicate Effectively with Policymakers: Combine Insights from Psychology and Policy Studies' (2017) 3 Palgrave Communications 37

Calster GV and Reins L, *EU Environmental Law* (Edward Elgar Publishing 2017)
<<https://www.elgaronline.com/view/9781782549178/9781782549178.xml>>

Campbell-Johnston K and others, 'The Circular Economy and Cascading: Towards a Framework' (2020) 7 Resources, Conservation & Recycling: X 100038

——, 'Future Perspectives on the Role of Extended Producer Responsibility within a Circular Economy: A Delphi Study Using the Case of the Netherlands' (2021) 30 *Business Strategy and the Environment* 4054

CarTakeBack.com Limited, 'Scrap Car Recycling' (*CarTakeBack.com*, 2021) <<https://www.cartakeback.com>> accessed 3 September 2021

Cavoski A, 'An Assessment of Compliance Strategies in the Environmental Policy Area' (2016) 41 *European Law Review* 252

Champ J, 'De Minimis Threshold for WEEE Producers – What's Happening?' (*Ecosurety*, 2013) <[news/de-minimis-threshold-for-weee-producers-what-s-happening/](#)> accessed 2 June 2020

Chartered Institute for Waste Management, 'Packaging Waste Recovery: A European Comparison' (2016) <<https://www.ciwm.co.uk/Custom/BSIDocumentSelector/Pages/DocumentViewer.aspx?id=QoR7FzWBtisamYEcWSfL6SxAJRLAPT9vBc%252bTYqJHvnIIMlqCsWkEmaE8Zjg6eL94FxU9JUBUd8Rj%252byAOnDWYXkztrE1PEmyUBCW7arrTnHmOfLZ8G0g%252bbwjKsjLkGTK1ilgTYlZwYcfX%252fLeeXbKFmSYINJ1eC0w32gFIQphsYg%253d>> accessed 30 October 2022

——, 'End of Life Vehicles' (*CIWM*, 2023) <<https://www.ciwm.co.uk/ciwm/knowledge/end-of-life-vehicles.aspx>> accessed 6 July 2020

Circular, 'How the Circular Economy Is Solving the Problem of Spent Batteries' (*Circular Online*, August 2022) <<https://www.circularonline.co.uk/features/how-the-circular-economy-is-solving-the-problem-of-spent-batteries/>> accessed 8 January 2023

Circular Online, 'European Commission Adopts New Circular Economy Action Plan' (*Circular Online*, 12 March 2020) <<https://www.circularonline.co.uk/news/european-commission-adopts-new-circular-economy-action-plan/>> accessed 19 March 2020

Citroën UK Limited, 'ELV Directive' (*Citroen.co.uk*, 2021) <<https://www.citroen.co.uk/maintain/end-of-life-vehicle-regulations-and-battery-waste.html>> accessed 2 September 2021

Coelho PM and others, 'Sustainability of Reusable Packaging—Current Situation and Trends' (2020) 6 *Resources, Conservation & Recycling*: X 100037

Cole C and others, 'An Assessment of Achievements of the WEEE Directive in Promoting Movement up the Waste Hierarchy: Experiences in the UK' (2019) 87 *Waste Management* 417

Cole C, Cooper T and Gnanapragasam A, 'Extending Product Lifetimes through WEEE Reuse and Repair: Opportunities and Challenges in the UK', 2016 *Electronics Goes Green 2016+ (EGG)* (IEEE 2016)

Comptroller and Auditor General, 'The Packaging Recycling Obligations' (National Audit Office 2018) HC 1386 Session 2017-19 <<https://www.nao.org.uk/wp->

content/uploads/2018/07/The-packaging-recycling-obligations.pdf> accessed 7 January 2022

Corvellec H, Stowell AF and Johansson N, 'Critiques of the Circular Economy' (2022) 26 Journal of Industrial Ecology 421

Costa M and Peers S, '15. Harmonisation', *Steiner and Woods EU Law* (Oxford University Press 2023)

<<https://www.oxfordlawtrove.com/view/10.1093/he/9780192884534.001.0001/he-9780192884534-chapter-15>>

Creech L, 'France to Force Online Retailers to Tackle Compliance Free-Riding' (*Resource.co*, 27 January 2019) <<https://resource.co/article/france-force-online-retailers-tackle-compliance-free-riding-13061>> accessed 18 November 2021

Dawson L, "'Our Waste, Our Resources; a Strategy for England" – Switching to a Circular Economy Through the Use of Extended Producer Responsibility' (2019) 21 Environmental Law Review 210

Dawson L, Ahuja J and Lee R, 'Steering Extended Producer Responsibility for Electric Vehicle Batteries' (2021) 23 Environmental Law Review 128

Demirbas A, 'Waste Management, Waste Resource Facilities and Waste Conversion Processes' (2011) 52 Energy Conversion and Management 1280

Department for Business, Innovation and Skills, 'The End of Life Vehicles Regulations 2003, 2005 and 2010: Government Guidance Notes' (HM Government 2010)

<<http://www.bis.gov.uk/assets/biscore/business-sectors/docs/e/10-897-elv-regulations-guidance-june-2010.pdf>> accessed 2 July 2020

Department for Environment, Food & Rural Affairs, 'Consultation on Recovery and Recycling Targets for Packaging Waste for 2013- 2017' (HM Government 2011)

<https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/82440/packaging-consult-doc.pdf> accessed 18 January 2022

——, 'Guidance on the Legal Definition of Waste and Its Application' (HM Government 2012)

<https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69590/pb13813-waste-legal-def-guide.pdf> accessed 3 November 2021

Department for Environment, Food & Rural Affairs and Government Statistical Service, 'UK Statistics on Waste' (HM Government 2021)

<https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1002246/UK_stats_on_waste_statistical_notice_July2021_accessible_FINAL.pdf> accessed 31 January 2022

Department for Levelling Up, Housing & Communities, 'Policy Statement: Scottish Deposit Return Scheme - UK Internal Market Exclusion' (HM Government 2023)

<<https://www.gov.uk/government/publications/scottish-deposit-return-scheme-uk-internal->

market-exclusion/policy-statement-scottish-deposit-return-scheme-uk-internal-market-exclusion> accessed 6 June 2023

Dimitrakakis E and others, 'Small WEEE: Determining Recyclables and Hazardous Substances in Plastics' (2009) 161 *Journal of Hazardous Materials* 913

Doherty J, 'Nationwide TV Campaign Launches to Tackle WEEE' (*letsrecycle.com*, March 2923) <<https://www.letsrecycle.com/news/nationwide-tv-campaign-launches-to-tackle-weee/>> accessed 20 July 2023

Domroes M, 'The Tropical Forest Ecosystem: Reviewing the Effects of Deforestation on Climate and Environment', *The Global Environment* (Springer 1991) <https://link.springer.com/chapter/10.1007/978-3-662-01085-3_5> accessed 7 December 2021

Eberle EJ, 'The Method and Role of Comparative Law' (2009) 8 *Washington University global studies law review* 451

Ecosurety, 'Batteries - Collections' (*Ecosurety*, 2020) <www.ecosurety.com/collections/batteries/> accessed 6 November 2020

Ellen MacArthur Foundation, 'Towards a Circular Economy: Business Rationale for an Accelerated Transition' (Ellen MacArthur Foundation 2015) <https://www.ellenmacarthurfoundation.org/assets/downloads/publications/TCE_Ellen-MacArthur-Foundation_26-Nov-2015.pdf> accessed 22 April 2021

—, 'Schools of Thought' (*Ellen MacArthur Foundation*, 2017) <<https://www.ellenmacarthurfoundation.org/circular-economy/concept/schools-of-thought>> accessed 9 July 2021

—, 'The EU's Circular Economy Action Plan' (*Ellen Macarthur Foundation*, 2020) <<https://www.ellenmacarthurfoundation.org/assets/downloads/EU-Case-Study-june2020-EN.pdf>> accessed 26 April 2021

—, 'Extended Producer Responsibility: A Necessary Part of the Solution to Packaging Waste and Pollution' (*Ellen MacArthur Foundation*, 2021) <<https://plastics.ellenmacarthurfoundation.org/epr>> accessed 3 February 2022

—, 'What Is a Circular Economy?' (*Ellen MacArthur Foundation*, 2021) <<https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview>> accessed 18 February 2022

'End of Life Vehicles (ELVs): Guidance for Waste Sites' (*GOV.UK*) <<https://www.gov.uk/guidance/end-of-life-vehicles-elvs-guidance-for-waste-sites>> accessed 30 July 2020

Environment Agency, 'National Packaging Waste Database' (*Environment Agency*, February 2020) <<http://npwd.environment-agency.gov.uk/PublicRegisterBatteriesSchemes.aspx?ReturnUrl=%2fBatteriesPublicRegis>>

terLinks.aspx%3fReturnUrl%3d%252fPublic%252fBatteriesHome.aspx> accessed 6 November 2020

——, 'Packaging Waste: Producer Responsibilities' (*GOV.UK*, 15 December 2020) <<https://www.gov.uk/guidance/packaging-producer-responsibilities>> accessed 18 January 2022

——, 'Packaging Recycling Targets 2021 & 2022 Confirmed' (*Environment Agency*, 18 January 2022) <<http://npwd.environment-agency.gov.uk>> accessed 18 January 2022

Eunomia Research & Consulting Ltd, 'Final Implementation Report for Directives 2002/96/EC and 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE): 2013 – 2015' (European Commission 2018) <https://ec.europa.eu/environment/archives/waste/reporting/pdf/Final_Implementation_Report_2013_2015_WEEE.pdf> accessed 27 May 2020

——, 'Effectiveness of the Essential Requirements for Packaging and Packaging Waste and Proposals for Reinforcement.' (European Commission 2020) Final

European Commission, 'Frequently Asked Questions on Directive 2006/66/EU on Batteries and Accumulators and Waste Batteries and Accumulators' (European Commission 2014) <<https://ec.europa.eu/environment/waste/batteries/pdf/faq.pdf>> accessed 4 November 2020

——, 'Closing the Loop: Commission Adopts Ambitious New Circular Economy Package to Boost Competitiveness, Create Jobs and Generate Sustainable Growth' (2015) <https://ec.europa.eu/commission/presscorner/detail/en/IP_15_6203> accessed 13 December 2023

——, 'A European Strategy For Plastics in a Circular Economy' (European Commission 2018) <<https://www.europarc.org/wp-content/uploads/2018/01/Eu-plastics-strategy-brochure.pdf>> accessed 13 December 2021

——, 'Making the Most of Waste Electrical and Electronic Equipment' (2019) Document 32012L0019 <<https://eur-lex.europa.eu/legal-content/EN/LSU/?uri=celex:32012L0019>> accessed 10 November 2021

——, 'Batteries & Accumulators' (*European Commission*, 2020) <<https://ec.europa.eu/environment/waste/batteries/index.htm>> accessed 26 October 2020

——, 'Circular Economy Action Plan' (European Commission 2020) <https://ec.europa.eu/environment/pdf/circular-economy/new_circular_economy_action_plan.pdf> accessed 31 August 2021

——, 'Waste Electronic Equipment' (*European Commission*, 2020) <https://ec.europa.eu/environment/waste/weee/index_en.htm> accessed 26 February 2020

- , ‘Inception Impact Assessment’ (European Commission 2020)
<https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12263-Reducing-packaging-waste-review-of-rules_en> accessed 16 December 2021
- , ‘June Infringements Package: Key Decisions’ (*European Commission*, 2021)
<https://ec.europa.eu/commission/presscorner/detail/en/inf_21_2743> accessed 5 March 2023
- , ‘Packaging Waste’ (*European Commission*, 2021)
<https://ec.europa.eu/environment/topics/waste-and-recycling/package-waste_en> accessed 7 December 2021
- , ‘Waste Prevention and Management’ (*European Commission*, 2021)
<https://ec.europa.eu/environment/green-growth/waste-prevention-and-management/index_en.htm>
- , ‘Infringement Procedure’ (15 July 2022)
<https://commission.europa.eu/law/application-eu-law/implementing-eu-law/infringement-procedure_en> accessed 12 February 2024
- , ‘End-of-Life Vehicles Regulations’ (*European Commission: Energy, Climate change, Environment*, 2023) <https://environment.ec.europa.eu/topics/waste-and-recycling/end-life-vehicles/end-life-vehicles-regulation_en> accessed 13 August 2023
- , ‘Implementing EU Law’ (14 July 2023)
<https://commission.europa.eu/law/application-eu-law/implementing-eu-law_en> accessed 12 February 2024
- , ‘Legal Enforcement’ (8 February 2024) <https://environment.ec.europa.eu/law-and-governance/legal-enforcement_en> accessed 12 February 2024
- , ‘A New Circular Economy Action Plan’ COM (2020) 98 final
- , ‘Closing the Loop - An EU Action Plan for the Circular Economy’ COM (2015) 614 final
- , ‘Commission Consults Citizens and Stakeholders on the Directive on Waste from Electrical and Electronic Equipment (WEEE)’ (*European Commission: Energy, Climate change, Environment*) <https://environment.ec.europa.eu/news/commission-consults-citizens-and-stakeholders-directive-waste-electrical-and-electronic-equipment-2023-06-16_en> accessed 13 August 2023
- , ‘Europe 2020 - a Strategy for Smart, Sustainable and Inclusive Growth’ COM (2010) 2020
- , ‘Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles’ SWD (2021) 60 Final
- , ‘Evaluation of the Directive 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators and Repealing Directive 91/157/EEC’ SWD (2019) 1300 final

——, ‘Executive Summary of the Evaluation of Directive (EC) 2000/53 of 18 September 2000 on End-of-Life Vehicles’ SWD P (2021) 60 final

——, ‘Ex-Post Evaluation of Five Waste Stream Directives’ COM (2014) 397 final

——, ‘On the Implementation and the Impact on the Environment and the Functioning of the Internal Market of Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on Batteries and Accumulators and Waste Batteries and Accumulators and Repealing Directive 91/157/EEC’ COM (2019) 166 final

——, ‘Proposal for a Directive of the European Parliament and of the Council Amending Directive 94/62/EC on Packaging and Packaging Waste’ COM (2015) 596 final

——, ‘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

——, ‘Proposal for a Directive of the European Parliament and of the Council Amending Directive 2008/98/EC on Waste’ COM (2015) 595 final

——, ‘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’ COM (2014) 397 final

——, ‘Proposal for a Directive of the European Parliament and of the Council Reviewing the Targets in Directives 2008/98/EC on Waste, 94/62/EC on Packaging and Packaging Waste, and 1999/31/EC on the Landfill of Waste, Amending Directives 2000/53/EC on End-of-Life Vehicles, 2006/66/EC on Batteries and Accumulators and Waste Batteries and Accumulators, and 2012/19/EC on Waste Electrical and Electronic Equipment’ COM (2014) 397 final

——, ‘Proposal for a Directive of the European Parliament and the Council Amending Directives 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’ COM (2015) 593 final

——, ‘Proposal for a Regulation of the European Parliament and of the Council Concerning Batteries and Waste Batteries, Repealing Directive 2006/66/EC and Amending Regulation (EU) No 2019/1020 5469/23’ COM (2020) 798 final

——, ‘Proposal for a Regulation of the European Parliament and of the Council on Circularity Requirements for Vehicle Design and on Management of End-of-Life Vehicles, Amending Regulations (EU) 2018/858 and 2019/1020 and Repealing Directives 2000/53/EE and 2005/64/EE’ COM (2023) 451 final

——, ‘Proposal for a Regulation of the European Parliament and of the Council on Packaging and Packaging Waste, Amending Regulation (EU) 2019/1020 and Directive (EU) 2019/904, and Repealing Directive 94/62/EC’ COM (2022) 677 final

——, ‘Report from the Commission to the European Parliament, the Council, European Economic and Social Committee and the Committee of the Regions on the Implementation of EU Waste Legislation, Including the Early Warning Report for Member States at Risk of Missing the 2020 Preparation for Re-Use/Recycling Target on Municipal Waste’ COM (2018) 656 final

——, ‘Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Identifying Member States at Risk of Not Meeting the 2025 Preparing for Re-Use and Recycling Target for Municipal Waste, the 2025 Recycling Target for Packaging Waste and the 2035 Municipal Waste Landfilling Reduction Target’ COM (2023) 304 final

——, ‘Roadmap to a Resource Efficient Europe’ COM (2011) 571 final

——, ‘Summary of Directive 94/62/EC on Packaging and Packaging Waste’ (*European Commission*) <<https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1595838206165&uri=LEGISSUM:l21207>> accessed 1 October 2020

——, ‘The European Green Deal’ COM (2019) 640 final

——, ‘Towards a Circular Economy: A Zero Waste Programme for Europe’ COM (2014) 398 final

——, ‘Assessment of the Implementation of Directive 2000/53/EU on End-of-Life Vehicles (the ELV Directive) with Emphasis on the End of Life Vehicles of Unknown Whereabouts’ (Publications Office of the European Union 2018) <<https://op.europa.eu/en/publication-detail/-/publication/1ca32beb-316a-11e8-b5fe-01aa75ed71a1>> accessed 7 September 2021

——, ‘Study to Support Preparation of the Commission’s Guidance for Extended Producer Responsibility Scheme : Recommendations for Guidance’ (Publications Office of the European Union 2020) <<https://op.europa.eu/en/publication-detail/-/publication/ecb86ea2-932e-11ea-aac4-01aa75ed71a1/language-en>> accessed 28 July 2022

European Commission – Directorate-General for Environment, ‘Guidance on the Interpretation of Key Provisions of Directive 2008/98/EC on Waste’ (2012) <<https://ec.europa.eu/eurostat/documents/342366/351811/WEEE-2+Guidance+of+interpretation+Directive+2008-09-EC+on+waste.pdf/cb1c4f5e-d534-470a-cd71-3dc8b7d53bf7?t=1621959857496>> accessed 10 January 2024

——, ‘Waste from Electrical and Electronic Equipment (WEEE)’ (*European Commission*, 2021) <https://ec.europa.eu/environment/topics/waste-and-recycling/waste-electrical-and-electronic-equipment-weee_en> accessed 14 October 2021

European Council of the European Union, ‘Council and Parliament Strike Provisional Deal to Create a Sustainable Life Cycle for Batteries’ (*European Council of the European Union*, 9 December 2022) <<https://www.consilium.europa.eu/en/press/press-releases/2022/12/09/council-and-parliament-strike-provisional-deal-to-create-a->

sustainable-life-cycle-for-batteries/#:~:text=19%3A00-
,Council%20and%20Parliament%20strike%20provisional%20deal%20to%20create%20a
%20sustainable,for%20batteries%20and%20waste%20batteries.> accessed 21 February
2023

European Court of Auditors, 'EU Actions and Existing Challenges on Electronic Waste'
(2021) Review 04
<[https://www.eca.europa.eu/Lists/ECADocuments/RW21_04/RW_Electronic_Waste_EN.p
df](https://www.eca.europa.eu/Lists/ECADocuments/RW21_04/RW_Electronic_Waste_EN.pdf)> accessed 28 October 2021

European Environment Agency, 'The Plastic Waste Trade in the Circular Economy' (2019)
<<https://www.eea.europa.eu/publications/the-plastic-waste-trade-in>> accessed 1 August
2023

——, 'The Case for Increasing Recycling: Estimating the Potential for Recycling in Europe'
<<https://www.eea.europa.eu/publications/the-case-for-increasing-recycling>> accessed 31
July 2023

European Environmental Bureau and Zero Waste Europe, 'Harmonisation of Waste
Separate Collection across Europe' (2020) <[https://zerowasteeurope.eu/wp-
content/uploads/2020/07/2020_07_14_zwe_eeb_position-paper_harmonisation-of-waste-
separate-collection_en.pdf](https://zerowasteeurope.eu/wp-content/uploads/2020/07/2020_07_14_zwe_eeb_position-paper_harmonisation-of-waste-separate-collection_en.pdf)> accessed 12 January 2022

