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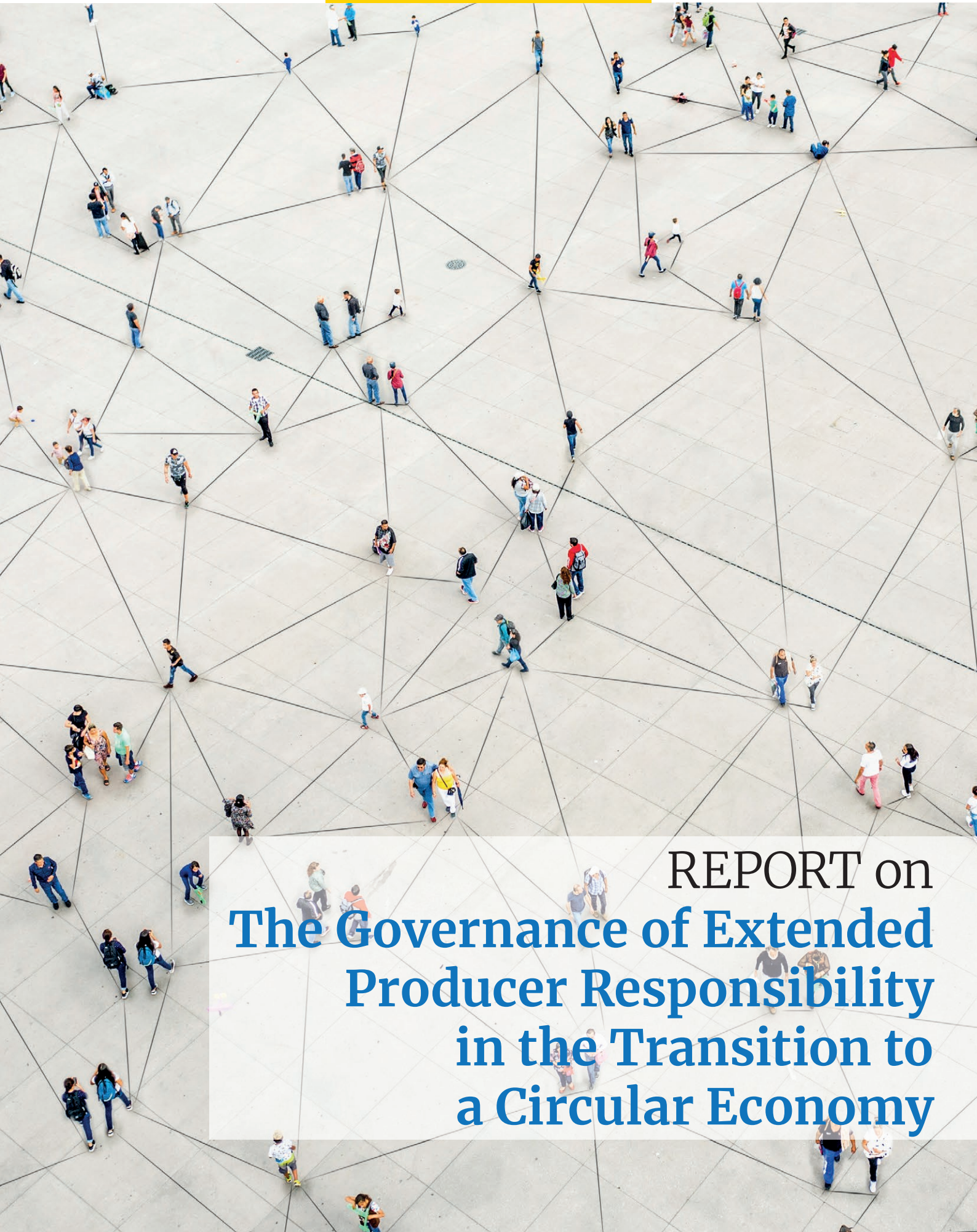

REPORT on

The Governance of Extended Producer Responsibility in the Transition to a Circular Economy

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This report is based on a synthesis of work from the Horizon 2020 research project Cresting (work package 1.2 and grant number 765198), which examines the sustainability implications of the transition to a circular economy. This report used interviews, policy and legal analysis to arrive at the results.