European Parliament, 'Revision of the Packaging and Packaging Waste Directive' (2023)
Briefing Paper
<[https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/745707/EPRS_BRI\(2023\)74
5707_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/745707/EPRS_BRI(2023)745707_EN.pdf)> accessed 6 July 2023

Eurostat, 'Waste Statistics: Electrical and Electronic Equipment - Statistics Explained'
(*Eurostat*, May 2019) <[https://ec.europa.eu/eurostat/statistics-
explained/index.php?title=Waste_statistics_-
_electrical_and_electronic_equipment&oldid=470242#Collection_of_WEEE_by_country](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics_-_electrical_and_electronic_equipment&oldid=470242#Collection_of_WEEE_by_country)>
accessed 1 April 2020

——, 'End-of-Life Vehicle Statistics: Statistics Explained' (*Eurostat*, 2020)
<[https://ec.europa.eu/eurostat/statistics-explained/index.php/End-of-
life_vehicle_statistics#Number_of_end-of-life_vehicles](https://ec.europa.eu/eurostat/statistics-explained/index.php/End-of-life_vehicle_statistics#Number_of_end-of-life_vehicles)> accessed 4 August 2020

——, 'Waste Statistics: Recycling of Batteries and Accumulators' (*Eurostat*, 2020)
<[https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics_-
_recycling_of_batteries_and_accumulators&stable=0#Sales_and_collection_of_portable_
batteries_and_accumulators](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics_-_recycling_of_batteries_and_accumulators&stable=0#Sales_and_collection_of_portable_batteries_and_accumulators)> accessed 9 November 2020

——, 'Waste Statistics' (*Eurostat*, April 2021) <[https://ec.europa.eu/eurostat/statistics-
explained/index.php?title=Waste_statistics](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics)> accessed 15 February 2022

——, 'Ensure Sustainable Consumption and Production Patterns' (*Eurostat*, May 2021)
<https://ec.europa.eu/eurostat/statistics-explained/index.php?title=SDG_12_-

_Responsible_consumption_and_production#Responsible_consumption_and_production_in_the_EU:_overview_and_key_trends> accessed 14 February 2022

—, ‘Packaging Waste Statistics’ (*Eurostat*, 18 October 2021)

<[https://ec.europa.eu/eurostat/statistics-](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Packaging_waste_statistics#Recycling_and_recovery_targets_and_rates)

[explained/index.php?title=Packaging_waste_statistics#Recycling_and_recovery_targets_and_rates](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Packaging_waste_statistics#Recycling_and_recovery_targets_and_rates)> accessed 18 January 2022

Faulkner DW, ‘How Well Are We Handling Electronic-Waste?’, *2012 17th European Conference on Networks and Optical Communications* (2012)

Ferrão P, Nazareth P and Amaral J, ‘Strategies for Meeting EU End-of-Life Vehicle Reuse/Recovery Targets’ (2006) 10 *Journal of Industrial Ecology* 77

Forrest A and Hilton M, ‘Assessment of WEEE Collection Systems and Their Effectiveness in Other European Countries’ (2019)

<<https://dts.valpak.co.uk/Content/Documents/Eunomia%20Valpak%20DTS%20Report%202019.pdf>> accessed 8 April 2020

Forslind H, ‘Implementing Extended Producer Responsibility: The Case of Sweden’s Car Scrapping Scheme’ (2005) 13 *Journal of Cleaner Production* 619

Foschi E and Bonoli A, ‘The Commitment of Packaging Industry in the Framework of the European Strategy for Plastics in a Circular Economy’ (2019) 9 *Administrative Sciences* 18

Foster N, *Foster on EU Law* (8th edn, Oxford University Press 2021)

<<https://www.oxfordlawtrove.com/10.1093/he/9780192897961.001.0001/he-9780192897961>>

Gaines L, ‘The Future of Automotive Lithium-Ion Battery Recycling: Charting a Sustainable Course’ (2014) 1–2 *Sustainable Materials and Technologies* 2

Gardiner R and Hajek P, ‘Municipal Waste Generation, R&D Intensity, and Economic Growth Nexus – A Case of EU Regions’ (2020) 114 *Waste Management* 124

Geissdoerfer M and others, ‘The Circular Economy – A New Sustainability Paradigm?’ (2017) 143 *Journal of Cleaner Production* 757

Gerrard J and Kandlikar M, ‘Is European End-of-Life Vehicle Legislation Living up to Expectations? Assessing the Impact of the ELV Directive on “Green” Innovation and Vehicle Recovery’ (2007) 15 *Journal of Cleaner Production* 17

Ghisellini P, Cialani C and Ulgiati S, ‘A Review on Circular Economy: The Expected Transition to a Balanced Interplay of Environmental and Economic Systems’ (2016) 114 *Journal of Cleaner production* 11

GiffGaff Limited, ‘An Urgent Call’ (*giffgaff*, 2023) <<https://www.giffgaff.com/hub/an-urgent-call/>> accessed 4 May 2023

- Global Forum on Environment: Promoting Sustainable Materials Management through Extended Producer Responsibility (EPR), 'The State of Play on Extended Producer Responsibility (EPR): Opportunities and Challenges' (Organisation for Economic Co-Operation and Development 2014) <<https://www.oecd.org/environment/waste/Global%20Forum%20Tokyo%20Issues%20Paper%2030-5-2014.pdf>> accessed 19 April 2021
- Government Office for Science, 'Foresight Future of the Sea: A Report from the Government Chief Scientific Adviser' (HM Government 2018) <<https://www.gov.uk/government/publications/future-of-the-sea--2>> accessed 6 December 2021
- Gregson N and others, 'Interrogating the Circular Economy: The Moral Economy of Resource Recovery in the EU' (2015) 44 *Economy and society* 218
- Grilli F, 'To Be or Not To Be Recyclable? An Examination of the Proposal for an EC Directive on Packaging and Packaging Waste' (1993) 95 *British Food Journal* 25
- Groh K and others, 'Overview of Known Plastic Packaging-Associated Chemicals and Their Hazards' (2019) 651 *Science of The Total Environment* 3253
- Gui L and others, 'Design Incentives under Collective Extended Producer Responsibility: A Network Perspective' (2018) 64 *Management Science* 4967
- Gupt Y and Sahay S, 'Review of Extended Producer Responsibility: A Case Study Approach' (2015) 33 *Waste Management & Research* 595
- Haddaway NR and others, 'Evidence of the Impacts of Metal Mining and the Effectiveness of Mining Mitigation Measures on Social–Ecological Systems in Arctic and Boreal Regions: A Systematic Map Protocol' (2019) 8 *Environmental Evidence* 9
- Haenn N, Harnish A and Wilk R (eds), *The Environment in Anthropology (Second Edition): A Reader in Ecology, Culture, and Sustainable Living* (NYU Press 2016)
- Halleux V and European Parliament, 'A European Green Deal: Revision of Directive 94/62/EC on Packaging and Waste Packaging' (*Legislative Train Schedule: European Parliament*, 17 December 2021) <[https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-revision-of-packaging-and-packaging-waste-directive-\(refit\)](https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-revision-of-packaging-and-packaging-waste-directive-(refit))> accessed 5 January 2022
- Harper G and others, 'Recycling Lithium-Ion Batteries from Electric Vehicles' (2019) 575 *Nature* 75
- He W and others, 'WEEE Recovery Strategies and the WEEE Treatment Status in China' (2006) 136 *Journal of Hazardous Materials* 502
- Hennlock M and others, 'Economic Policy Instruments for Plastic Waste – A Review with Nordic Perspectives' (Nordic Council of Ministers 2014) <<https://norden.diva-portal.org/smash/get/diva2:791794/FULLTEXT02.pdf>> accessed 20 January 2022

Hildebrandt T and others, '19 - Standards and Tests for Lead–Acid Batteries in Automotive Applications' in Jürgen Garche and others (eds), *Lead-Acid Batteries for Future Automobiles* (Elsevier 2017)

<<https://www.sciencedirect.com/science/article/pii/B9780444637000000192>> accessed 20 November 2022

Hilton M and others, 'Extended Producer Responsibility (EPR) and the Impact of Online Sales' (Organisation for Economic Co-Operation and Development 2019)

<<https://www.oecd-ilibrary.org/content/paper/cde28569-en>> accessed 18 November 2021

HM Government, 'Our Waste, Our Resources: A Strategy for England' (HM Government 2018)

——, 'Battery Waste: Retailer and Distributor Responsibilities' (GOV.UK, 2020)

<<https://www.gov.uk/battery-waste-supplier-reponsibilities>> accessed 5 November 2020

——, 'Electrical Waste: Retailer and Distributor Responsibilities' (GOV.UK, 2020)

<<https://www.gov.uk/electricalwaste-producer-supplier-responsibilities/take-back-waste-in-store>> accessed 8 April 2020

——, 'Net Zero Strategy: Build Back Greener' (2021)

<<https://assets.publishing.service.gov.uk/media/6194dfa4d3bf7f0555071b1b/net-zero-strategy-beis.pdf>> accessed 5 January 2024

HM Revenue & Customs, 'Introduction of Plastic Packaging Tax from April 2022' (GOV.UK, 20 July 2021) <<https://www.gov.uk/government/publications/introduction-of-plastic-packaging-tax-from-april-2022/introduction-of-plastic-packaging-tax-2021>> accessed 2 August 2023

——, 'Plastic Packaging Tax: Steps to Take' (GOV.UK, 2022)

<<https://www.gov.uk/guidance/check-if-you-need-to-register-for-plastic-packaging-tax>> accessed 19 January 2022

Hou M, Li L and Wang L, 'Research on Correspondence between ELV Exemption and Auto Parts Products' (2020) 555 IOP Conference Series: Earth and Environmental Science 012044

House of Commons, Environmental Audit Committee, 'Electronic Waste and the Circular Economy' First Report of Session 2019-21, HC 220

House of Commons Library, 'Scrap Metal Dealers Bill (Bill 9 of 2012-13)' (2012) Research Paper <<https://researchbriefings.files.parliament.uk/documents/RP12-39/RP12-39.pdf>> accessed 2 September 2021

Hutchinson T and Duncan N, 'Defining and Describing What We Do: Doctrinal Legal Research' (2012) 17 Deakin L. Rev. 83

Individual Producer Responsibility Working Group, 'Waste Electrical and Electronic Equipment (WEEE) Regulations: Individual Producer Responsibility (IPR) in a UK Context.' (HM Government 2012)

<https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/34569/12-1007-waste-electrical-and-electronic-wEEE-regulations-individual-producer-ipr-responsibility.pdf> accessed 21 March 2021

Jack B, 'Enforcing Member State Compliance with EU Environmental Law: A Critical Evaluation of the Use of Financial Penalties' (2011) 23 *Journal of environmental law* 73

Jaeger B and Upadhyay A, 'Understanding Barriers to Circular Economy: Cases from the Manufacturing Industry' (2020) 33 *Journal of Enterprise Information Management* 729

Jesus A de and Mendonça S, 'Lost in Transition? Drivers and Barriers in the Eco-Innovation Road to the Circular Economy' (2018) 145 *Ecological Economics* 75

Jørgensen S and Pedersen LJT, 'The Circular Rather than the Linear Economy', *RESTART sustainable business model innovation* (Springer 2018)

Kaffine DT, O'Reilly P and Börkey P, 'What Have We Learned About Extended Producer Responsibility in the Past Decade? A Survey of the Recent Epr Economic Literature' (Organisation for Economic Co-Operation and Development 2015) ENV/EPOC/WPRPW(2013)7/FINAL

Kale SK and others, 'Microbial Degradation of Plastic: A Review' (2015) 6 *Journal of Biochemical Technology* 952

Kanari N, Pineau J-L and Shallari S, 'End-of-Life Vehicle Recycling in the European Union' (2003) 55 *JOM* 15

Karagoz S, Aydin N and Simic V, 'End-of-Life Vehicle Management: A Comprehensive Review' (2020) 22 *Journal of Material Cycles and Waste Management* 416

Karnchanawong S and Limpiteeprakan P, 'Evaluation of Heavy Metal Leaching from Spent Household Batteries Disposed in Municipal Solid Waste' (2009) 29 *Waste Management* 550

Kasassi A and others, 'Soil Contamination by Heavy Metals: Measurements from a Closed Unlined Landfill' (2008) 99 *Bioresource Technology* 8578

Kautto P, 'New Instruments – Old Practices? The Implications of Environmental Management Systems and Extended Producer Responsibility for Design for the Environment' (2006) 15 *Business Strategy and the Environment* 377

Khetriwal DS and others, 'One WEEE, Many Species: Lessons from the European Experience' (2011) 29 *Waste Management & Research* 954

Khetriwal DS, Kraeuchi P and Widmer R, 'Producer Responsibility for E-Waste Management: Key Issues for Consideration – Learning from the Swiss Experience' (2009) 90 *Journal of Environmental Management* 153

Kierkegaard S, 'Charging up the Batteries: Squeezing More Capacity and Power into the New EU Battery Directive' (2007) 23 *Computer Law & Security Review* 357

Kingston S, Heyvaert V and Čavoški A, *European Environmental Law* (Cambridge University Press 2017)
<<https://www.cambridge.org/core/product/6835791734BD396F2B7CD5B98259CC6B>>

Kirchherr J and others, 'Barriers to the Circular Economy: Evidence From the European Union (EU)' (2018) 150 *Ecological Economics* 264

Kitazume C, Kohlmeyer R and Oehme I, 'Effectively Tackling the Issue of Millions of Vehicles with Unknown Whereabouts' (Umwelt Bundesamt 2020)
<https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/sciopap_uba_elv_measures_to_combat_illegal_dismantling_2020_06_29.pdf> accessed 3 September 2021

Kol R and others, 'Recent Advances in Pre-Treatment of Plastic Packaging Waste', *Current topics in recycling* (IntechOpen 2021)

Kosacka-Olejniak M, 'How Manage Waste from End-of-Life Vehicles? - Method Proposal' (2019) 52 *IFAC-PapersOnLine* 1733

Krämer L, 'The Future Role of the ECJ in the Development of European Environmental Law', *The European Convention and the future of European Environmental Law. Europa Law Publishing, Groningen* (2003)

Kramer L, 'EU Enforcement of Environmental Laws: From Great Principles to Daily Practice - Improving Citizen Involvement Public Participation' (2014) 44 *Environmental Policy and Law* 247

Krueger MC, Harms H and Schlosser D, 'Prospects for Microbiological Solutions to Environmental Pollution with Plastics' (2015) 99 *Applied Microbiology and Biotechnology* 8857

Kumar JR and others, 'Brief Study on Restriction of Hazardous Substances Directive (RoHS)' (2008) 17 *Journal of the Korean Institute of Resources Recycling* 3

Laubinger F and others, 'Modulated Fees for Extended Producer Responsibility Schemes (EPR)' (Organisation for Economic Co-Operation and Development 2021)
<[https://one.oecd.org/document/ENV/WKP\(2021\)16/En/pdf](https://one.oecd.org/document/ENV/WKP(2021)16/En/pdf)> accessed 8 January 2023

Lazarevic D and Valve H, 'Narrating Expectations for the Circular Economy: Towards a Common and Contested European Transition' (2017) 31 *Energy Research & Social Science* 60

Lee M, 'Accountability for Environmental Standards after Brexit' (2017) 19 *Environmental Law Review* 89

——, 'Environmental Pasts and Futures: The European Union and the "British Way"' (2019) 31 *Journal of Environmental Law* 559

Lee R, 'Marketing Products under the Extended Producer Responsibility Framework: A Battery of Issues' (2008) 17 Review of European Community & international environmental law 298

Legrand P, 'Comparative Legal Studies and Commitment to Theory' (1995) 58 The Modern Law Review 262

Licence T, 'Normalising Bottle Return and Reuse: Lessons from the Victorians on the Limits of Voluntary Schemes' (*History & Policy*, 30 January 2020) <<https://www.historyandpolicy.org/policy-papers/papers/normalising-bottle-return-and-reuse-lessons-from-the-victorians-on-the-limits-of-voluntary-schemes>> accessed 19 January 2022

Lindhqvist T, 'Extended Producer Responsibility in Cleaner Production: Policy Principle to Promote Environmental Improvements of Product Systems' (Lund University 2000)

——, 'Policies for Waste Batteries' (2010) 14 Journal of Industrial Ecology 537

Lindhqvist T and Lidgren K, 'Towards an Extended Producer Responsibility-Analysis of Experiences and Proposals' [1992] Ministry of the Environment and Natural Resources, Stockholm

Macrory R, 'European Moves on Environmental Enforcement (2014) European Moves on Environmental Enforcement', *European Moves on Environmental Enforcement (2014) European Moves on Environmental Enforcement* (Second Edition, Hart Publishing 1999) <<http://dx.doi.org/10.5040/9781474202138.ch-029>>

——, 'Subsidiarity and European Community Environmental Law (1999)', *Regulation, Enforcement and Governance in Environmental Law* (Second Edition, Hart Publishing 1999) <<http://dx.doi.org/10.5040/9781474202138.ch-026>>

——, 'The Enforcement of EU Environmental Law – Some Proposals for Reform (2005)', *Regulation, Enforcement and Governance in Environmental Law* (Second Edition, Hart Publishing 1999) <<http://dx.doi.org/10.5040/9781474202138.ch-027>>

Macrory R and Newbigin J, 'Emerging Issues with Enforcement Mechanisms' (Centre for International Governance Innovation 2017) <<http://www.jstor.org/stable/resrep15501.10>> accessed 12 February 2024

Magrini C, D'Addato F and Bonoli A, 'Municipal Solid Waste Prevention: A Review of Market-Based Instruments in Six European Union Countries' (2020) 38 Waste Management & Research 3

——, 'Municipal Solid Waste Prevention: A Review of Market-Based Instruments in Six European Union Countries' (2020) 38 Waste Management & Research 3

Maisel F and others, 'Preparing WEEE Plastics for Recycling – How Optimal Particle Sizes in Pre-Processing Can Improve the Separation Efficiency of High Quality Plastics' (2020) 154 Resources, Conservation and Recycling 104619

Maitre-Ekern E, 'Re-Thinking Producer Responsibility for a Sustainable Circular Economy from Extended Producer Responsibility to Pre-Market Producer Responsibility' (2021) 286 *Journal of Cleaner Production* 125454

Manomaivibool P, 'Network Management and Environmental Effectiveness: The Management of End-of-Life Vehicles in the United Kingdom and in Sweden' (2008) 16 *Journal of Cleaner Production* 2006

——, 'Extended Producer Responsibility in a Non-OECD Context: The Management of Waste Electrical and Electronic Equipment in India' (2009) 53 *Resources, Conservation and Recycling* 136

Massarutto A, 'The Long and Winding Road to Resource Efficiency – An Interdisciplinary Perspective on Extended Producer Responsibility' (2014) 85 *Resources, Conservation and Recycling* 11

Mayers K, 'Strategic, Financial, and Design Implications of Extended Producer Responsibility in Europe: A Producer Case Study' (2007) 11 *Journal of Industrial Ecology* 113

——, 'Implementing Individual Producer Responsibility for Waste Electrical and Electronic Equipment through Improved Financing' (2013) 17 *Journal of Industrial Ecology* 186

Mazzanti M and Zoboli R, 'Economic Instruments and Induced Innovation: The European Policies on End-of-Life Vehicles' (2006) 58 *Ecological Economics* 318

McConville M and Chui WH (Eric), *Research Methods for Law* (2nd edn, Edinburgh University Press 2017)

<<http://ebookcentral.proquest.com/lib/bham/detail.action?docID=5013854>> accessed 4 March 2022

'Memorandum to The Waste Electrical and Electronic Equipment Regulations 2013, SI 2013/3113'

Moore D, 'Simply Changing the Colour of Bins Can Increase Recycling' (*Circular Online*, 2019) <<https://www.circularonline.co.uk/news/simply-changing-the-colour-of-bins-can-increase-recycling/>>

——, 'EA to Packaging Firms: Comply with Recovery and Recycling Directives, or Face "Enforcement Action"' (*Circular Online*, 2020) <<https://www.circularonline.co.uk/news/ea-to-packaging-firms-comply-with-recovery-and-recycling-directives-or-face-enforcement-action/>>

——, 'MPs Relaunch E-Waste and Circular Economy Inquiry' (*Circular Online*, 13 March 2020) <<https://www.circularonline.co.uk/news/mps-relaunch-e-waste-and-circular-economy-inquiry/>>

——, 'Research by Giffgaff Suggest 72% of UK Adults Have "No Idea" What e-Waste Is' (*Circular Online*, 20 October 2021) <<https://www.circularonline.co.uk/news/research-by-giffgaff-suggest-72-of-uk-adults-have-no-idea-what-e-waste-is/>>

giffgaff-suggest-72-of-uk-adults-have-no-idea-what-e-waste-is/> accessed 22 October 2021

Mudgal S and others, 'Equivalent Conditions for Waste Electrical and Electronic Equipment (WEEE) Recycling Operations Taking Place Outside the European Union' (European Commission 2013)

Napier F, D'Arcy B and Jefferies C, 'A Review of Vehicle Related Metals and Polycyclic Aromatic Hydrocarbons in the UK Environment' (2008) 226 *Desalination* 143

Nkwachukwu OI and others, 'Focus on Potential Environmental Issues on Plastic World towards a Sustainable Plastic Recycling in Developing Countries' (2013) 4 *International Journal of Industrial Chemistry* 34

Nowakowski P, 'Investigating the Reasons for Storage of WEEE by Residents – A Potential for Removal from Households' (2019) 87 *Waste Management* 192

Oguchi M, Sakanakura H and Terazono A, 'Toxic Metals in WEEE: Characterization and Substance Flow Analysis in Waste Treatment Processes' (2013) 463–464 *Science of The Total Environment* 1124

Onyanta A, 'Cities, Municipal Solid Waste Management, and Climate Change: Perspectives from the South' (2016) 10 *Geography Compass* 499

Organisation for Economic Co-Operation and Development, *Extended Producer Responsibility: A Guidance Manual for Governments* (OECD Publishing 2001) <https://www.oecd-ilibrary.org/environment/extended-producer-responsibility_9789264189867-en> accessed 3 September 2020

——, *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management* (OECD Publishing 2016) <<https://www.oecd.org/env/extended-producer-responsibility-9789264256385-en.htm>> accessed 7 June 2023

Paul Ekins and others, 'The Circular Economy: What, Why, How and Where' (UCL Institute for Sustainable Resources, University College London 2019) <<https://www.oecd.org/cfe/regionaldevelopment/Ekins-2019-Circular-Economy-What-Why-How-Where.pdf>> accessed 6 February 2024

Pearce D and Turner K, 'Economics of Natural Resources and the Environment' (1991) 73 *American Journal of Agricultural Economics* 378

Phelan A (Anyia) and others, 'Plastic Pollution and Packaging: Corporate Commitments and Actions from the Food and Beverage Sector' (2022) 331 *Journal of Cleaner Production* 129827

Pinto VN, 'E-Waste Hazard: The Impending Challenge' (2008) 12 *Indian journal of occupational and environmental medicine* 65

Pouikli K, 'Concretising the Role of Extended Producer Responsibility in European Union Waste Law and Policy through the Lens of the Circular Economy' (2020) 20 ERA Forum 491

Prime Minister's Office, 'Press Release on Green Industrial Revolution' (GOV.UK, 18 November 2020) <<https://www.gov.uk/government/news/pm-outlines-his-ten-point-plan-for-a-green-industrial-revolution-for-250000-jobs>> accessed 9 August 2021

Puckett J, Brandt C and Palmer H, 'Holes in the Circular Economy: WEEE Leakage from Europe' (Basel Action Network 2018)

Recknagel S, Radant H and Kohlmeyer R, 'Survey of Mercury, Cadmium and Lead Content of Household Batteries' (2014) 34 Waste Management 156

Recolight, 'PR Club Debate Recommends New Legal Requirements in WEEE/Waste Legislation to Tackle Online Free Riders' (*In Blogs*, 27 July 2018) <<https://www.recolight.co.uk/epr-club-debate-recommends-new-legal-requirements-in-weee-waste-legislation-to-tackle-online-free-riders/>> accessed 24 November 2021

Reike D, Vermeulen WJV and Witjes S, 'The Circular Economy: New or Refurbished as CE 3.0? — Exploring Controversies in the Conceptualization of the Circular Economy through a Focus on History and Resource Value Retention Options' (2018) 135 Resources, Conservation and Recycling 246

REPIC Limited, 'Your Obligations as a Battery Producer' (*REPIC*, 2022) <<https://repic.co.uk/producer/batteries-compliance-2/your-obligations-as-a-battery-producer/>> accessed 27 October 2022

Rhein S and Sträter KF, 'Intended and Unintended Effects of Statutory Deposit Return Schemes for Single-Use Plastic Bottles: Lessons Learned from the German Experience' (2021) 30 GAIA - Ecological Perspectives for Science and Society 250

Riley A, '10 - Paper and Paperboard Packaging' in Anne Emblem and Henry Emblem (eds), *Packaging Technology* (Woodhead Publishing 2012) <<https://www.sciencedirect.com/science/article/pii/B978184569665850010X>>

Rizos V, Tuokko K and Behrens A, 'The Circular Economy: A Review of Definitions, Processes and Impacts' [2017] IDEAS Working Paper Series from RePEc

Roller G and Führ M, 'Individual Producer Responsibility: A Remaining Challenge under the WEEE Directive¹' (2008) 17 Review of European Community & International Environmental Law 277

Román E, '22 - WEEE Management in Europe: Learning from Best Practice' in Vanessa Goodship and Ab Stevels (eds), *Waste Electrical and Electronic Equipment (WEEE) Handbook* (Woodhead Publishing 2012) <<https://www.sciencedirect.com/science/article/pii/B9780857090898500222>>

Ronkay F and others, 'Plastic Waste from Marine Environment: Demonstration of Possible Routes for Recycling by Different Manufacturing Technologies' (2021) 119 Waste Management 101

Rotter VS, Chancerel P and Schill W-P, 'Practicalities of Individual Producer Responsibility under the WEEE Directive: Experiences in Germany' (2011) 29 Waste Management & Research 931

Royal Society of Chemistry, 'Coronavirus Lockdowns Lead to UK Tech Sales Boom and Adds to E-Waste Problem' (RSC, 4 January 2021) <<https://www.rsc.org/news-events/articles/2021/jan/precious-elements-lockdown/>> accessed 4 May 2023

Rubio S and others, 'Effectiveness of Extended Producer Responsibility Policies Implementation: The Case of Portuguese and Spanish Packaging Waste Systems' (2019) 210 Journal of Cleaner Production 217

Sachdeva A, Araujo A and Hirschnitz-Garbers M, 'Extended Producer Responsibility and Ecomodulation of Fees' (Ecologic 2021) <<https://rethinkplasticalliance.eu/wp-content/uploads/2021/08/Ecologic-report-EPR-and-ecomodulation-August2021-1.pdf>> accessed 6 January 2023

Sachs N, 'Planning the Funeral at the Birth: Extended Producer Responsibility in the European Union and the United States' (2006) 30 Harv. Envtl. L. Rev. 51

Sadeleer ND, 'The Polluter-Pays Principle in EU Law - Bold Case Law and Poor Harmonisation', *Pro Natura: Festschrift til Hans Christian Bugge* (Universitetsforlaget 2012)

——, *Environmental Principles: From Political Slogans to Legal Rules* (Oxford University Press, Incorporated 2020)
<<http://ebookcentral.proquest.com/lib/usw/detail.action?docID=6376163>>

Sander K and others, 'The Producer Responsibility Principle of the WEEE Directive' (DG Environment Brussels 2007)
<https://ec.europa.eu/environment/pdf/waste/weee/final_rep_okopol.pdf> accessed 12 November 2021

Sara Priestley, 'EU Circular Economy Package' (House of Commons Library 2015) Research Briefing <<https://commonslibrary.parliament.uk/research-briefings/cbp-7416/>> accessed 13 December 2023

Schneider J and others, 'End of Life Vehicles: Legal Aspects, National Practices and Recommendations for Future Successful Approach' (European Parliament 210AD)
<[https://www.europarl.europa.eu/RegData/etudes/etudes/join/2010/447507/IPOL-ENVI_ET\(2010\)447507_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/etudes/join/2010/447507/IPOL-ENVI_ET(2010)447507_EN.pdf)> accessed 6 September 2021

——, 'A European Refunding Scheme for Drinks Containers' (European Parliament 2011)
<[https://www.europarl.europa.eu/RegData/etudes/note/join/2011/457065/IPOL-AFET_NT\(2011\)457065_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/note/join/2011/457065/IPOL-AFET_NT(2011)457065_EN.pdf)> accessed 20 January 2022

Scottish Environment Protection Agency, 'Scotland's Deposit Return Scheme' (SEPA, 2022) <<https://www.sepa.org.uk/regulations/waste/deposit-return-scheme/>> accessed 13 January 2022

Scottish Government, 'Reforming the UK Packaging Producer Responsibility System: Partial Business and Regulatory Impact Assessment (BRIA)' (GOV.SCOT, 19 January 2023) <<https://www.gov.scot/publications/reforming-uk-packaging-producer-responsibility-system-partial-business-regulatory-impact-assessment-bria/pages/2/>> accessed 20 July 2023

Seban M, Nowak O and Markit I, 'An Analysis of EU Collection and Recycling of Lead-Based Automotive Batteries During the Period 2015-2017' (European Automobile Manufacturers Association 2020) <<https://www.acea.auto/files/ES-RECYCLING-V10.pdf>> accessed 13 November 2022

Seyring N and others, 'Study on WEEE Recovery Targets, Preparation for Re-Use Targets and on the Method for Calculation of the Recovery Targets' (European Commission 2015) Final
<https://ec.europa.eu/environment/waste/weee/pdf/16.%20Final%20report_approved.pdf> accessed 1 June 2020

Sjöström M and Östblom G, 'Decoupling Waste Generation from Economic Growth — A CGE Analysis of the Swedish Case' (2010) 69 Ecological Economics 1545

Skeete J-P and others, 'Beyond the Event Horizon: Battery Waste, Recycling, and Sustainability in the United Kingdom Electric Vehicle Transition' (2020) 69 Energy Research & Social Science 101581

Sluisveld MAE van and Worrell E, 'The Paradox of Packaging Optimization – a Characterization of Packaging Source Reduction in the Netherlands' (2013) 73 Resources, Conservation and Recycling 133

Smith MJ and Gray FM, 'Batteries, from Cradle to Grave' (2010) 87 Journal of Chemical Education 162

Söderholm P, 'Taxing Virgin Natural Resources: Lessons from Aggregates Taxation in Europe' (2011) 55 Resources, Conservation and Recycling 911

Song Q, Li J and Zeng X, 'Minimizing the Increasing Solid Waste through Zero Waste Strategy' (2015) 104 Journal of Cleaner Production 199

Stahel W, 'The Product Life Factor' [1982] An Inquiry into the Nature of Sustainable Societies: The Role of the Private Sector (Series: 1982 Mitchell Prize Papers), NARC 74

Stahel W and Reday-Mulvey G, *The Potential for Substituting Manpower for Energy: Final Report 30 July 1977 for the Commission of the European Communities* (Battelle, Geneva Research Centre 1977) <<https://books.google.co.uk/books?id=RTTzMgEACAAJ>>

Staniškis JK, 'Sustainable Consumption and Production: How to Make It Possible' (2012) 14 Clean Technologies and Environmental Policy 1015

Steenmans K, 'Extended Producer Responsibility: An Assessment of Recent Amendments to the European Union Waste Framework Directive' (2019) 15 *The Journal of Environment & Development*

——, 'Brexit and Circular Economy Law: Challenges and Opportunities' [2020] *Coventry Law Journal* 25

Steenmans K and Malcolm R, 'Using Plastic Wastes to Exemplify Justice Dimensions of Extended Producer Responsibility' (2023) 04 *Advances in Environmental and Engineering Research* 024

Stewart R, '2 - EU Legislation Relating to Electronic Waste: The WEEE and RoHS Directives and the REACH Regulations' in Vanessa Goodship and Ab Stevels (eds), *Waste Electrical and Electronic Equipment (WEEE) Handbook* (Woodhead Publishing 2012) <<https://www.sciencedirect.com/science/article/pii/B9780857090898500027>>

Swansea Council, 'Frequently Asked Questions about Recycling and Rubbish' (*Swansea Council*, 2022) <<https://www.swansea.gov.uk/article/5366/Frequently-asked-questions-about-recycling-and-rubbish>> accessed 11 January 2022

Tencati A and others, 'Prevention Policies Addressing Packaging and Packaging Waste: Some Emerging Trends' (2016) 56 *Waste Management* 35

Tesco Plc, 'Shoppers Can Now Return All Their Soft Plastic Packaging to Recycling Points at Every Large Tesco Store in the UK' (*Tesco*, 21 August 2021) <<https://www.tescopl.com/news/2021/shoppers-can-now-return-all-their-soft-plastic-packaging-to-recycling-points-at-every-large-tesco-store-in-the-uk/>> accessed 11 January 2022

The Advanced Rechargeable & Lithium Batteries Association, 'The Batteries Report' (RECHARGE 2018) <<https://www.storelio.com/files/2018/05/RECHARGE-The-Batteries-Report-2018-April-18.pdf>> accessed 19 November 2020

The European Organisation for Packaging and the Environment, 'Understanding the CEN Standards on Packaging and the Environment: Some Questions and Answers' (2006) <<https://www.europen-packaging.eu/wp-content/uploads/2021/03/CEN-QA-February-2006.pdf>> accessed 14 December 2021

——, 'Extended Producer Responsibility' (*European-packaging*, 2015) <<https://www.europen-packaging.eu/policy-area/extended-producer-responsibility/>> accessed 1 February 2022

The Faraday Institution, 'Towards a Greener Lead Acid Battery Recycling Process' (*The Faraday Institution*, 2021) <<https://www.faraday.ac.uk/success-stories/greener-lead-acid-battery-recycling/>> accessed 18 November 2022

The UK Plastics Pact, 'Blazing a Trail on Plastics: Annual Report 2019/20' (WRAP 2020) <<https://wrap.org.uk/sites/default/files/2020-12/The-UK-Plastics-Pact-Annual-Report-19-20.pdf>> accessed 7 December 2021

The Waste and Resources Action Programme, 'WRAP and the Circular Economy' (WRAP, 2021) <<https://wrap.org.uk/about-us/our-vision/wrap-and-circular-economy#>>

Thompson DL and others, 'The Importance of Design in Lithium Ion Battery Recycling – a Critical Review' (2020) 22 Green Chem. 7585

Tojo N, 'Extended Producer Responsibility as a Driver for Design Change - Utopia or Reality?' (Lund University 2004)

Tojo N, Lindhqvist T and Davis G, 'EPR Programme Implementation: Institutional and Structural Factors', *Proceeding of OECD Seminar on Extended Producer Responsibility, Paris, France* (Citeseer 2001)

Topcu E, Altinoz B and Aslan A, 'Global Evidence from the Link between Economic Growth, Natural Resources, Energy Consumption, and Gross Capital Formation' (2020) 66 Resources Policy 101622

Turner JM and Nugent LM, 'Charging up Battery Recycling Policies: Extended Producer Responsibility for Single-Use Batteries in the European Union, Canada, and the United States' (2016) 20 Journal of Industrial Ecology 1148

'UK the "second Largest Producer" of WEEE' (*letsrecycle.com*, 6 July 2020)
<<https://www.letsrecycle.com/news/uk-the-second-largest-producer-of-weee/>> accessed 4 May 2023

United Nations, 'Used Vehicles and the Environment' (United Nations Environment Programme 2020)

——, 'UN Sustainable Development Goals' (*United Nations*)
<<https://www.un.org/sustainabledevelopment/sustainable-consumption-production/>> accessed 7 February 2022

United Nations Environment Programme Sustainable Consumption, 'Decoupling Natural Resource Use and Environmental Impacts from Economic Growth' (United Nations Environment Programme Sustainable Consumption 2011)
<<https://www.resourcepanel.org/reports/decoupling-natural-resource-use-and-environmental-impacts-economic-growth>> accessed 3 February 2022

Valpak Retail WEEE Services, 'DTS Information' (*Valpak Retail WEEE Services*, 2021)
<<https://dts.valpak.co.uk/DTS/Fees>> accessed 21 October 2021

Valpak Retail WEEE Services and The British Retail Consortium, 'Proposal to the Department for Environment, Food and Rural Affairs' (2019)
<<https://www.360environmental.co.uk/documents/DTS%20Phase%205%20Proposal%20-%20Defra%20-%202008.11.2019%20%20FINAL.pdf>> accessed 21 October 2021

Van Rossem, Chris, 'Individual Producer Responsibility in the WEEE Directive - From Theory to Practice?' (Lund University 2008)
<<https://lucris.lub.lu.se/ws/portalfiles/portal/5603015/1266800.pdf>> accessed 28 June 2021

Walkers Snacks Limited, 'A Free and Simple Way to Recycle Walkers Crisp Packets' (*Walkers*) <<https://walkers.co.uk/recycle>> accessed 12 January 2022

Walls M, 'The Role of Economics in Extended Producer Responsibility: Making Policy Choices and Setting Policy Goals' (2003) <<http://ageconsearch.umn.edu/record/10855>>

——, 'EPR Policy Goals and Policy Choices: What Does Economics Tell Us' (Organisation for Economic Co-Operation and Development 2004)

——, 'Extended Producer Responsibility and Product Design: Economic Theory and Selected Case Studies' (2006) 06–08 RFF Discussion Paper
<https://papers.ssrn.com/sol3/papers.cfm?abstract_id=901661#> accessed 10 May 2021

Waste and Resources Action Programme, 'WRAP and the Circular Economy' (*WRAP*, 2022) <<https://wrap.org.uk/taking-action/climate-change/circular-economy>>

——, 'Plastic Bags and Wrapping' (*WRAP*, 2023) <<https://wrap.org.uk/taking-action/plastic-packaging/actions/plastic-bags-and-wrapping>> accessed 28 July 2023

WasteWise Program, 'Environmental Factoids' (*U.S Environmental Protection Agency*, 30 March 2016)
<<https://archive.epa.gov/epawaste/conserv/smm/wastewise/web/html/factoid.html>>

Watkins E and others, 'EPR in the EU Plastics Strategy and the Circular Economy: A Focus on Plastic Packaging' (Institute for European Environmental Policy 2017)
<<https://ieep.eu/uploads/articles/attachments/95369718-a733-473b-aa6b-153c1341f581/EPR%20and%20plastics%20report%20IEEP%209%20Nov%202017%20final.pdf?v=63677462324>> accessed 16 March 2021

Waugh R and others, 'Development of Guidance on Extended Producer Responsibility (EPR)' (European Commission 2014)
<https://ec.europa.eu/environment/archives/waste/eu_guidance/pdf/report.pdf>

——, 'Study on the Implementation of Product Design Requirements Set out in Article 4 of the WEEE Directive : The Case of Re-Usability of Printer Cartridges' (Publications Office of the European Union 2018) <<https://op.europa.eu/443/en/publication-detail/-/publication/17b7b664-15f0-11e8-9253-01aa75ed71a1/language-en/format-PDF>>
accessed 26 February 2020

WEEE Comply, 'Batteries' (*Weeeecomply.co.uk*, 2020)
<<https://www.weeeecomply.co.uk/batteries.htm>> accessed 2 December 2020