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The Copernicus Institute of Sustainable Development is an interdisciplinary research institute based at the Faculty of Geosciences, Utrecht University in the Netherlands. It aims to have a positive impact on the transition to a sustainable society through the development and transfer of research.
InStyTE is an interdisciplinary research unit based at the université of Technologie of Troyes in France. It aims to develop knowledge, methods and tools to better understand the interactions between technology, society and the environment in our current and future (sustainable) societies.
Plus Projects is a grant and incentives consultancy based in The Hague, the Netherlands. It specializes in innovation and sustainability projects that positively impact the world. Focus areas are circularity, digitalisation, and sustainable construction.

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This report is part of a series of work on extended producer responsibility led by researchers in Utrecht University. Other work in this series include:

- Vermeulen WJV, Backes CW, Munck MCJ de, et al. *WHITE PAPER on Pathways for Extended Producer Responsibility on the Road to a Circular Economy*.; 2021. doi:10.13140/RG.2.2.11527.93602
- Campbell-Johnston K, de Wall IM, Roos Lindgreen E, et al. *POLICY BRIEF on Critical Raw Materials and Their Integration in Extended Producer Responsibility and Eco-Design Policy*.; 2022. doi:10.5281/zenodo.6444189
- Thapa K, Vermeulen WJV, Olawale O, Deutz P. *Policy Brief: Blueprint for Ultimate Producer Responsibility*.; 2022. doi:10.5281/zenodo.5957710

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Executive summary for policymakers

During their lifespan, products can cause severe environmental and social impacts in all stages of their lifecycle. The circular economy with its focus on closing and slowing material and energy loops, is a means to reduce these broad impacts. Circular economy forms the basis of the EU's ambitions to reconcile present economic activities within the planetary boundaries while meeting its aim for climate neutrality by 2050.

Electronic and electronics equipment is a key product focus area for the European Commission, during the waste stage. Similar to other EU Directives, current electronics waste legislation will be updated in the coming years. The transition to a circular economy will require new and modified roles and responsibilities for actors, e.g. government, businesses and citizens. This report provides a detailed exploration of the governance issues within the current electronics waste policy, focusing on the instrument of extended producer responsibility. Through three detailed case studies of Italy, France and the Netherlands, the key organisational and policy features are explained, and the strengths and weaknesses are outlined.

Based on the analysis of the case studies, we argue the subsequent developments for extended producer responsibility for waste electrical and electronic equipment to include the four followings aspects in its development:

1. **Introducing the modulation of fees at the European level:** the fee paid by producers for the collection and recycling of their products should be modulated based on the circularity and sustainability of the product in question. Fee modulation is allowed under the current EU WEEE law. However, it is not applied systematically. This is already done in France for EEE based on the standardisation of components, weight and specific materials. Fee modulation guidelines have been developed by the OECD. However, the key aspect to the ability of the fees to affect product design is the size of the fee. Studies have illustrated that current fees are between 0.2 and 2% of the product price. Higher levels of fees, e.g. more than the 2% product price, combined with a visible fee are recommended to be implemented at the EU level;