WEEE Forum, 'Successfully Countering Online Free-Riders: Response to the Consultation Regarding the Study to Support the Preparation of the Commission's Guidance for Extended Producer Responsibility Schemes' (WEEE Forum 2019) <https://weee-forum.org/wp-content/uploads/2019/06/countering_online_free-riders_consultation_issue_paper-2.pdf> accessed 24 November 2021

Welsh Government, 'Environment (Wales) Act 2016 Factsheet: Carrier Bag Charging Scheme' (2016) <<https://gov.wales/sites/default/files/publications/2019-05/environment-wales-act-2016-carrier-bag-charging-scheme.pdf>> accessed 13 August 2022

——, 'How Wales Became a World Leader in Recycling' (*Welsh Government*, 18 March 2020) <<https://gov.wales/how-wales-became-world-leader-recycling>> accessed 13 January 2022

Widmer R and others, 'Global Perspectives on E-Waste' (2005) 25 *Environmental Impact Assessment Review* 436

Williams G, "'ELVs: Carrot or Stick?'" (2017) 59 *CIWM Journal* <http://uk.emrgroup.com/files/ciwm-may-2017_emr.pdf> accessed 4 August 2020

Wilson C, Williams ID and Kemp S, 'Compliance with Producer Responsibility Legislation: Experiences from UK Small and Medium-Sized Enterprises' (2011) 20 *Business strategy and the environment*. 310

World Wildlife Fund, 'Biodiversity' (*World Wildlife Fund*, 2020) <https://www.wwf.eu/what_we_do/biodiversity/> accessed 15 February 2022

Ylä-Mella J and others, 'Implementation of Waste Electrical and Electronic Equipment Directive in Finland: Evaluation of the Collection Network and Challenges of the Effective WEEE Management' (2014) 86 *Resources, Conservation and Recycling* 38

Zeben J van, 'Environmental Law' [2022] *The Oxford Encyclopedia of EU Law* <<https://opil.ouplaw.com/display/10.1093/law-oeel/law-oeel-e112>> accessed 8 February 2024

Zero Waste Europe, 'Extended Producer Responsibility – Creating the Frame for Circular Products' (*Zero Waste Europe*, 2017) <<https://www.zerowasteurope.eu/wp-content/uploads/2017/01/EPRpolicypaper.pdf>> accessed 15 July 2019

Zero Waste Scotland, 'The Regulations' (*Zero Waste Scotland*, 2022) <<https://depositreturnscheme.zerowastescotland.org.uk/regulations>> accessed 13 January 2022

Zhou G and others, 'A Systematic Review of the Deposit-Refund System for Beverage Packaging: Operating Mode, Key Parameter and Development Trend' (2020) 251 *Journal of Cleaner Production* 119660

Zweigert K, Kotz H and Millns S, 'An Introduction to Comparative Law, 3rd Edition' (1999) 48 *International and comparative law quarterly* 982

Appendix 1: A Circular Economy for Electric Vehicle Batteries: Driving the Change

Citation: Ahuja J, Dawson L and Lee R, 'A Circular Economy for Electric Vehicle Batteries: Driving the Change' (2020) 12 Journal of Property, Planning and Environmental Law 235. DOI: <https://doi.org/10.1108/JPEL-02-2020-0011>

1: Introduction

Global carbon dioxide (CO₂) emissions have increased steadily in the past few decades and human fossil combustion is fundamentally linked to the causes of global warming (Siqi et al., 2019). Further, petroleum that has been widely used in the transport sector (for example, for fuelling traditional internal combustion engine automobiles, aircraft etc.) contributes significantly to environmental and air pollution, which is now recognised as the major global risk factor for ill-health and death (Apte et al., 2017). The more recent emergence of lithium-ion batteries (LIBs), which are increasingly becoming the main power source for electric and electronic equipment such as mobile phones, laptops and electric vehicles (hereafter, EVs), provide a significant opportunity to decrease fossil fuel consumption and mitigate air pollution (Siqi et al., 2019). The move to electric mobility is now a key aspect of the global effort to tackle climate change. The transition to electric vehicles has significant potential to reduce global warming and improve air quality. In the United Kingdom (UK), the government is committed, under the Paris Accord 2015 (Paris Agreement to the United Nations Framework Convention on Climate Change, 2015) and the Climate Change Act 2008 (s1(1)), to reduce greenhouse gas emissions by 80% of 1990 levels by 2050. In its bid to achieve this target, the *UK Government's* 2018 Road to Zero

strategy (Department of Transport, 2018) has committed to phasing out the sale of all new petrol and diesel (internal combustion engine, or ICE) vehicles by 2040 (Ahuja et al., 2019). The Committee on Climate Change, however, now recommends that the commitment to end sales of new ICE vehicles needs to be brought forward to 2035 in order to meet the target for road transport emissions to be near-zero by 2050 (Gummer *et al.*, 2019). Latest reports indicate that the Government now plans to move this deadline to 2035, and possibly even further forward to 2032 (Jolly, 2020).

Alongside the potential benefits of this transition, however, is a potential danger that many of the environmental gains from EVs could be diluted if we do not adequately plan for their sustainable and safe end-of-life (hereafter, EoL) management. In particular, this paper focuses on the EoL management of EV batteries, or lithium-ion batteries (LIBs). Because of the power needed to propel an EV, these batteries will still contain significant residual capacity (70-80% of their capacity, according to current estimates) even after they are no longer able to provide vehicle traction. In addition, these batteries also contain many valuable and critical materials. Extraction of some of these rare metals has raised environmental and ethical concerns in countries where they are mined (Hirst et al., 2018). Many of these materials, such as cobalt, nickel and lithium, are also at risk of supply shortfalls in the future.

Circular Economy goals demand that the residual power remaining in these batteries at the end of their life in an EV, as well as their valuable material components, are utilised to the fullest possible extent before the battery is disposed of. A sustainable value chain for EV batteries is one which reduces environmental impacts and avoids the depletion of natural

resources to maintain an environmental balance while promoting economic growth (Hill et al., 2019, p.119). A battery economy which has moved away from a traditional linear (take, make, use and throw) disposal model, to one which is fundamentally circular (reuse, repurpose, recycle) will enable the battery economy to become resource efficient, thus ensuring that maximum potential is harnessed from an EV battery (see 3(a) below for further discussion of Circular Economy models in batteries).

Recycling of LIBs is, however, not unproblematic, for several reasons including lack of standardisation of LIB design and chemistry, recycling processes that are still in development and inadequate recycling infrastructure (discussed further in 2(b) below). Furthermore, LIBs contain many potentially hazardous materials, and due to the high amounts of residual power contained in them, can be vulnerable to explosions, fire and toxic gaseous emissions, especially if damaged. Thus, they also pose a significant threat to human health and the environment if not managed or disposed of correctly.

EVs represent a new application of LIB technology and will constitute LIB application at a scale not previously seen in the UK, due to the large size and power of EV LIBs. So far, most LIBs that have needed end-of-life management in the UK have been smaller portable batteries used in electronic equipment such as laptops, mobile phones etc. Most EV batteries in the UK have not yet reached the end of their first life, although the manufacture and sales of EVs is growing exponentially and the scale of the problem will rise rapidly in the next few years (The projected volumes of EV LIBs that will soon need processing are estimated below at 2(a)). Recycling processes for these batteries are still in development and recycling efficiencies are still relatively low. Within the UK, there is an absence of any

infrastructure for LIB recycling, and many regulatory and policy uncertainties remain regarding second-use of LIBs (explored further in section 4 below).

This paper will discuss why changes to the legal frameworks applying to EVs are needed to reduce safety risks, facilitate effective take-back mechanisms, and to optimise sustainability in the end-of-life management of EV LIBs. We outline the barriers to Circular Economy objectives for EV LIBs and offer a potential regulatory solution based on rethinking EV ownership models to help improve the safety and efficiency of managing used EV batteries.

This paper will highlight why safe and sustainable end-of-life management of LIBs is much more complex than for traditional automotive (ICE) batteries. A battery economy which is circular is unlikely to arise without incentivisation, thus innovative legal and regulatory frameworks are now essential for supporting the EV transition. This paper discusses one such solution, based on servitisation, which involves revaluating ownership models for EVs and EV batteries such that manufacturers retain greater ownership and control of EV batteries through battery leasing to replace consumer ownership of the battery. This could help to improve EV LIB collection and take-back rates, as well as better maintenance of batteries throughout their life in an EV. In turn, this would reduce risks of unsafe or illegal disposal and make more batteries available for recycling and reuse. It could also potentially help ensure the take-back of LIBs that are in a better or more diagnosable state of health, easing decision-making about potential reuse, thus allaying manufacturer anxieties about second use.

2: End-of-life management of EV LIBs: the challenges

Scale of the problem: projected volumes

Future estimates of global EV stocks vary, ranging from 50 million (Trafigura Research Report, 2018) to a possible 130 million by 2030 (International Energy Agency, 2018). The number of licensed ULEVs on UK roads is rising steadily year-on-year. Projections from the National Grid suggest that the stock of EVs in the UK could reach between 2.7 and 10.6 million by 2030, rising to as much as 36 million by 2040 (National Grid, 2018). If the phase out date for new petrol/diesel sales is brought forward to 2035 or 2032, as currently being contemplated by the Department for Transport, the UK stock could be even higher by 2040.

The Faraday Institution ReLib Project estimates that if the first life of an EV battery ranges from 8 to 10 years, the UK will need to manage or reprocess around 16,650 tonnes of end of life EV battery packs (or around 8,000 tonnes of cells/modules) (The Faraday Institution, ReLiB project) by 2028. Globally, the tonnage of spent LIBs discarded by 2030 is estimated to range from 11 million tonnes (Trafigura Research Report, 2018) to 16 million tonnes. The UK does not currently have any LIB recycling facilities, and relies on trans-shipment to recycling facilities in Europe in order to meet recycling targets for the relatively small volume of end-of-life portable LIBs that need managing at present. Trans-shipment is not, however, a viable long-term solution as LIB volumes increase; especially as options to trans-ship to Europe are limited by the available infrastructure, and there remains uncertainty surrounding the complexity and cost (including tariff costs) of transshipment post-Brexit. Currently, some UK manufacturers do export spent LIBs to European facilities for recycling, but gate prices are very high in part because these facilities are insufficient to cater to the level of need we will be facing in the coming decade. For example, at present, the largest battery recycling

facility in the EU (Umicore in Belgium) can process just 7,000 tonnes per year (Ahuja et al., 2019). The available recycling infrastructure in European facilities contrasts sharply with the scale of the problem we will need to soon address: as mentioned earlier in this section, estimates suggest that we will need to manage about more than twice the Umicore tonnage of spent EV battery packs in the UK alone by 2028. Efficient systems for managing LIBs from EVs are imperative if their widespread use is to be sustainable, and the UK, therefore, must consider investing in and facilitating this if it is to be a major consumer and manufacturer of EVs.

Various options are currently being actively explored for the end-of-life management of LIBs: these include recycling and second-use. Second use could include both re-using the battery again in an EV for the same purpose it was originally designed for, which we label here 're-use', or redirecting the LIB for a different use such as stationary storage applications, which we label 're-purposing'. Both re-use and re-purposing present a number of challenges to be overcome in order to improve feasibility for widespread applications, as discussed below.

Challenges of recycling LIBs: why is this more difficult than recycling traditional automotive batteries?

The recycling of EV batteries is far more complex and costlier at present than lead-acid batteries used in traditional (ICE) automotive. LIBs are more powerful and variable, in terms of technology and chemical composition, than ICE batteries. Whereas ICE batteries have over time developed almost uniform and standardised chemistries, lithium-ion is not one single technology but a common denominator for several different chemistries which all use

a similar principle (Trafigura Research Report, 2018, p. 8). Unlike ICE batteries, no standard form or chemistry has yet emerged for EV batteries and so far, no LIB recycling technology has been developed or deployed in the UK (Ahuja et al., 2019, pp. 5–6). However, several processes have been proposed and some have been deployed in various parts of the world, but attempts are still being made to optimise the whole process (Ahuja et al., 2019). At present the number of EVs reaching end-of-life in the UK is still relatively small, so the volume of batteries to be processed is insufficient for the establishment of a commercially viable operation (Ahuja et al., 2019). These volumes (and potential profitability) will rise in the future as more EV batteries start reaching the end of their first life, (as discussed in projections above, 16,500 tonnes of LIB packs and 8,000 tonnes of LIB cells and modules will be available for recycling by 2028 in the UK alone) (Ahuja et al., 2019). The complex planning and infrastructure needed to set up such facilities require that meeting this imminent need must be planned and facilities put in place before volumes rise to unmanageable levels. Further, LIB recycling processes are still in the developmental stage and are far from achieving the recycling efficiencies of lead–acid batteries. Umicore processes are reported to achieve, for example, a recycling efficiency of around 50% of materials contained in the cells: mainly, cobalt, nickel and copper (Tytgat, 2018). This is in contrast to the over 90% recycling efficiencies for most traditional lead-acid automotive batteries.

Given the current challenges of LIB recycling, LIB second-use is an alternative option that is actively being explored to extract maximum value from EV LIBs before recycling.

Challenges of LIB second-use

As explained above second use could include re-use (using the battery again in an EV after repair/refurbishment), or repurposing it for a different application such as energy storage or grid back-up. As a precursor to recycling, re-use is where a battery, which has been designed for EV use and has already been used for this purpose, is then used again as a battery for an electric vehicle. Typically, reuse of an EV battery would require inspection, and potentially intensive refurbishment or repair in order for it to function for the same purpose. The question of whether re-use of a LIB is feasible or not is heavily dependent on the condition and state of health of the battery (Hill et al., 2019, p. 19-20).

In contrast to re-use, battery repurposing refers to redeployment of the battery for a different purpose from that for which it was originally designed. The residual power remaining in traction LIBs after their use in EVs ranges between 60% and 80% of the nominal capacity. There is thus a high interest and potential for less energy-demanding applications, e.g. grid back-up, residential buildings, uninterruptible power supply, sweepers and driverless transport vehicles (Bobba et al., 2019, p.280). A recent European Commission stakeholder consultation indicated that ‘*a significant share*’ of the batteries reaching end of life within a vehicle would be suitable and could be used for such repurposing. This also appears to be supported by analysis from the US National Renewable Energy Laboratory (NREL) who expect most batteries to become available for second use at the end of an expected EV service life of up to 15 years: “*NREL studies show that these batteries can retain as much as 70% of their initial capacity and potentially continue to operate for another 10 years in second use as energy storage for utilities—translating into a total service life of up to 25 years.*” (Hill et al., 2019, p.26)

Second use of spent EV batteries is currently challenging for a number of reasons. Amongst the foremost rank concerns around the safety of second use, and uncertainties about how the first user may have handled or maintained the battery. Some car and battery manufacturers have indicated reluctance about engaging with reuse and remanufacture because they take the view that the proportion of batteries which may be available for this use at end of life depends to a great extent on the ownership and usage during first life. If an EV owner owns their battery and uses it until it has reached an unacceptable state of health, then it may not be suitable for repurposing (Hill et al., 2019, p.26). Under traditional car ownership models, where a purchaser owns the car as well as its battery, manufacturers have little information and no control over how the first user uses or maintains the battery. They also have little access to usage history and data which could help them better diagnose damage and the extent of degradation which is not readily discernible upon inspection. Thus, concerns about potential reputational damage appears to have led to some reluctance on part of EV manufacturers to facilitate second life applications of their EV batteries. For example, if an EV owner owns their battery and uses it until it has reached an unacceptable state of health (SOH), it may no longer be suitable for re-purposing. A proper assessment of state of health needs to consider aging/stress in the first life (which could influence failure and safety), as well as information about battery usage/charging history. As experts point out: *“The uncertainties in quality, time and quantity of the returns are a great challenge for a successful remanufacturing business model”* (Kampker, 2016) .

There are also various other challenges which impact on the feasibility of second-use in comparison to recycling, such as unclear regulations, technical challenges and perceptions

of reused products. A number of commentators express concerns about LIB second-use due to dangers arising from the flammable and explosive nature of the active material as well as the toxicity of the gaseous emissions in the event of an explosion, (Commission for Environmental Cooperation., 2015) particularly while working with a battery pack (Kampker, 2016). However, more recent advances have focussed on addressing some of these issues, and some of these health & safety concerns could be overcome through improvements in the initial battery design and manufacturing process: batteries for the electrified Mercedes models are now being designed so that they can be opened easily and the components can be replaced easily and without any risks (see Hill et al., 2019, p. 21-22). We contend that technological improvements, in combination with regulatory measures that give manufacturers greater control over battery use and maintenance, could go a long way in enhancing safety as well as the economic feasibility of LIB second-use.

As well as concerns about general state of health, it is also possible that initial owners of these batteries may use them well below the 70-80% capacity which is widely recommended as being the time when an EV should have its battery replaced (Tytgat and Tomboy, 2017). This can damage the battery and reduce the number of batteries available for effective second-use, which may mean that a higher proportion will need to be recycled rather than re-used/or repurposed. Schemes that give manufacturers access to reliable information about battery usage/maintenance will facilitate efficient resource allocation through more informed decision-making. This may be very helpful in addressing manufacturer anxieties about second-use applications. Our proposed solution (explained in section 5 below), shows one potential avenue forward which could help the take-back of not just more EV batteries,

but arguably produce second life batteries that are in a better state of health and thus potentially more useful for re-use purposes.

3: Circular Economy dilemmas in managing LIBs at the end of their first life in an EV

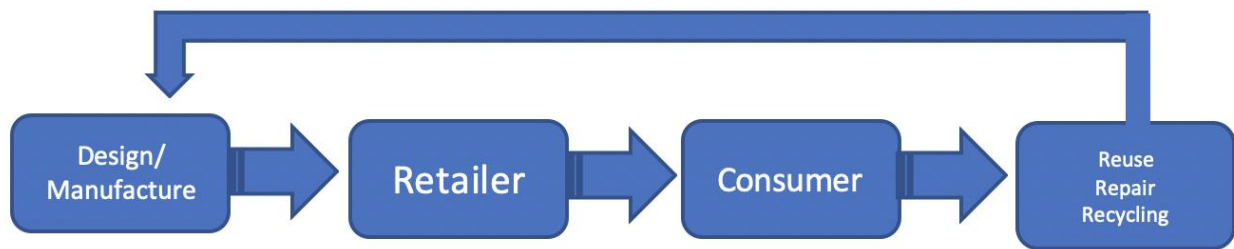
Circular Economy objectives and critical materials shortages:

Present EV battery chemistry contains a varied and expansive list of materials, and no standard battery chemistry type has been developed by the automotive industry. This is partly because EV batteries are new to the market and there is a need to experiment with chemistry in order to achieve a balance between range and power in order to gain a competitive advantage. However, other restricting factors include the price, availability and potential environmental harm attaching to different materials. Current EV batteries typically, but not exclusively, use materials such as cobalt, silicon and graphite in different quantities; all of which are classified as critical materials (European Commission, 2018). By critical it is meant that the material is essential to the development of the EV market but there could be insufficient quantities of it available in order to support its predicted future demand (Spears, 2015). A material is often classed as critical if there are significant supply limits as a result of geographical or political issues, price volatility, or ethical and environmental concerns.

As reliance on critical materials grows for EVs batteries within both the UK and the EU, so too does the importance of transitioning from a linear economy which takes, makes, uses and discards to one which is fundamentally circular. An economy which is circular seeks to keep resources in use so that maximum value can be extracted from them, and waste can

be kept to a minimum. The Circular Economy theory enables resources to travel in a circular motion through the key stages of the economy continuously, in a looped cycle, which therefore reduces the need to extract virgin raw materials (see Fig 1 below). This paper proposed solution, discussed below, helps to minimise reliance on critical materials, and furthers the development of the Circular Economy through helping to maximise the value of the battery by facilitating repair, re-use, repurposing and recycling.

Figure 1: the Circular Economy model



Managing LIBs at the end of first use: recycling or re-use?

Second-use of EV batteries once they reach a point where they are no longer able to power an EV, but still retain considerable amounts of residual power, seems a promising way forward to effectively harness residual value and capacity. Both, legislative frameworks (e.g. the Waste Framework Directive (Directive 2008/98/EC) and literature (Bobbà et al., 2019, p.280) concur that in general the extension of product lifetime through reuse or remanufacturing contributes to the Circular Economy theory that supports the minimisation of waste and better resource management. In theory, re-use (i.e. using the battery again in an EV) is preferable to repurposing (i.e using the battery in an alternative application; such as a storage battery to back-up the grid) as it should be less energy and resource intensive

to make the battery fit again for the same purpose, compared with the effort and time required to remanufacture (Hill et al., 2019, p.20-22). However, reuse may not necessarily be feasible, and will be heavily dependent on the state of health of the battery, and whether the technology is capable of repairing and refurbishing it for the energy intensive task of powering an EV. Thus, it is likely that in most situations the only route for second use will be to repurpose the battery for less demanding applications. Although traditional Circular Economy models (as enshrined for example in the EU's (Directive 2008/98/EC)) would generally view repurposing before recycling as the most sustainable strategy, the relative sustainability merits of repurposing versus recycling are not so clear where EV LIBs are concerned. As discussed below, it is possible to argue that due to the rising demand for critical materials needed to manufacture LIBs and the environmental costs of mining these, there may, currently, be greater Circular Economy benefits to direct recycling in this area.

It is important to remember that despite benefits, repurposing of EV LIBs may interrupt the type of supply loop envisioned by the Circular Economy objectives and EPR, and will delay recycling. Recycling can potentially help bring some of these raw materials back into the value chain, and repurposing would have a negative impact on the efficiency of closed-loop recycling. Further, as discussed in section 2, the economic case for setting up recycling infrastructure and allocating resources to improve recycling processes is weak at present as end-of-life LIBs have not yet started to emerge in large enough numbers for recycling to be sufficiently profitable. Repurposing before recycling would further delay the availability of sufficient numbers of batteries for recycling, and thus further reduce manufacturer engagement in developing recycling infrastructure.

Further analyses and data are still needed to make decisions about whether best Circular Economy benefits could be achieved through direct recycling of LIBs, or whether repurposing before recycling would be more advantageous. We suggest, however, that our new regulatory proposals for battery ownership would help to facilitate improved efficiencies for both recycling and second use, and thus benefit either of the optional routes for managing EoL LIBs (discussed in more detail in section 5 below).

4: Current UK regulatory landscape for batteries

Currently, EoL EV batteries are exported from the UK to the EU for recycling. In time, this may become problematic (due to issues around processing capacity, transport, safety, waste shipment regulations, etc.) (Ahuja et al., 2019). As a result of the rapid uptake of EVs in China, the Chinese Government has introduced EV battery recycling regulations (Liqiang, 2019) and studies illustrate that recycling LIBs will be a significant global business (Melin, 2018). UK EoL vehicle management companies, who have been accustomed to handling only one battery type (i.e., lead/acid), will need to develop systems for managing a wide range of EV battery configurations and chemistries in the near future, depending on contractual arrangements for waste management.

The current policy landscape in the UK relies on EU legislation to regulate the EV battery value chain so as to reduce any negative environmental impacts as far as possible: that is, to prioritise the development of a sustainable EV battery value chain. A sustainable value chain for EV batteries can be defined as one which reduces environmental impacts and avoids the depletion of natural resources to maintain an environmental balance while

promoting economic growth (Hill *et al.*, 2019, p.119). An efficient value chain contributes to the introduction of an economy which is fundamentally circular; something that both the EU and UK strive for.

The key policies regulating the market include the Batteries Directive (Directive 2006/66/EC), ELV Directive (Directive 2000/53/EC) and REACH (Regulation (EC) 1907/2006). Together these policies regulate the use of hazardous substances, environmental performance of batteries throughout their lifecycle and the collection, treatment and recycling of waste batteries (including targets for collection rates and for recycling efficiencies).

The Batteries Directive (Directive 2006/66/EC) regulates the collection, treatment and recycling of waste batteries by extending the producers responsibility. Extended Producer Responsibility (EPR) legislation, which acts as an extension of the polluter pays principle, has two main aims: firstly, to reduce the immediate environmental impact of the product by mitigating the products' harm at the end of its life, and secondly, to influence the design of a product (Directive 2008/98/EC). EPR legislation passes responsibility for the whole life-cycle (but focusing particularly on end-of-life) of a product away from municipalities and transfers it to the producer of the targeted product. In consequence, this results in the producer having both physical, and/or financial responsibility for their product.

Batteries are presently classified into three different categories within the Batteries Directive: portable, automotive and industrial batteries. Rather oddly, electric vehicle batteries currently fall within the classification of 'industrial' rather than 'automotive' batteries. This is

largely because the Directive pre-dates the rapid transition from ICE to EV, and was drafted before LIB EVs were in widescale use. Thus, EV LIBs do not fall within the definition of 'automotive' batteries, as the technology was not available to the market at that time. One effect of EV batteries being classified as 'industrial' is that producers are not currently subject to any formal collection and recycling targets. Therefore 'industrial' producers are currently in a less onerous position than that of the producers of lead-acid batteries used in traditional ICE vehicles. EV battery producers (i.e., those who 'place batteries... on the market for the first time...on a 'professional basis' (Directive 2006/66/EC, Art. 3 (12))) are required, under the Batteries Directive, to 'take-back' the spent vehicle battery at no additional cost to the end-user, if the producer has supplied a new battery and also sells the same chemistry type of the spent battery (Directive 2006/66/EC, Art.8 (3)). Thereafter, they are mandated to ensure that the batteries are treated and recycled. It is notable that EV producers do not have to meet any take-back target, apart from being obliged to give end-users information about the existence of take-back schemes and the harmful effects of incorrect disposal (Directive 2006/66/EC, Art. 20). Moreover, once a producer has taken-back an industrial battery, it is under an obligation to put the battery through treatment and recycling (Directive 2006/66/EC, Art. 12); there is a complete prohibition on placing industrial batteries in landfill or incineration (Directive 2006/66/EC, Art.14). Any net cost arising from the collection, treatment, and recycling of batteries (Directive 2006/66/EC, Art.16), as well as information campaigns, (Directive 2006/66/EC, Art. 16(3)) is financed by the producer.

We argue that the current 2006 battery regulations are inadequate to deal with the new EV landscape, and arguably are no longer 'fit for purpose' to support effective use and management of EV LIBs; a recent review of the Directive acknowledged this point, and also

raised the possibility of a redraft (European Commission, 2019). Within the Directive, there are several regulatory gaps and inadequacies in regard to safe storage and transport of lithium-ion batteries. The anomalous classification of EV batteries as industrial rather than automotive means that there is no regulatory demand or incentive for producers of EV LIBs to facilitate end-of-life management, and they have no specific EoL battery collection targets to fulfil. Further, unclear regulations about reuse applications (including the lack of definitional clarity about what constitutes reuse/repurposing etc.) (Ahuja *et al.*, 2019) increases producers' reluctance to engage with reuse. Despite an increasing interest in reusing batteries, studies highlight that manufacturers feel there is a need for "governmental incentives on battery reuse" (Bobba *et al.*, 2018, p.20).

One significant question in relation to regulation is therefore the extent to which it can influence business models in favour of those which promote re-use and safe and effective end of life management. Our regulatory proposal, which seeks to ensure that EV batteries remain the property of the manufacturer even when the EV belongs to the consumer, could help to incentivise and promote, safer and more efficient reuse, thus increasing the incentive for producers to engage with this, which is discussed below.

5: New ownership model: Purchaser buys the car, but manufacturer owns the battery

This paper suggests that a new approach is needed for the management of batteries at the end of their first life. We propose new legal frameworks for EV ownership such that the manufacturer retains ownership of the EV battery, even when a purchaser owns the rest of the car. Current battery leasing schemes, trialled by companies such as Renault, can provide

an effective example of how such a regulatory model could work in practice. Here, Renault offers a battery leasing scheme for their ZOE models to customers: the “Z.E. flex battery hire agreement” (Hill et al., 2019, p.137). Under this arrangement, customers purchase the vehicle but lease the battery, with the price per month linked to annual mileage. RECHARGE explains that this allows manufacturers to retain ownership of the battery and therefore control the value chain, including decisions about whether to repair or replace the batteries and, if replaced, whether a used battery should be recycled or used again. (Tytgat and Tomboy, 2017). However, unfortunately there has been little consumer uptake of this scheme, which strengthens our call for regulatory drivers or incentives.

As we discussed earlier in section 1(c), the feasibility of LIB second-use is dependent to a large extent on the state of health of the battery when it reaches the end of its first life. Moreover, diagnosing battery state of health can be complex and difficult: knowledge about the usage history of a LIB can greatly help to assess state of health. However, in traditional models of ownership, where a purchaser owns the car and all its components, the battery is ultimately in the control of the user. In such models, the battery SOH is not something that the manufacturer can influence or understand before the used battery is returned to them (Hill et al., 2019); although we accept that some information may be attained by the manufacturer where vehicle servicing has been undertaken by a dealership. Understandably, this could make manufacturers more reluctant to engage with developing re-use or repurposing applications of their EV LIBs. Ford, for example, expressed caution about this, indicating in a 2014 presentation that their approach is to ‘de-energise’ (or discharge) and then recycle these batteries, with no re-use allowed (see Hill et al., 2019, p. 23)

Further, where a purchaser owns all components of the car, initial owners of these batteries may use them well below the 70-80% capacity which is widely recommended as being the time when an EV should have its battery replaced (Tytgat and Tomboy, 2017). This may reduce the number of batteries that become available, and may also mean that a higher number will need to be recycled rather than re-used or repurposed (Ahuja et al., 2019). However, a leased battery is likely to be replaced when the battery is nearing 70%-80% SOH, and as such it will be more easily re-purposed. Therefore, we argue that such a model allows the manufacturer greater control of the battery, which therefore facilitates the take-back, reuse/repair and recycling of batteries; whilst also encouraging design for recycling.

Under the above-mentioned framework, manufacturers (as owners of the battery) will have had greater control over battery maintenance and this may help to ensure EV LIBs remain in a better state of health. At the very least, it would help manufacturers to run more effective diagnostic checks on EV batteries, detect potential damage and give them access to usage history and state-of-health data that is clearer and more certain. This would ease decision-making about battery safety, thus helping alleviate some anxieties about putting batteries to second use. This, we argue, could increase industry engagement with reuse; although we concede that such a model will require more research not only on mechanisms for implementation, but also any foreseen industry effects (such as the possible effect on consumer choice, and independent garages).

However, the revision of EV ownership models presented by this paper could enhance the producer's ability to retain value via ensuring efficient take-back. It could enable this because

inherently, leases contain a definitive termination date for which the consumer will be obligated to return the battery to the manufacturer. Once in possession of the battery, producers of 'industrial' batteries are required to treat, and recycling the battery at its own cost; This, as Bobba *et al.* (2018) and Bobba, Mathieux, & Blengini (2019) note that although second use could be an economically feasible solution, increasing the size of the available flows of EV batteries is crucial for improving economic viability of recycling.

Such an ownership model could also help to support the facilitation of a Circular Economy, which both the EU (through their Circular Economy Package legislation (European Commission, 2015)) and the UK (through England's Waste Strategy (DEFRA, 2018)) are hoping to achieve in the near future. With this in mind, manufactures could seek the initiative to develop practices that will enable the maximisation of battery value through changing the ownership model in order to facilitate a closed-loop cycle, which decreases reliance on critical materials, of battery components; therefore, allowing for components to continuously flow from manufacture to consumer and back to manufacturer in order to start the process again. As a result, while the new ownership models as proposed in this paper could in some ways place greater burdens or responsibility on manufacturers, it could also constitute an opportunity to enhance profitability by ensuring more LIBs come back to manufacturers for reuse, repurposing or recycling.

6: How will this work in devising a Circular Economy?

Notions of ownership pervade waste management law. For the most part we assume that where goods have been acquired for value there will be adequate incentives to safeguard and exercise custody over those goods. However, when goods are thought no longer to be

of value and such that the holder forms an intention to discard those goods or does so discard them (Article 3(1) Waste Framework Directive (Directive 2008/98/EC – as amended) then we might worry about their fate to the point that we may regulate their handling as waste. Concerns may relate to abandonment and to issues of harm to health or environment since (for example) even the deposit of organic waste may cause problems of leachate contamination of soil and water as well as the generation of methane gas. For these reasons local waste collection to serve the public good have been provided for almost 175 years in the UK (Public Health Act 1848). Those waste collection services, in modern times, do seek to realise value from what are often low value waste flows which come in high volumes. Here, however, in relation to lithium ion batteries, the waste is of potentially high value both in terms of its material components but also in relation to its potential for a second purpose.

As is demonstrated in this paper, at the point that an EV LIB leaves the vehicle, there are reasons to worry about leaving its fate entirely to the market. Undesirable second use, unwanted processes of waste transshipment outside of the UK, and questions of future safety might cause us to intervene in the market by way of regulation. Like any regulatory intervention, however, policing and enforcement may mean the deployment of considerable public resources and may be beset by regulatory failure. We see an example of this in the apparently simple model for end of life vehicles in the European market. There are as many as 3.5 to 4.5 million vehicles per year leaving the European market with ‘unknown whereabouts’. These ghost vehicles are deregistered in the Member States but are not reported either as legally treated ELVs or as legal exports as second-hand vehicles. (Report of the Commission on the implementation of Directive 2000/53/EC on end-of-life vehicles,

2017). This suggests the need for other solutions which work more closely to the market and drives our call for a servitisation model. (Spring and Araujo, 2017).

Servitisation is an increasingly common form of business model in which manufacturing companies retain ownership of assets throughout their lifetime such that the use or the function of a product is sold rather than the product itself, with the customer paying to ensure the availability and reliability of the good. This model is increasingly seen as 'one possible enabling factor of the Circular Economy'. (de Estarrona *et al.* 2019). The repair (or re-use) of (usually high value) products during their lifetime, together with the accessibility to the product to remanufacture at the end of life, is seen as an increasing attraction of this model. It runs in a very different direction to that of public service provision of waste collection. It passes responsibility away from the public to the private sector, in an extended manner to the producer of the goods. However, rather than simply seeing this as the passage of a burden to the private sector, there is increasing recognition of the value of the component parts and materials that may make this retained ownership model attractive, thereby negating the need for costly and troublesome end of life regulation.

This involves a philosophical change as well as a sectoral one. Rather than positioning waste handling as the problematic combatting of pollution from waste, it becomes seen as the further extraction of value from material flows, to allow an extension of profit from the goods placed on the market. European Union law has been slow historically to grasp this fundamental. In a whole series of cases on waste classification, it has stuck dogmatically to the need to regulate discarded materials long past the point at which they have regained economic value (Lee and Stokes, 2008) though recent reforms to the Waste Framework

Directive do try to promote the efficiency of resource use, and to the value attached to waste as a resource. (Directive (EU) 2018/851). Oddly this raises the question of whether the regulation of waste flows may be loosened to help establish servitisation models.

Servitisation models are not easily achieved if the company placing goods on the market do not see additional income flows from the model. It follows that some incentives towards the adoption of leasing or other forms of servitisation may be useful in driving the shift towards retained ownership and responsibility. Reduction in the red tape of waste management regulation may prove one such incentive, but this can only go so far. There remains a strong public interest in retaining some monitoring of the LIBs throughout their life-cycle at least until the point (as may now be the case with lead acid batteries) that the economic drivers attaching to the recovery of critical materials offers the assurance of responsible handling of critical material flows.

Note, finally, the disruption that may attach to the business models surrounding servitisation. If ownership is retained by a producer, then design for disassembly, becomes much more likely, which is a positive benefit. However, then, with increasingly automated disassembly, and with remanufacturing alongside the materials recovery, it may become overwhelmingly likely that the entire reprocessing is undertaken by the battery manufacturer. This might displace current metal recycling and waste management enterprises or at the very least leave them as handlers of only low value material flows, as the high value products remain in closed loops. It is unsurprising, perhaps, that re-shaping the fundamentals of market economies, such a property rights, can have profoundly disruptive effects.

7. CONCLUSION:

This paper highlights the potential environmental, social and health and safety costs of failing to adequately plan for end-of-life management of LIBs. It has argued that the cost and complexity of LIB manufacture and recycling necessitate more robust and innovative regulatory interventions that are underpinned by Circular Economy objectives, to achieve the environmental goals that EVs are hoping to achieve. Specifically, it has highlighted the benefits of a change to traditional ownership models in relation to electric vehicles, such that customers may purchase their EVs but only lease the battery, so that the EV battery remains the property of the manufacturer. It has outlined the advantages that such a servitisation model may have in relation to ensuring higher rates of take-back of LIBs, which in turn will facilitate safe handling and disposal, higher rates of recycling, and better potential for re-use applications.

Where, as with EV LIBs, there are strong reasons to promote materials' recycling, rethinking property rights in such products might help drive circularity and maintain the value of the material flows. However, it seems clear that, at least in present market conditions, an economy which is circular is unlikely to shape itself as far as EV LIBs are concerned, so that thus this needs to be driven by regulation or incentivisation. Quite how one shifts business models from sale to service is itself challenging and will require further study. It is less likely to be achieved by command and control regulation than by the re-shaping of market incentives. While this may prove a challenging exercise in regulatory design, the benefits of reconfigured business models based around matching ownership and responsibility may well prove worth the effort.

References

Ahmadi, L., Yip, A., Fowler, M., Young, S.B. and Fraser, R.A. (2014), "Environmental feasibility of re-use of electric vehicle batteries", *Sustainable Energy Technologies and Assessments*, Vol. 6, pp. 64-74.

Ahuja, J. and Lee, R. (2019), "The imperative for an effective EV management policy in the UK", working paper, The Faraday Institution ReLiB project, (accessed 31 October 2019) (in draft).

Apte, J.S., Messier, K.P., Gani, S., Brauer, M., Kirchstetter, T.W., Lunden, M.M., Marshall, J.D., Portier, C.J., Vermeulen, R.C.H. and Hamburg, S.P. (2017), "High-resolution air pollution mapping with Google street view cars: exploiting big data", *Environmental Science and Technology*, Vol. 51 No. 12, pp. 6999-7008, doi: 10.1021/acs.est.7b00891. (accessed 20 February 2020).

BBC News (2020), "Petrol and diesel car sales ban could start in 12 years, says Shapps", available at: www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law (accessed 5 June 2020).

Bobba, S., Mathieux, F. and Blengini, G.A. (2019), "How will second-use of batteries affect stocks and flows in the EU? A model for traction Li-ion batteries", *Resources, Conservation and Recycling*, Vol. 145, pp. 279-291, doi: 10.1016/j.resconrec.2019.02.022. (accessed 5 June 2020).

Bobba, S., Podias, A., Di Persio, F., Messagie, M., Tecchio, P., Cusenza, M., Eynard, U., Mathieux, F. and Pfrang, A. (2018), "Sustainability assessment of second life application of automotive batteries", JRC Technical Reports, available at: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC112543/saslab_final_report_2018_2018-08-28.pdf (accessed 5 June 2020).

Bressanelli, G., Adrodegari, F., Perona, M. and Sacconi, N. (2018), "Exploring how usage-focused business models enable circular economy through", *Digital Technologies Sustainability*, Vol. 10 No. 3, pp. 639-660.

Climate Change Act (2008), (c.27) [Online] London: The Stationary Office, available at: www.legislation.gov.uk/ukpga/2008/27/contents (accessed 11 August 2020).