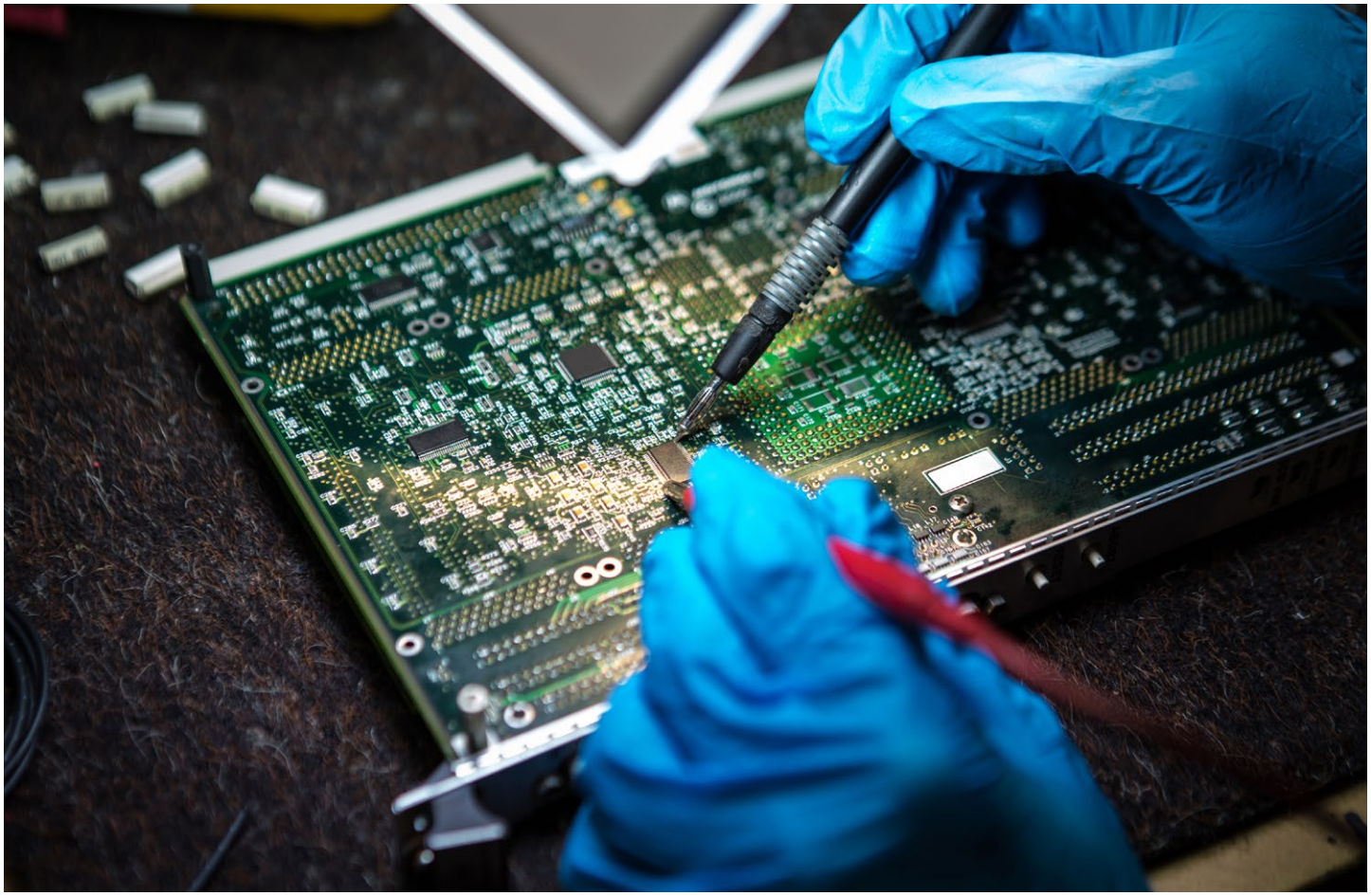
2. **Broadening the scope of which actors are included in national EPR systems while promoting high R-strategies:** the types of actors and responsibilities within the extended producer responsibility schemes need to be broadened. This is possible under EU law and has partly been done in France, where civic actors are now included in the functioning and directing of the schemes. However, the transition to a circular economy requires the promotion of more than just recycling of EEE to the other R-strategies. This requires systematically integrating the other economic actors in the design and functioning of the system, e.g. Repair, Remanufacturing etc.;

3. **Measures to promote the highest value recycling of collected WEEE:** products that reach their end-of-life they need to be effectively collected and treated to the best standard. The current targets and quality measures promote the collections and recycling of electronics based on mass, not on specific material or quality criteria. A standard for the treatment of WEEE EN 45558 is available, although it is not mandatory. We recommend this standard be made mandatory across the EU. In addition, we call for a systematic pan-EU assessment of available and future recycling technologies, possibilities for urban mining from WEEE, and funding options needed to direct this, specifically in the area of critical raw materials recovery from electronics;

4. **Expanding the scope of EPR beyond national borders:** the scope of extended producer responsibility schemes needs to be expanded to account for the multiple uses of the product and the responsibility when products move internationally. While EPR has shown great ability to shift WEEE away from landfilling. The complexity of systems, rules and their enforcement between member states and beyond has led to varying national rules and issues of

transparency between jurisdictions. The quantity of producers, importers, distributors and second-hand sellers makes the tracking and monitoring of WEEE within and between national jurisdictions challenging, especially for the export of collected and secondary products. In particular, this relates to the need for a solid understanding of the quantities of WEEE moving between jurisdictions and suitable mechanisms in place to finance the appropriate disposal. The highly international nature of WEEE supply chains and global trade and flows of WEEE have led some to call for a 'global EPR' or 'ultimate producer responsibility' system.