Commission for Environmental Cooperation (2015), "Environmentally sound management of end-of-life batteries from electric-drive vehicles in North America", CEC Project Report, available at: www3.cec.org/islandora/en/item/11637-environmentally-sound-management-end-life-batteriesfrom-electric-drive-vehicles-en.pdf (accessed 20 February 2020).

Committee on Climate Change (2019), "Net zero the UK's contribution to stopping global warming committee on climate change", available at: www.theccc.org.uk/publications (accessed 20 February 2020).

Department for Business, Energy and Industrial Strategy and The Rt Hon Chris Skidmore (2019), "UK becomes first major economy to pass net zero emissions law", Gov.uk, available at: www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law (accessed 5 June 2020).

Department of Transport (2018), "The road to zero. Next steps towards cleaner road transport and delivering our industrial strategy", Department of Transport, available at: www.gov.uk/dft (accessed 20 February 2020). JPPEL 12,3 248

Estarrona, U M D., Seneviratne, D., Villarejo, R. and Galar, D. (2019), "The new asset management: Implications of servitization in circular economy", Journal of Industrial Engineering and Management Science, Vol. 2018 No. 1, pp. 109-120.

European Commission (2015), "Closing the loop – an EU action plan for the circular economy", available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52015DC0614> (accessed 26 February 2020).

European Commission (2018), "Report on raw material for battery applications", available at: https://ec.europa.eu/commission/sites/beta-political/files/report-building-strategic-battery-value-chainapril2019_en.pdf (accessed 26 February 2020).

European Commission (2019), "Commission publishes evaluation of the EU batteries directive of European commission", available at: https://ec.europa.eu/info/news/commission-publishesevaluation-eu-batteries-directive-2019-apr-09-0_en (accessed 21 February 2020).

Hill, N., Clarke, D., Blair, L. and Menadue, H. (2019), "Circular economy perspectives for the management of batteries used in electric vehicles 'European commission draft project report'", Public Office of the European Union, doi: 10.2760/537140 (accessed 20 December 2019).

Hirst, D., Butcher, L. and Hinson, S. (2018), "Electric vehicles and infrastructure", House of Commons Library, doi: 10.1007/978-3-540-33037-0_13.

Hou, L. (2019), "New guidelines regulate battery recycling sector", China Daily, available at www.chinadaily.com.cn/a/201905/20/WS5ce1f286a3104842260bc865.html%3E (accessed 20 December 2019).

International Energy Agency (2018), "Global EV outlook 2018", available at: <https://webstore.iea.org/global-ev-outlook-2018> (accessed 17 February 2020).

Jolly, J. (2020), "UK could ban sale of petrol and diesel cars in 12 years, says Shapps", The Guardian, available at: www.theguardian.com/environment/2020/feb/12/uk-ban-sale-petrol-diesel-cars-shappstransport (accessed 23 February 2020).

Kampker, A. (2016), "Evaluation of a remanufacturing for lithium ion batteries from electric cars", International Journal of Mechanical and Mechatronics Engineering, Vol. 10 No. 12, pp. 1922-1928.

Lee, R. and Stokes, E. (2008), "Rehabilitating the definition of waste: is it fully recovered?", YEEL, Vol. 162, pp. 179-180.

Loughran, J. (2018), "Japan's first electric car battery recycling plant to sell old batteries at half price", Engineering and Technology, available at: <https://eandt.theiet.org/content/articles/2018/03/japan-sfirst-electric-car-battery-recycling-plant-to-sell-old-batteries-at-half-price/> (accessed 5 June 2020).

Melin, H.E (2018), "The Lithium-Ion battery end-of-Life market 2018-2025", available at: www3.weforum.org/docs/GBA_EOL_baseline_Circular_Energy_Storage.pdf (accessed 26 February 2020).

National Grid (2018), "Future energy scenarios system operator", available at: <http://fes.nationalgrid.com/media/1363/fes-interactive-version-final.pdf> (accessed 20 February 2020).

Neely, N. (2007), "Exploring the financial consequences of servitisation of manufacturing", Operations Management Research, Vol. 1 No. 2, pp. 103-118.

Office for Low Emission Vehicles (2015), "Uptake of ultra low emission vehicles in the UK", available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/464763/uptake-of-ulev-uk.pdf (accessed 12 June 2020).

Paris Agreement to the United Nations Framework Convention on Climate Change (2015), available at: https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf (accessed 27 February 2020).

Sacciani, N. (2012), "Servitisation strategies and sourcing decisions for product services: an exploratory study", International Journal of Industrial and Systems Engineering, Vol. 10 No. 3, pp. 336-354.

Spears, J. (2015), "Electric vehicles and critical metals", SETIS Magazine, No. 8, p. 14. Electric vehicle batteries 249

Spring, M. and Araujo, L. (2017), "Product biographies in servitization and the circular economy", Industrial Marketing Management, Vol. 60, pp. 126-137.

Trafigura Research Report (2018), "Meeting the EV challenge: responsible sourcing in the electric vehicle battery", available at: www.trafigura.com/brochure/meeting-the-evchallenge-responsible-sourcing-in-the-electric-vehicle-battery-supply-chain (accessed 15 February 2020).

Tytgat, J. (2013), "The recycling efficiency of Li-ion EV batteries according to the EC regulation, and the relation with the end-of-life vehicles directive recycling rate", World Electric Vehicle Journal, Vol. 6 No. 4, p. 1039.

Tytgat, J. and Tomboy, W. (2017), “New insights into residual value: RECHARGE perspective”, 5th E-Mobility Stateholder Forum.

Zhao, S., Li, G., He, W., Huang, J. and Zhu, H. (2019), “Recovery methods and regulation status of waste lithium-ion batteries in China: a mini review”, *Waste Management and Research*, Vol. 37 No. 11, pp. 1142-1152.

Further reading:

Department of Environment Food and Rural Affairs (2018), “Our waste, our resources: a strategy for England”, HM Government.

Directive 2000/53/EC of the European Parliament and of the Council of 18th September 2000 on end-of life vehicles OJ L 269/1.

Directive 2006/66/EC of the European Parliament and of the Council of 6th September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC OJ 266/1.

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.

Directive 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste OJ L 150.

Faraday Institution, ReLiB project (2020), “Recycling and reuse”, available at: <https://faraday.ac.uk/research/lithium-ion/recycle-reuse> (accessed 25 February 2020).

Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC.

Report from the Commission (2017), Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the Implementation of Directive 2000/53/EC on End-Of-Life Vehicles for the periods 2008-2011 and 2011-2014; COM(2017) 98 final.

Appendix 2: Steering Extended Producer Responsibility for Electric Vehicle

Batteries

Citation: Dawson L, Ahuja J and Lee R, 'Steering Extended Producer Responsibility for Electric Vehicle Batteries' (2021) 23 Environmental Law Review 128. DOI: <https://doi.org/10.1177/14614529211006069>

Section 1: Introduction

The Prime Minister of the United Kingdom (UK) recently announced that the prohibition on sales of new petrol and diesel vehicles will be brought forward to 2030 from 2040.¹ The electric vehicle (EV) revolution is advancing rapidly. This is welcome for the many potential environmental and health benefits that should result from the decarbonisation of transport. However, the full potential of this revolution can only be unlocked alongside timely planning to support appropriate end-of-life management of EVs in a way that is compatible with the principle of the Circular Economy; which seeks to keep resources in use for as long as possible. Amongst the most complex and urgent of issues that must be addressed in this context is the need to ensure safe and sustainable management of the vehicles' batteries (most commonly, lithium-ion batteries: hereafter, LIBs) at the end of their first life in an EV.²

¹ Prime Minister's Office, Press Release on Green industrial Revolution 18 November 2020 at: <https://www.gov.uk/government/news/pm-outlines-his-ten-point-plan-for-a-green-industrial-revolution-for-250000-jobs>; see earlier Department for Transport, 'Consulting on ending the sale of new petrol, diesel and hybrid cars and vans' (2020). Available at: <https://www.gov.uk/government/consultations/consulting-on-ending-the-sale-of-new-petrol-diesel-and-hybrid-cars-and-vans/consulting-on-ending-the-sale-of-new-petrol-diesel-and-hybrid-cars-and-vans> (accessed 20th September 2020)

² G. Harper and others, 'Recycling lithium-ion batteries from electric vehicles' (2019) 575 Nature 78 - 86.

Technological advancement in the field of EVs has raised new end-of-life management challenges that previous end-of-life vehicle (ELV) and battery legislation felt little need to address. The size, weight and power of EV LIBs, coupled with the significant variations in their design and chemical complexity, presents unique challenges to their recycling and reuse. Lead-acid batteries used in traditional automobiles for ignition and lighting have achieved significant take-back and recycling rates (the mooted figure is above 90%³; with four fifths of European Union (EU) member-states at least achieving at least 75%⁴) with relative ease due to lead-acid battery standardisation and the high return of recoverable lead contained within such batteries. By contrast, the current complexities of EV LIB recycling suggest that as volumes of spent EV batteries grow, significant waste management problems will arise, unless appropriate infrastructure and governance systems are developed to manage this.⁵ Crucially, EV LIBs retain significant capacity at the end of their first life when they are no longer able to power an EV.⁶ These LIBs also continue to house valuable rare and critical materials, whereas inappropriate disposal can lead to a loss of valuable materials without utilising the residual capacity contained in the battery. Disposal may also present risks of serious injury to health and the environment (for example through explosions, toxic gas emissions, fires and leachate).

³ European Commission, 'Evaluation of the Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC' SWD (2019) 1300 final 25. Available at: https://ec.europa.eu/environment/waste/batteries/pdf/evaluation_report_batteries_directive.pdf (accessed 13th October 2020)

⁴ Eurostat, 'Waste statistics - recycling of batteries and accumulators' (2020). Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics_-_recycling_of_batteries_and_accumulators&oldid=491889 (accessed 13th October 2020)

⁵ See G. Harper, above n. 2.

⁶ Ibid.

This paper suggests that current regulatory mechanisms for end-of-life battery management (primarily enshrined in the 2006 Batteries Directive (2006/66/EC),⁷ which operates in conjunction with the 2000 End-of-Life Vehicles (ELV) Directive (2000/53/EC)⁸ fail to provide a sufficiently robust EPR framework to facilitate a Circular Economy for EV batteries in the UK. The paper explores why regulation, as it presently stands, is ill-equipped to handle the waste implications of electric mobility. It suggests how regulation may be strengthened in the UK's post-Brexit era to facilitate a battery Circular Economy. Importantly, the EU has recently (December 2020) released a proposal⁹ for new battery regulations that will address some deficiencies in the 2006 Directive. Although we focus here mainly on the 2006 Directive (currently in force at the time of writing), we will, where relevant, discuss the anticipated direction of future regulations as outlined in the new proposals.

Section 2 of the paper clarifies the EV battery problem, and explains why a Circular Economy is not likely to shape itself in this area without policy and regulatory interventions. Moreover, timeframes are short given the projected scale and volume of end-of-life EV LIBs that will need to be processed in the near future. EV LIB recycling and reuse represents a tough challenge due to (*inter alia*) limitations of technology, lack of UK facilities and infrastructure, as well as the ill-adapted regulatory framework. Section 3 explores the concept of extended producer responsibility (EPR) and its value in facilitating a Circular Economy through responsible management of end-of-life products. We cite evidence from other waste streams

⁷ Council Directive 2006/66/EC (OJ L 266/12 6.9.2006) on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC.

⁸ Council Directive 2000/53/EC (OJ L 269 21.10.2000) on end-of life vehicles.

⁹ European Commission, Proposal for a regulation of the European Parliament and of the Council concerning batteries and waste batteries, repealing Directive 2006/66/EC and amending Regulation (EU) No 2019/1020 (2020) Available at: https://ec.europa.eu/environment/waste/batteries/pdf/Proposal_for_a_Regulation_on_batteries_and_waste_batteries.pdf (Accessed on 18th February 2021)

to show how robust EPR frameworks can benefit environmental and sustainability goals, and promote more responsible handling of valuable or hazardous waste. Section 4, considers current UK ELV regulation, and Section 5 reviews the Batteries Directive. These sections highlight legislative gaps, and oddities such as the lack of integrated take-back and recycling targets, as well as definitional uncertainty. Section 6, which concludes the paper, suggests how battery regulation post-Brexit, may be revised, through robust EPR frameworks, to manage the EV transition more effectively. Here, we recommend that a newly formed, EV specific EPR scheme may be necessary to deal adequately with the expected exponential increase in ELV EV batteries.

Section 2: The EV battery problem: volumes and lifespan

Although EV LIBs are durable, they have a finite lifespan.¹⁰ Current evidence suggests that once the effective charging capacity of the battery has fallen to about 75-80% of the original capacity, it is no longer optimal for providing traction for EVs.¹¹ However, the battery will still contain significant residual capacity at this point; this represents both opportunities and threats. The large residual power means that the battery needs careful management when discarded from EV use, as there are significant potential risks of electrocution, fire, explosions and from chemical toxicity. At the same time, the residual power can be an opportunity to extract further value from the battery: already, such batteries are being put to

¹⁰ Trafigura, 'Meeting the EV challenge: Responsible sourcing in the electric vehicle battery supply chain' (2020). Available at: https://www.trafigura.com/media/1268/2018_trafigura_responsible_sourcing_in_the_electric_vehicle_battery_supply_c.pdf (accessed 13th October 2020)

¹¹ L. Canals Casals, M. Barbero, C. Corchero, 'Reused second life batteries for aggregated demand response services' (2019) 212 *Journal of Cleaner Production* 99-108 Available at: <http://www.sciencedirect.com/science/article/pii/S0959652618337077> (Accessed 29th January 2021)

several other less demanding second-use applications, such as stationary energy storage systems, including home or neighbourhood back-up power systems or grid power buffering strategies.¹² If it is assumed that the first-life period of an EV battery is 8-10 years, studies estimate that the number of lithium-ion batteries becoming available globally per annum for remanufacturing, recycling and repurposing is likely to exceed 3,000,000 between 2029 and 2032 as well as reaching 50% of new vehicle demand between 2020 and 2033.¹³

LIBs contain a variety of valuable, critical materials (including nickel, cobalt, lithium and graphite) and as such, they provide a significant potential opportunity for obtaining value from material recycling, recovery and reuse. The main options for end-of-life management of EV LIBs are recycling or second-use of spent batteries. However, there are a number of challenges surrounding both of these options.¹⁴ Neither LIB second-use practices, nor recycling processes in this new and emerging technology are as yet fully developed. As a result, ongoing research is still needed to identify the most efficient processes. As the growth of e-mobility is a relatively recent phenomenon, few EV LIBs have reached the end of their first life, thus volumes are not yet sufficient for large-scale recycling to be economically profitable. Safe and sustainable EV LIB management systems will not only require planning but will also need to be steered through effective regulation. This paper highlights how sound EPR frameworks for EV batteries can contribute to this.

¹² European Commission (2018), 'Sustainability assessment of second-life applications of automotive batteries (SASLAB)' Technical report. Available at: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC112543/saslab_final_report_2018_2018-08-28.pdf (accessed 13th October 2020)

¹³ M. Foster and others, 'Feasibility Assessment of remanufacturing, repurposing, and recycling end-of-vehicle application lithium-ion batteries' (2014) 7(3) *Journal of Industrial Engineering and Management* 698

¹⁴ See European Commission, above n. 12.

The number of licensed ultra-low emissions vehicles on UK roads is rising steadily year-on-year. Projections from the National Grid suggest that the stock of EVs in the UK could reach between 2.7 and 10.6 million by 2030, rising to as much as 36 million by 2040.¹⁵ The *UK Government's* 2018 Road to Zero strategy aims to drive this forward. The strategy largely focuses on replacing petrol and diesel vehicles with low and zero emission EVs: a move which is identified as having a crucial role in the 'least cost pathway' to achieving the UK's 2050 climate change targets. To do so the Government set the target that by 2050 almost every car and van will be zero-emission, and is now committed to phasing out new petrol-diesel cars by 2030 to accelerate the EV transition.¹⁶ According to the International Energy Agency's 2017 EV outlook, these figures place the UK fourth worldwide by EV market share, and seventh by volume.¹⁷

Forecasts of the annual weight of EV batteries to be managed suggest that over 16,000 tonnes of end-of-life EV battery packs will need to be reprocessed as they leave the UK vehicle market by 2028 though this may accelerate if there is to be a phase out of petrol-diesel cars by 2030.¹⁸ Foster and others estimate that the number of LIBs becoming available globally per annum for remanufacturing, recycling and repurposing is likely to exceed 3,000,000 between 2029 and 2032¹⁹. The International Energy Agency (2020) estimates that 100-120 Gigawatt hours of EV batteries will be retired by 2030, a volume roughly equivalent to current annual battery production, warning that without effective

¹⁵ National Grid, 'Future Energy Scenarios' (2018). Available at: <http://fes.nationalgrid.com/media/1363/fes-interactive-version-final.pdf> (accessed on 20th September 2020)

¹⁶ See Prime Minister's Office, above n. 1.

¹⁷ International Energy Agency, 'Global EV Outlook 2017' (2017). Available at: <https://www.cleanenergyministerial.org/sites/default/files/2018-07/GlobalEVOutlook2017.pdf> (accessed 20th September 2020)

¹⁸ Faraday Institution, 'Recycling and Reuse' (2020). Available at: <https://faraday.ac.uk/research/lithium-ion/recycle-reuse/> (accessed 13th October 2020)

¹⁹ See Foster, above n. 13 at 698.

measures to address such volumes, this could become a significant environmental liability.²⁰ Estimates of the global tonnage of spent LIBs discarded by 2030 range from 11 million tonnes to 16 million tonnes.²¹ The rapid uptake of EVs in China, for example, has resulted in projections for 120,000 - 200,000 tonnes of LIBs for recycling in 2020.²² This has been facilitated by a number of strategic measures at the local, state and national level in China: for example, a number of Chinese cities such as Shenzhen now have a fully electrified bus fleet.²³ With similar schemes being rapidly developed across the UK and the EU²⁴; this provides some idea of the potential volumes of spent EV batteries that we will need to deal with in the near future.

Despite the anticipated volume of EV LIBs that will soon need to be managed, the UK does not currently have any LIB recycling facilities or infrastructure. Some end-of-life LIBs are exported at present for recycling, mainly to the EU (e.g., to facilities in Belgium).²⁵ This export will become more problematic after 2025 when volumes rise substantially due to issues around processing capacity, transport, safety and waste shipment regulations.²⁶ Moreover, the handling and transportation of end-of-life LIBs requires a good degree of care,

²⁰ International Energy Agency, 'Global EV Outlook' (2020). Available at: <https://www.iea.org/reports/global-ev-outlook-2020#batteries-an-essential-technology-to-electrify-road-transport> (accessed 13th October 2020)

²¹ See Trafigura, above n.10.

²² I Slav, 'China sets up EV battery recycling scheme' (OilPrice.com, 2018). Available at: <https://oilprice.com/Energy-General/China-Sets-Up-EV-Battery-Recycling-Scheme.html> (accessed 10th September 2020)

²³ A. Evers, 'Why the US has been slow to adopt electric buses' (CNBC, 2019). Available at: <https://www.cnn.com/2019/09/28/electric-buses-are-taking-over-china-and-the-us-is-trying-to-catch-up.html> (accessed 10th September 2020)

²⁴ Department for Transport, 'Coventry and Oxford set to be UK's first all-electric bus cities' (2021), <https://www.gov.uk/government/news/coventry-and-oxford-set-to-be-uks-first-all-electric-bus-cities>; accessed 19 February 2021

²⁵ J. Ahuja, L. Dawson and R. Lee, 'A Circular Economy for Electric Vehicles EV Batteries: Driving the Change' 12(3) Journal of Property Planning and Environmental Law 235 - 250

²⁶ R. Lee and J. Ahuja, 'The Importance of Coherent Regulatory and Policy Strategies for the Recycling of EV Batteries' [2020] Faraday Insights 9 <https://faraday.ac.uk/wp-content/uploads/2020/09/Faraday_Insights_9_FINAL.pdf> accessed 30 November 2020.

leading to high transportation costs. Environmental considerations, and current regulation prevent the disposal of LIBs in landfills. Further, EU regulations may restrict exporting end-of-life LIBs in the future (post-Brexit, from 1st January 2021, the UK will be treated as a third country for the purposes of waste shipment).²⁷ As such, and owing to current low levels of LIB take-back, it is difficult to ascertain how vehicle manufacturers intend to proceed post Brexit, when volumes of EV batteries that have reached the end of their first life begin to rise substantially.

Evidence suggests that recovery of battery materials through recycling has many environmental benefits, such as reduced energy demand, conservation of natural resources, lower toxicity potential of secondary materials and reduced greenhouse gas emissions: thus battery recycling can potentially fulfil several crucial EU and UK goals²⁸ (for example, lead-acid battery recycling, which produces secondary lead, results in the reduction of greenhouse gas emissions by two thirds compared to primary production of lead; and the human toxicity potential for producing primary lead is about 18 times higher compared to that of secondary lead).²⁹ The multiple potential environmental and economic benefits of battery recycling make it crucial to develop regulatory frameworks that support improvements in recycling efficiencies and infrastructure for the high-growth sector of EV LIBs. It is essential that efficient systems for managing LIBs from EVs are developed if their widespread use is to be sustainable, and it is imperative that these are deployed in the UK if it is to be a major manufacturer and consumer of EVs.

²⁷ As from 1 January 2021, the UK will be treated as a third country for the purposes of Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste.

²⁸ See European Commission, above n. 3 at 4.

²⁹ Ibid. at 4

Section 3: What is EPR?

Since the late 1980's, EPR has been a ubiquitous regulatory tool used to combat the potential environmental and health effects that products can pose, particularly where a product has reached the end of its useful life.³⁰ As a result, over 400 EPR schemes are now known to be in existence worldwide,³¹ with the EU championing such policies.³² EPR, which acts as an extension of the polluters pays principle and the prevention principle within the EU,³³ has two main aims: one, to reduce the immediate environmental impact of the product via mitigating the product's harm at the end of its life, and the other, to influence the long-term design of a product.³⁴ EPR seeks to achieve these aims via passing responsibility for the whole life-cycle (but focusing particularly on waste) of a targeted product to producers. In consequence, this can result in the producer having various physical and/or financial responsibilities for a marketed product throughout its life, and thereafter at the end-of-life. Typical responsibilities may include design restrictions, as well as collection, treatment and recycling/reuse obligations. In addition to the benefits detailed above, EPR is also an effective regulatory tool in transitioning economics from the traditional linear model of disposal which evolves around single-use to one which promotes circularity. Circularity means that goods travel in a resource-efficient, continuous circular motion through the

³⁰ L. Dawson, "'Our Waste, our Resources; A Strategy for England' – Switching to a Circular Economy through the use of extended producer responsibility" (2019) 21(2) Environmental Law Review 210-218

³¹ Organisation for Economic Co-operation and Development, 'Extended Producer Responsibility – Guidance for Efficient Waste Management' (OECD, 2016). Available at:

<https://www.oecd.org/environment/waste/Extended-producer-responsibility-Policy-Highlights-2016-web.pdf> (accessed 13th October 2020)

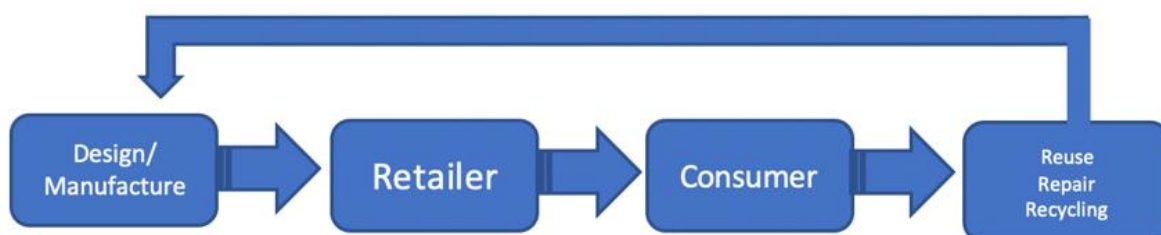
³² The EU has introduced explicit EPR policy directives in 3 waste streams to include: batteries, end-of-life vehicles and waste electronic and electrical equipment. A 4th waste stream, which does not explicitly mandate the use of EPR policy (although most member states have implemented the directive in the form of EPR) is in relation to waste plastic packaging.

³³ Article 191(2) TFEU. The EU introduced the 'producer pays principle' under Council Directive 2008/98/EC (OJ L 312, 22.11.2008) on waste and repealing certain Directives, Art. 8.

³⁴ See OECD, above n. 31

different stages of its life-cycle (i.e design/manufacture -> distributor -> consumer -> reuse/repair/recycling -> design/manufacture... and so on), see *Figure 1*.

*Figure 1.*³⁵



In implementing EPR, legislation often demands that producers meet their extended responsibilities through individual or collective schemes.³⁶ The concept of individual responsibility is based on the premise that producers, individually, should bear the physical and/or financial burden for their own product. This can benefit the Circular Economy goals in many ways: e.g., it may incentivise the producer to eco-design their product as the costs for recycling will be lower, which would improve recycling efficiency. If producers eco-design their products by, for example, making them easier to disassemble, or by ensuring compatibility with current recycling techniques and environmental standards, then this can significantly reduce the end-of-life management costs for the producer as well as offer many environmental benefits. Individual responsibility models of EPR may be suited to a ‘closed-loop’ Circular Economy, which aims to backhaul products that can thereafter be recycled and those same materials are used to make the same product. A looped system such as this gives certainty of material quality and security to the producer. A simple example might

³⁵ See J. Ahuja, above n. 25

³⁶ Council Directive 2018/851/EC (OJ L 150, 14.6.2018) amending Directive 2008/98/EC on Waste Art, 1(3)(h)

be where a tin-can is recycled and the material is modeled back into a tin-can by the original producer, ready for resale.³⁷ However, individual responsibility will undoubtedly increase costs associated with logistics.³⁸ On the other hand, collective responsibility enables producers to discharge their burden of responsibility as a 'group'. This usually operates via producers funding a 'producer responsible organisation', which takes on and discharges the burden of responsibility on behalf of the obligated producer for a fee. This could include the producers' administrative, collection, treatment and recycling responsibilities. Such collective responsibility schemes may, in some instances, stifle any incentive to eco-design, but may ultimately be easier to introduce.³⁹ As such, most EPR schemes are designed to include an element of collective responsibility; individual responsibility is optimal, but seldom used.⁴⁰

EPR has demonstrated effectiveness in managing end-of-life waste. It was first conceptualised in Sweden during the 1990s⁴¹ and came to regulatory fruition in Germany under the 1991 Packaging Ordinance.⁴² The Ordinance sought to place regulatory EPR responsibility on producers to collectively take-back and recycle a targeted percentage of waste packaging from manufacturers and their distributors. In the early years of implementation, Germany saw a drop of 1 million tonnes in packaging use, and 66% of

³⁷ F. Schultmann, M. Zumkeller, O. Rentz, 'Modelling reverse logistic tasks within closed-loop supply chains: An example from the automotive industry' (2006), 171 *European Journal of Operational Research* 1033.

³⁸ A. Atasu, R. Subramanian, 'Extended Producer Responsibility for E-Waste: Individual or Collective Producer Responsibility' (2012) 21 *Production and Operations Management* 1042–59.

³⁹ *Ibid.*

⁴⁰ EXPRA, 'Extended Producer Responsibility at a Glance' (2016). Available at: http://www.expra.eu/uploads/downloads/EXPRA%20EPR%20Paper_March_2016.pdf (accessed 19 May 2020)

⁴¹ T. Linqhqvist, 'Extended Producer Responsibility in Cleaner Production: Policy Principle to Promote Environmental Improvements of Product Systems' (PhD Thesis, Lund University 2000).

⁴² Packaging Ordinance 1991, Federal Law Gazette I, page 1434

producers had optimised at least 50% of their packaging.⁴³ Some commentators saw the Ordinance as highly problematic due to a continued low market demand for waste plastic packaging within Germany. This led to increased amounts of waste packaging entering other EU member-states markets; thus, acting as a disincentive for domestic collection and recycling of member-state packaging. However, this resulted in harmonised action from the EU, by way of the Waste Packaging Directive (Directive 94/62/EC)⁴⁴. Another example of EPR success is evidenced in the Japanese Electric Household Appliance Recycling Law which was first enacted in 2001 and aimed to shift waste responsibility from government to producers for refrigerators, washing machines, air conditioners and TVs.⁴⁵ Here, distributors take responsibility for transporting targeted goods from final users to producers so as to facilitate recycling. Since 2008, all targeted goods have seen a recycling rate of between 74%-91%, which is up from a range of 56%-78% in 2001.⁴⁶

Globally, there is now a continued drive towards enacting EPR policy; the EU has enacted 4 waste streams that contain EPR principles, namely batteries, end-of-life vehicles, waste packaging and waste electronic and electrical equipment (the first two streams being the focus of this paper). Experience from such waste streams globally have shown that EPR policy is effective in raising consumer awareness, expanding waste collection infrastructure, and shifting costs of end-of-life management from municipalities to producers or stewardship

⁴³ Organisation for Economic Co-operation and Development, 'Case study on the German Packaging ordinance (1998). Available at: [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&cote=env/epoc/ppc\(97\)21/rev2](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&cote=env/epoc/ppc(97)21/rev2) (accessed 11 May 2020).

⁴⁴ Council Directive 94/62/EC (OJ L 365, 31.12.1994) on Packaging and Waste Packaging.

⁴⁵ M. Yamaguchi, 'Extended Producer Responsibility in Japan' 19 ECP Newsletter (JEMAI) 12. Available at: [EPR in Japan 2002 ECP No19.pdf](#) (accessed 13th October 2020)

⁴⁶ Y. Hotta, A. Santo and T. Tasaki, 'EPR-Based Electronic Home Appliance Recycling System under Home Appliance Recycling Act of Japan' (OECD, 2014) 15. Available at: https://www.oecd.org/environment/waste/EPR_Japan_HomeAppliance.pdf (accessed 18 May 2020).

organizations, thus easing the cost burden for local and central governments. In addition, EPR offers a number of other potential benefits, such as, encouraging producers to internalise life-cycle costs, and promoting environmental benefits through improved product design, reverse logistics, closed loop supply chains, and resource recovery.⁴⁷

Section 4: End-of-Life Vehicles and Extended Producer Responsibility in the UK

The End of Life Vehicles (ELV) Directive introduced EPR for vehicle manufacturers in relation to vehicles coming off the market. Manufacturers must take-back their products, in order to reuse, recycle or remanufacture, either directly or in association with one or more networks of treatment companies or via a collective scheme.⁴⁸ In 2015, the targets for ELVs (set by reference to vehicle weight) were raised so that there must be 85% reuse or recycling rising to 95% by the inclusion of recovery (mainly incineration for energy).

This EPR structure, devised at the end of the twentieth century, envisioned the recycling of internal combustion engine vehicles rather than EV equivalents and as such it does not directly address responsibility for the battery pack. On the one hand it may seem obvious that, as part of the vehicle, the EV battery must be included in the EPR scheme and its targets. The battery may constitute up to 20% of the weight of the vehicle, so meeting of ELV targets should necessarily include the battery. On the other hand, there is a separate regulatory regime, also incorporating EPR principles in relation to batteries more generally

⁴⁷ J. Turner and L. Nugent, 'Charging up battery recycling policies: extended producer responsibility for single-use batteries in the European Union, Canada and the United States' (2016) 20(5) *Journal of Industrial Ecology* 1148-1158.

⁴⁸ See Council Directive 2006/66/EC, above n. 7 at Article 8 (3).

under the Batteries Directive.⁴⁹ Again, given its history, the Directive (discussed further in Section 5) inadequately addresses EV batteries. ‘Automotive batteries’ under the Batteries Directive are restricted to ‘any battery or accumulator used for automotive starter, lighting or ignition power’.⁵⁰ In internal combustion engine vehicles this will ordinarily be a lead acid battery for which (as we have seen) there are strong market-based recycling incentives.⁵¹ In contrast, lithium-ion EV batteries are classed as industrial. Although this issue is dealt with in more detail in section 6, it is important to note here that the Batteries Directive defines an industrial battery as any battery or accumulator designed for exclusively industrial or professional uses or used in any type of EV.⁵² There is a misnomer, therefore, in labelling an EV battery in everyday consumer use as ‘industrial’. The European Commission has acknowledged the problems with this, particularly in view of the impending rise in numbers of EV batteries that will be placed on the market, noting that for industrial batteries the Directive only vaguely regulates the obligations stemming from the extended producer responsibility principle.’⁵³

The revision of the 2006 Directive addresses the current vagaries of regulation (see Section 5) and has been anticipated for some time. The new 2020 European Commission proposals⁵⁴ now finally provides some indications about the likely form of that revision. The current preferred option, according to the proposals, is to introduce a new discrete category for EV batteries, which will be defined as ‘any battery specifically designed to provide traction

⁴⁹ *ibid.*

⁵⁰ *Ibid.* at Article 3(5).

⁵¹ See Eurostat, above n. 4 and section 1 of the paper.

⁵² See Council Directive 2006/66/EC, above n. 7 at Article 3(6).

⁵³ See European Commission, above n. 3 at 58; also see further Section 5..

⁵⁴ See European Commission, above n. 9

to hybrid and electric vehicles for road transport'.⁵⁵ It is less clear what the English response, promised in the Resources and Waste Strategy for England,⁵⁶ will be and how closely this will align to the EU review either in terms of definitions or targets (this issue is discussed further in Section 5).

In the meanwhile, the regulatory structure for EV LIBs straddles the two directives in a somewhat unsatisfactory manner. For example, there are contrasting processes of take-back and differing targets under the two Directives. The Batteries Directive does not currently set targets for the take-back of industrial batteries, though it does demand that these should be collected on request. There are targets for the recycling of industrial batteries but unlike the ELV Directive, these are not simply weight-based but (for industrial batteries) instead set as a recycling efficiency target of 50% by average weight. Not only is this a complex equation but the ease with which that recycling efficiency target can be met will vary considerably depending on battery chemistry (discussed further in Section 5, n63). The 2020 European Commission proposals indicate plans to introduce increased reporting obligations for EV battery producers,⁵⁷ along with higher recycling efficiency targets (although they are unlikely to impose any explicit collection targets for EV/automotive batteries: the proposals indicate this is not the current preferred option).

In practice, there seems no major issue with the take-back of industrial batteries, but to date the vast majority of such batteries would not emanate, in large quantities, from EVs (this may change in the future as EV uptake rises and present EV fleets start to age). Effective

⁵⁵ See European Commission, above n. 9, Article 2(12)

⁵⁶ HM Government, 'Our Waste, Our Resources: A Strategy for England' (London: The Stationery Office, 2018) 4.

⁵⁷ See European Commission, above n. 9, p 9

take-back may be unsurprising in that the Directive prohibits the landfill or incineration of industrial batteries.⁵⁸ Turning to the ELV Directive, this demands that producers must provide a suitable network of authorised treatment facilities, or make approved alternative arrangements, offering free take-back for their vehicles. In the UK, verification of a vehicle is provided by the authorised treatment facility issuing a certificate of destruction (without charge to the owner), which will allow the Driver and Vehicle Licensing Agency to de-register the vehicle. It is estimated that 1.8 million cars leave the market every year, but that there is a shortfall of between 500,000 to 800,000 certificates of destruction meaning that there is considerable 'leakage' in the system.⁵⁹ This may result in part from owners, who are required to check that a facility is approved and licensed, failing to appreciate what constitutes an approved route of disposal.

Since the vehicle will contain certain hazardous materials, until the point that it is depolluted, an ELV should be treated as hazardous waste.⁶⁰ Depollution will involve the removal of fluids and other hazardous substances and components. The EV battery pack may be considered hazardous in the general sense of that word and should doubtless be removed as part of the treatment process, though regulatory clarity on this point would be welcome. Given the weight-based targets under the ELV Directive, referred to at the beginning of this section, a weighty EV battery will need to be the subject of reuse, recycling or recovery. One must bear in mind that incineration of the battery is prohibited (see above) but recovery processes based on pyrometallurgy are in use⁶¹ and presumably not classed as incineration (but again

⁵⁸ See Council Directive 2006/66/EC, above n. 7 at Article 14.

⁵⁹ G. Williams, 'ELVs: Carrot or Stick?' (2017) *CIWM Journal* 59. Available at: http://uk.emrgroup.com/files/ciwm-may-2017_emr.pdf (accessed 13th October 2020).

⁶⁰ See Council Directive 2000/53/EC, above n. 8 at Article 6.

⁶¹ S. Zhao and others, 'Recovery methods and regulation status of waste lithium-ion batteries in China: a mini review' (2019) 37 (11) *Waste Management and Research*, 1142 - 1152

clarity would be welcome). Note, however, that battery reuse counts towards ELV targets. This suggests that obligations under the ELV Directive are met at the point at which the EV battery enters second-use. This raises a difficult question: who presently bears the responsibility for that battery when it leaves that repurposed use? It would be odd and somewhat unfair if the producer having once met obligations under the ELV Directive now faced further obligations under the Batteries Directive.

To address this dilemma, one needs to consider what is meant by reuse. If reuse is limited to use of the battery for the same purpose (as a vehicle battery) so that repurposing was not 'reuse' then only batteries retained to drive vehicles would be considered as reused. Repurposed batteries would not meet ELV targets, though such batteries would constitute waste as soon as the car owner chose to discard the vehicle⁶² rather than goods sold contractually for another purpose. One solution would be to accept that reuse includes repurposing. This would have some advantages but might create havoc in assessing targets if the same batteries are subject to double counting. The ELV Directive is ambiguous in this regard, defining reuse as "any operation by which components of end-of-life vehicles are used for the same purpose for which they were conceived."⁶³ EV batteries are designed to store energy but, acting as the drive engine of a vehicle, should they be regarded as 'conceived' for a purpose other than simple energy storage? If so, a battery repurposed for energy storage alone should not necessarily be regarded as used 'for the same purpose for which they were conceived.' The new European Commission proposals indicate a firm intention to clarify dilemmas of EV battery second use, with the current preferred option

⁶² Council Directive 2008/98/EC (*OJ L 312*, 22.11.2008) on waste and repealing certain Directives Article 3(1)

⁶³ See Council Directive 2000/53/EC, above n. 8 at Article 2 (6);

being to designate used batteries as waste at the end of first life (unless they will be reused again as EV batteries). It appears likely that repurposing will be considered a waste treatment operation and repurposed (second life) batteries will be designated as new products.⁶⁴

The European Automobile Manufacturers' Association (ACEA) proposes a definition of second-use, across EU waste legislation to overcome this conundrum.⁶⁵ The ACEA also advocates that the ELV Directive 'should prevail over any other legislation as the ELV Directive deals with the complete vehicle, including any automotive battery or industrial battery.' The position taken here seems to be that the take-back obligation to the vehicle owner should be considered as discharged once the battery pack is taken back as part of the vehicle. The ACEA also states that with regard to 'industrial batteries coming from end-of-life vehicles, (the) End-of-Life Vehicle Directive 2000/53/EC dealing with the complete vehicle should prevail over any other legislation.' This would mean presumably that having discharged its obligations under the ELV Directive an automotive or original equipment manufacturer ought not to face further take-back responsibilities under the Batteries Directive as repurposed batteries reach the end of their life. One can sympathise with this position but it provides no answer as to who does bear the take-back responsibilities for repurposed batteries. To have a comprehensive EPR system for EV batteries, this question requires an answer, and current regulation provides no clear response.