Content



1 Background

High quantities of resource extraction, excessive consumption and waste generation have underpinned calls for the transition to a circular economy. Through slowing, narrowing and closing material and energy loops, materials can be preserved and waste reduced [1]. This requires different forms of cooperation, collaboration and responsibilities between and for citizens, companies, and governments and the development of new and the updating of old policies. The European Commission's 2020 Circular Economy Action Plan is the basis of the European Green New Deal and its ambitions for climate neutrality in 2050 [2]. This plan outlines seven high-impact sectors: Batteries and Vehicles, Packaging, Plastics, Textiles, Construction and Building, Food and Water, and Electronics and ICT. This report focuses on the last category: Electronics and ICT.

Electrical or Electronic Equipment (EEE) is a highly diverse and often complex product category, spanning many products (from phones to fridges and PVs) with varying materials and lifespans. The total global weight (excluding PV panels) of EEE consumption increases annually by 2.5 metric tonnes (Mts). After disposal, EEE generates waste containing valuable metals, e.g. gold and antimony, and hazardous substances, e.g. mercury.

Waste Electrical or Electronic Equipment (WEEE), termed e-waste outside the EU, is a present and growing problem. In 2019, the world generated 53.6 MTs of WEEE, roughly 7.3 kgs per capita. Europe generates roughly 16.2 kgs per capita – the highest of any region globally [3]. Addressing WEEE is a significant and ongoing challenge for policymakers both nationally and internationally.

Extended producer responsibility (EPR) is a key policy instrument to manage WEEE globally and in the EU [4]. EPR for the end-of-life management of products emerged in North-Western Europe in the late 1980s and early 1990s. It responded to the challenge of increasing quantities and complexities of waste streams and the call to move this responsibility away from municipalities. In essence, EPR moves the responsibility of the post-user phase of a product back to the producer (or their representative). EPR (in theory) relates to the whole product lifecycle (design, use and waste) [5]. However, in European Union (EU) policy, it is primarily the domain of waste law in what we term the 'post-consumer phase'. Since 2002, EPR has been deployed as a key policy approach to waste management by the EU for batteries, packaging, cars, WEEE, and textiles. The current legislation for WEEE has

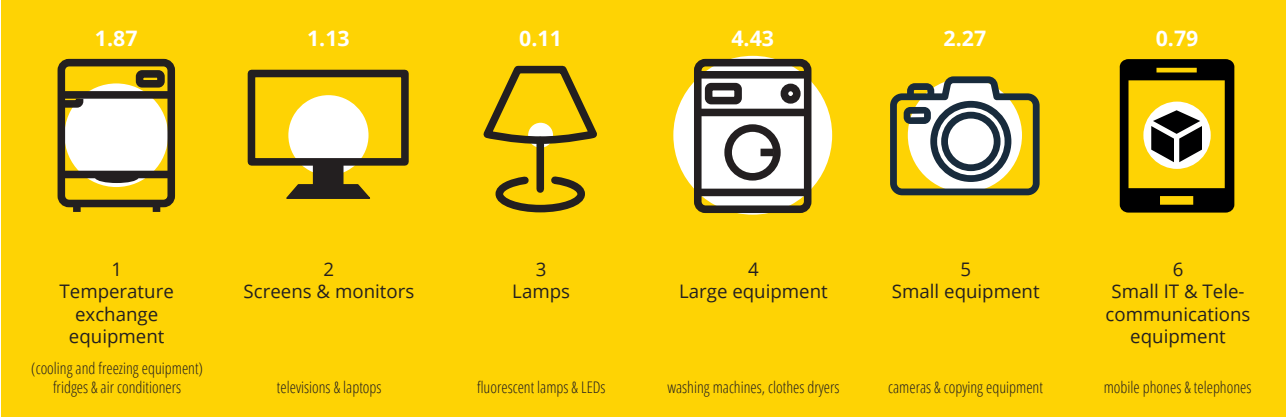


Figure 1 *Six WEEE categories as outlined by the 2012 EU Directive and the generation of WEEE per capita in kgs*[a]

a These six categories are merged from the 10 previous ones, which form the basis for EU statistics in the Appendix

not been comprehensively revised since 2012, with actors calling for an urgent review of the Directive [6].