Section 5: Batteries Directive and Extended Producer Responsibility in the UK

⁶⁴ See European Commission, above n. 9, p9 and Article 2(26)

⁶⁵ European Automobile Manufacturers Association, 'Revision of Batteries Directive 2006/66/EC' (EAMA, 2017). Available at: https://www.acea.be/uploads/publications/ACEA_Position_Paper-Revision_of_Batteries_Directive_200666EC.pdf (accessed 18th June 2020)

In trying to influence the immediate environmental impact of batteries, the EU introduced principles of EPR via the 2006 Batteries Directive, which has been transposed and used as the baseline for battery waste management across all European member-states; although note that the newly proposed regulation (see, section 4) seeks to ‘fine-tune’ the Directive’s EPR measures by introducing definitional changes, although its principle remains the same⁶⁶. Before examining how the 2006 Directive has shaped EPR in the batteries sector, let us briefly consider the future of that legislation post-Brexit.

While the EU has published its new batteries regulation, post-Brexit this will not apply to Great Britain. Northern Ireland finds itself in a rather different position by virtue of the Northern Ireland Protocol to the Withdrawal Agreement, as it is obliged to align with certain Single Market rules. Included here are areas such as technical regulation of goods, agriculture and environmental standards. If Northern Ireland is to avoid the need for regulatory checks on the Irish Border then it will need to meet requirements of measures such as the batteries regulation. For Great Britain, the Batteries and Accumulator Regulations 2009 will continue to apply. These regulations transposed the Batteries Directive 2006 using the now repealed powers under section 2(2) of the European Communities Act 1972 and apply for the most part⁶⁷ throughout England, Wales and Scotland. As EU-derived domestic legislation, as it continues to have effect in domestic law by virtue of section 2 of the EU Withdrawal Act 2018. For England at least, however, it is

⁶⁶ See European Commission, above n. 9.

⁶⁷ Reg.56 which governs disposal of batteries does not apply to Scotland (or Northern Ireland) which addressed this issue through Environmental Permitting Regulations.

clear that the 2009 Regulations are subject to review as part of a commitment made under the Resources and Waste Strategy.⁶⁸

A major question for that review is how closely aligned the English regulations (and those of the two other devolved governments) will be to the new EU regulation. Roughly 80% of cars manufactured in the UK are exported and just over half of these go to EU member states.⁶⁹ These vehicles would need to comply with the new batteries regulation so that the EV drive battery would be required to meet (e.g.) battery composition and labelling requirements. Some 85% of UK car imports emanate from the EU⁷⁰ and will arrive with batteries compliant to these requirements. Moreover, given the considerable integration of supply chains across the EU and UK, options to depart radically from the EU legislation may be limited by commercial considerations.

In terms of waste flows, the signing of the Withdrawal Agreement has eased worries that World Trade Organisation tariffs may apply to imports and exports of metal waste. There was early adaptation by the UK in preparation for Brexit of the Transfrontier Shipment of Waste Regulations 2007⁷¹ in the form of the International Waste Shipments (Amendment) (EU Exit) Regulations 2019⁷². With Brexit, the UK becomes a third country but in terms of waste flows it remains a Basel Convention party and an Organisation of Economic Co-operation and Development Decision country in the eyes of the EU, so providing the waste shipment is not for disposal, it will be controlled by established international mechanisms.

⁶⁸ See H M Government, above n. 57, page 38

⁶⁹ European Automobile Manufacturers Association, Brexit and the Auto Industry: Facts and Figures (2019) available at: https://www.acea.be/uploads/news_documents/Brexit-facts_figures_March_2019.pdf

⁷⁰ Ibid.

⁷¹ Transfrontier Shipment of Waste Regulations 2007 SI 2007, No. 1711

⁷² International Waste Shipments (Amendment) (EU Exit) Regulations 2019, SI 2019, No. 590

As with other trade issues there may be teething problems in the change of regime, though regulators are cooperating to prevent this happening. However, the danger in the longer term is whether Northern European capacity for metal recovery and recycling will be able to accommodate third country EV battery waste and whether it makes economic sense for the UK to lose the critical material components to other countries. Bear in mind that the new EU batteries regulation, mandating as it does minimum recycled content in newly produced batteries, may begin to place a premium on recycled metals.

Turning to the work done by the 2006 Directive, it regulates the large amounts of batteries being placed on the European market, and introduces measures to ensure sustainable management at their end-of-life by extending the producers' responsibilities. Here, the Directive contains obligations which burden those who produce and/or manufacture batteries, as they are most able to influence the design of their product so as to facilitate recycling (although, as noted above in section 3, the achievement of this goal is somewhat diluted in collective responsibility schemes). Under the Waste Batteries and Accumulators Regulation 2009, which implemented the Batteries Directive within the UK, the 'producer' includes any person that, irrespective of the selling technique used ... "places batteries, including those incorporated into appliances or vehicles, on the market for the first time in the United Kingdom on a professional basis;"⁷³ This primarily captures the manufacturer but could, in relevant circumstances, capture importers who sell to end users.

The primary objective of the Batteries Directive is to minimise the negative impact of batteries and waste batteries, thus contributing to the protection, preservation and

⁷³ Waste Batteries and Accumulators Regulations 2009, SI 2009, No. 890, Reg 2(1).

improvement of the environment and human health; whilst also ensuring efficient use of resources, reduction in greenhouse gas emissions, and stimulating the EU economy.⁷⁴ The Directive includes provisions that cover the entire life-cycle of batteries (this includes, design, placing on the market and end-of-life): producers are given responsibility for the management of waste batteries that they have placed on the market. However, in discharging these responsibilities, producers are permitted to instruct third-party producer responsible organisations, who in turn execute the EPR burden on behalf of (generally) a collective of producers.

The Directive currently contains three broad categories of batteries: portable, industrial and automotive. Portable batteries are defined as being able to be carried without difficulty, and are sealed (such as an AA battery). Due to their size and ease with which they can be disposed of in municipal waste, such batteries were, at the time the Directive was written, considered the most potentially problematic by the European Commission. Subsequently, they are the focus of the most rigorous provisions within the Directive. By contrast, industrial batteries (defined as those designed solely for industrial or professional use, as well as batteries used in EVs) and automotive batteries (which must act as an automotive starter, lighter or igniter) are subject to less stringent EPR obligations (note, however, that this is likely to change under revised batteries regulations, with the planned introduction of a distinct category for EV batteries).⁷⁵

⁷⁴ See European Commission, above n. 3 at 5.

⁷⁵ See European Commission, above n. 9, Article 2(12)

EVs are used predominantly by private individuals, although as aforementioned their batteries are currently somewhat oddly grouped in the Batteries Directive under the classification of industrial batteries. They are clearly not portable and neither fall within the category of automotive batteries, nor have a separate, distinct category, which might have enabled more specific, and targeted EV battery obligations. It is important to note however, that under the newly proposed regulations, the definitional oddities noted above are likely to be resolved.⁷⁶

As a result of the above misnomer in battery classification, the Directive includes a reactive 'take-back' measure for industrial EV batteries. Here, the producer shall "not refuse to take-back waste industrial batteries". This is as opposed to a proactive 'collection' obligation supported by distributors and targets, which can currently be found in the obligations for portable batteries. As such, EV battery producers are not required to meet any take-back targets, although they are obliged to give end-users information about the existence of take-back schemes and the harmful effects of incorrect disposal.⁷⁷ The fact that EPR obligations for producers of EV LIBs are so weak increases the risk that private individuals (who will be the most common users and owners of EV batteries) may remove, disassemble, store or use these batteries in highly dangerous or hazardous ways should they choose not to return them to the producer. It is noted, however, that where an EV is taken to an authorised treatment facility the EV battery will be removed under the depollution requirements of the ELV Directive (see section 4, n48) which may provide some safeguard against unsafe private disposal.

⁷⁶ See above, text to n. 56.

⁷⁷ See Council Directive 2006/66/EC, above n. 7 at Article 20.

In order to support take-back rates, the Directive stipulates that industrial batteries cannot be subject to disposal by way of landfill or incineration, owing to an enforced prohibition;⁷⁸ a prohibition that was taken to mean that take-back rates of industrial batteries would be close to one hundred percent. However, the small amount of available data does not support this assumption, as there are noticeable differences between industrial batteries being placed on the market and those actually being taken-back. In 2015, 491,000 tonnes of industrial batteries were placed on the market, whereas only 435,000 tonnes were taken-back by producers; a difference of 56,000 tonnes or 11%.⁷⁹ This therefore raises the question as to why current legislation makes no mention of take-back (as opposed to recycling) targets for industrial batteries.

Once the battery has been taken-back, producers must deliver-up the industrial battery to an Approved Battery Treatment Operator who will undertake the obligated battery recycling or recovery (reuse is a notable omission here, as the Directive is silent on the point).⁸⁰ This obligation is supported by the inception of targeted recycling efficiencies, which in essence requires all producers to meet certain recycling to weight percentages. Strikingly, LIBs, the most common chemistry used in EVs, are classified as 'other batteries' as the classifications are based on chemistry rather than application for recycling efficiency purposes. As such, 'other batteries' must meet a minimum recycling efficiency of just 50%, as opposed to 65% for lead-acid and 75% for nickel-cadmium batteries⁸¹ (note, however, that the new EC

⁷⁸ *ibid.* at Article 4

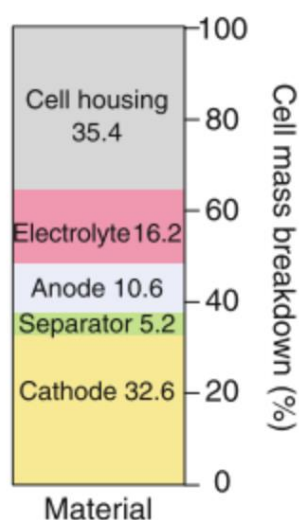
⁷⁹ See European Commission, above n. 3 at 43-44.

⁸⁰ See Council Directive 2006/66/EC, above n. 7 at Article 12.

⁸¹ *ibid.* at Article 12.

regulatory proposals indicate that this target will rise to 65% by 2025, and 70% by 2030).⁸² Recycling efficiency relates to the percentage sum of the battery weight which is needed to be recycled. Therefore, 50% of the total weight of an EV LIB battery is required to be recycled in order to comply with the Directive. This is particularly low considering the weight of an EV battery is predominantly attributable to the cell housing. EV battery casings alone typically amount to around 35.4% of the total battery weight (See *Figure 2*), which results in recycling efficiency targets being met rather easily.

*Figure 2*⁸³



Moreover, EV batteries house a number of critical and precious metals; some of which are at significant risk of supply chain shortfalls for EV battery producers: this includes fragilities due to production or distribution risk.⁸⁴ As such, the current recycling efficiencies do not promote efficient recovery of the critical, scarce and valuable metals (such as cobalt, nickel

⁸² See European Commission, above n. 9, Article 57 and Annex XII

⁸³ W. Li, E. Erickson and A. Manthiram, 'High-Nickel Layered Oxide Cathodes for Lithium-Based Automotive Batteries' (2020) 5 *Nature Energy* 26.

⁸⁴ A. Leader, G. Gaustad and C. Babbitt, 'The Effect of Critical Material Prices on the Competitiveness of Clean Energy Technologies' (2019) 8 *Materials for Renewable and Sustainable Energy*.

etc.) contained within the battery: it is even more necessary to ensure recovery of these materials as they are currently at risk of supply chain fragilities. In trying to tackle such low efficiencies, LIBs (or any EV battery composition) could be independently defined, and targeted. Moreover, as opposed to the current 'full battery' recycling efficiency target seen above, recycling efficiencies could instead relate to specified material components which are deemed important for resource efficiency.⁸⁵ It is important to note, also, that the composition of batteries may change as chemistries evolve. Battery chemistries often innovate to cut down on high-value components, or components that are particularly subject to supply chain fragilities. While these innovations may be environmentally beneficial in many ways, they may also have some unintended consequences, as the value of metals is an important driver for recycling. Thus, as low-value chemistries develop over time, economic drivers for recycling may actually reduce.

In 2015, LIBs used 40% of the world's lithium supplies (which is just one of the materials used in EV batteries). By 2025, projections estimate that EV battery production will outstrip the 2015 rate of lithium production; although, it is noted that known lithium reserves are expected to cope with the increased demand. However, this would require a scale-up in environmentally costly mining activity,⁸⁶ although, the European Union is continuing to explore ways of reducing demand via resource efficiency.⁸⁷ With this in mind, it is notable that producers are under no proactive obligation, nor incentivised (unlike under the ELV

⁸⁵ Linklaters, 'Powering the Future: Recycling and Reuse of Electric Vehicle Batteries' (2020). Available at: <https://www.linklaters.com/en/insights/thought-leadership/electric-vehicle-batteries/powering-the-future/recycling-and-reuse-of-electric-vehicle-batteries> (accessed 21 May 2020).

⁸⁶ European Commission, 'Report on Raw Materials for Battery Applications' SWD (2018) 245/2 final. Available at: <https://ec.europa.eu/transport/sites/transport/files/3rd-mobility-pack/swd20180245.pdf> (accessed 13 May 2020).

⁸⁷ *ibid.* at 17.

Directive) to first consider ‘second-life’ and/or reuse potential of EV batteries, before proceeding to recycling. To that end, a number of battery stakeholders have noted that the Directive is not well adapted to new developments, particularly concerning LIBs and battery reuse.⁸⁸ This is a significant shortcoming of current battery regulations: the batteries sector is highly dynamic and innovative, and is regarded as ‘a strategic imperative for Europe’ in the context of the clean energy transition and is a key component of its automotive sector.⁸⁹ The lack of reuse and second-use definitions, and obligations contributes to an unclear legal situation in which there is no definitive answer as to who takes responsibility for reused batteries (as noted in Section 4 of this paper).⁹⁰

Section 6: Recommendations and Conclusions

This paper has examined current legal and regulatory frameworks for the end-of-life management of EVs, in particular its suitability for the end-of-life management of EV batteries. A central problem, we have argued above, is that current legislation applicable to automotive and EV batteries has significant gaps and peculiarities that make it unsuited in supporting appropriate end-of-life battery management in the midst of a transition to electric mobility that is now well underway. These outdated Directives, which were written prior to the widespread adoption of e-mobility, could ultimately hinder further battery innovation, instead of facilitating it; as well as limiting the sustainability aims of the EV revolution. Strengthening EPR frameworks for EV battery management is imperative.

⁸⁸ See European Commission, above n. 3.

⁸⁹ European Commission, ‘Europe on the Move’ COM (2018) 293. Available at: https://eur-lex.europa.eu/resource.html?uri=cellar:0e8b694e-59b5-11e8-ab41-01aa75ed71a1.0003.02/DOC_1&format=PDF (accessed 13th October 2020)

⁹⁰ See European Commission, above n. 3 at 7.1.3

The UK, which is in its post-Brexit implementation period, now has an opportunity to revise and modernise its outdated EPR practices to better and more effectively achieve an EV battery Circular Economy. In fact, for England, the *UK Government* has already signaled its intention to do so via ‘Our waste, our resources: A strategy for England’⁹¹, which contains a promise to review current battery and ELV regulations by the end of 2020 and 2021 respectively. Although details are sparse in the 2018 strategy document, the Government has set out a guiding framework for EPR revisions which include: the setting of clear outcomes, objectives, targets and responsibilities; producers to bear the full net cost of end-of-life management of their product; the use of modulated fees to encourage sustainable development/design decisions; and finally, the scheme should allow consumers to easily play their part. Further, the Waste Strategy lays down that the underpinning principles of any revision will require, as a minimum, that all producers pay into the devised EPR system, and that costs to producers are fair and transparent.⁹²

Carrie Bradshaw has argued that frames of waste problems, as definitional interpretations of situations relating to waste, help to understand the complexities that need to be addressed.⁹³ The domain of that study, food waste, positions the problem as largely behavioural. In contrast, the issues in relation to electric vehicle batteries is much more structural, since the vast majority of EV batteries will end their first life as the vehicle makes its way to an authorised treatment facility and issues such as over-consumption are not nearly so significant. On the other hand there are similarities in relation to the Resource and

⁹¹ See HM Government, above n. 57

⁹² See L. Dawson, above n. 30

⁹³ Carrie Bradshaw, England's Fresh Approach to Food Waste: Problem Frames in the Resources and Waste Strategy (2020) 40(2) Legal Studies 321-343.

Waste Strategy for England to which Bradshaw points which do apply here. The Strategy positions EV battery waste (as it does food waste) as a specific challenge, pointing to the coming growth in EV take up and the volume of battery waste as problematic while promising legislative review.⁹⁴

Notably, the strategy sets a target of introducing two new EPR schemes by the end of 2021. Therefore, given the benefits of clear and consistent ELV and battery regulations, this paper argues for the enactment of a single-sourced EV battery EPR scheme, which has been solely designed to invoke EV battery producer responsibility. We argue this, because many uncertainties currently arise from the fact that end-of-life management of EV batteries is presently governed by two separate pieces of legislation (that is, the ELV Directive and Batteries Directive). Not only do these two Directives have areas of inconsistency (for example, in terms of take-back targets, and reuse obligations as discussed in section 4 and 5), but also, they lack clarity as to when one Directive applies over another.

Moreover, a single source of EV battery EPR legislation would help to clarify current definitional complexities. Importantly, such a move would enable EV batteries to be removed from the current 'industrial' battery definition which, we have contended, hinders effective end-of-life management. Any newly introduced EPR scheme should also, ideally, hold notions of individual producer responsibility (here, the producer will be solely responsible for their battery pack on an individual basis, not a collective one) so as to engage battery producers in facilitating reuse, recycling and recovery of their battery pack, whilst also incentivising eco-design. Moreover, it is also recommended that proactive and enforceable

⁹⁴ See HM Government, above n. 57 at p. 38

targets for battery collection are needed in order to facilitate better end-of-life battery management. Further, highly targeted recycling efficiencies are needed so as to promote recovery of the most critical and valuable battery materials: for example, by focusing recycling efficiency targets on specific materials contained in EV batteries, as opposed to the current 'full battery' recycling efficiency. Reuse is a notable omission in current EV battery legislation. Given that EV battery reuse and second life is currently being actively promoted and adopted as a promising way to harness maximum value, it is crucial that regulatory regimes are formulated to ensure safe and sustainable reuse and second life application. Current legal uncertainties and the absence of definitional clarity around second-use raise many unanswered questions about responsibility for a repurposed battery. The measures contained in the new European Commission regulatory proposals which clarify definitions and potential responsibilities arising from battery reuse and repurposing, is a positive and much-needed step. However, we recommend that wider policy decisions around EV LIB repurposing needs careful consideration of the relative Circular Economy benefits of this as an end of life management strategy, and one that should be informed by data from economic, safety and lifecycle analysis.

To conclude, this paper has examined current, and recommended further EPR mechanisms to improve waste management in the EV sector. This is particularly important in light of Britain's exit from the EU and the Prime Minister's recent announcement bringing forward the prohibition on the sale of new petrol and diesel vehicles from 2040 to 2030. We argue that although the tonnage of EV batteries reaching the end of their first life in an EV will soon grow exponentially, current regulations are ill-equipped to deal safely and efficiently with these quantities. Failing to address this issue could lead to human health and environmental

hazards in the future. EV batteries will have large amounts of residual energy even after they have reached the end of their first life, they also house considerable amounts of critical materials, many of which are at risk of future supply shortfalls. Regulatory structures for the safe and sustainable end-of-life management of these batteries is now imperative. We have discussed why current UK battery regulations are inappropriate for managing the end-of-life impacts of the EV transition, and recommend an EV specific battery EPR scheme. We acknowledge that the EU's newly proposed battery regulation would go some way to addressing the 2006 Directives deficiencies. However, given that this regulation will not apply in Great Britain as the UK is no longer a member-state of the EU, it remains to be seen whether the UK will align itself with the EU in any future legislative review of its waste battery legislation.