This report draws on the outcomes and experiences of an interdisciplinary EU Horizon 2020 research project on the circular economy (Cresting). It examines the issue of WEEE and EPR from a broad circular economy perspective. It takes a governance approach: looking at key actors and their activities and providing a rationale for the organisation, policy direction and actor engagement.

The report uses qualitative and quantitative analysis to provide a broad comprehensive overview of the issues at hand, by combining policy and legal documents, interviews with key stakeholders (see Appendix) and data from Eurostat. The intention is to clearly describe and illustrate the diversity in the organisation and governance of EPR for WEEE in the EU by drawing on three key cases (Italy, France and the Netherlands). We evaluate the EPR systems based on the requirements of the Directives and the perceived strengths and weaknesses of EPR schemes as understood in the scientific community. Next, we outline general possibilities for expanding and improving the governance of the EPR systems. This report provides recommendations for the upcoming review of the WEEE Directive. All opinions in this report are those of the authors.

In this report, we first present a conceptual overview of the circular economy and the policy landscape in the EU for WEEE and EPR. Next, the three case studies are presented and summarised. Finally, the potential improvement options to the governance of EPR are outlined.

2 Circular economy: a systems perspective

Resource depletion and concerns about waste and pollution have underpinned the push for recycling and waste policy over the previous 40 years. However, interest in the circular economy has grown over the last 15 years, with many competing visions and understandings.

Many definitions and understanding of circular economy are available [7,8] In the EU CE Action Plan, CE "will make a decisive contribution to achieving climate neutrality by 2050 and decoupling economic growth from resource use, while ensuring the long-term competitiveness of the EU and leaving no one behind" [2]. Therefore, the circular economy is not an end in itself but rather a means to contribute to a broad set of policy and sustainability goals.

This report builds on the lessons learnt from earlier circular economy-like regulations such as recycling, eco-design and waste policies, including extended producer responsibility. Building on these lessons, this report frames EPR in the context of the contemporary understanding of the circular economy: where reducing waste and consumption and altering consumption patterns is the central focus. This line of argumentation is based on the notion of the biophysical limits to the planet, and the high levels of consumption in the EU which requires changing production and consumptions patterns [9]. Earlier product-related policies sought to address product design and the associated waste, however these have proven insufficient given the increasing levels of consumptions and waste, and thus requiring the promotion of more substantial governance modifications.

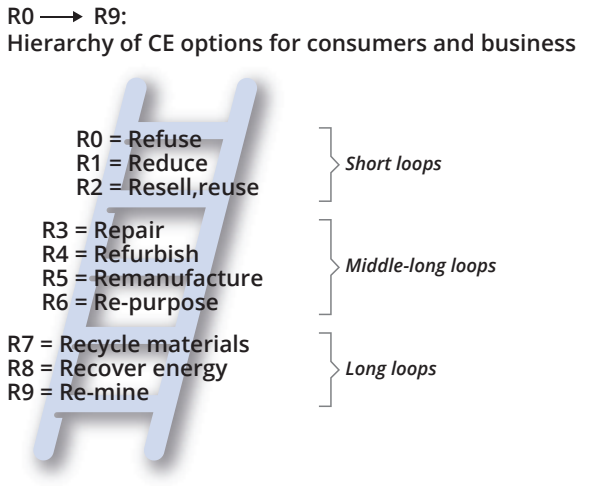


Figure 2 *Circular economy R-strategies with short, middle-long and long loops.*

In this report, we understand the circular economy as a hierarchy of R-strategies (Figure 2), which was derived from a synthesis of the literature on waste hierarchies [10] These contain short, medium and long loops. This understanding of circular economy has been adopted by national governments and features in earlier policy briefs and reports on EPR [11,12].

The circular economy is also not one single production and consumption cycle. Instead, we distinguish two interrelated versions of the product lifecycle [10]: i) *'produce and use'* lifecycle of the physical production and use of products and materials; and ii) *'design and concept'* lifecycle, where producers design and redesign their products regulatory to meet new demands, standards and constraints. These can include circular design, e.g. design for reuse or recycling. These two lifecycles address different actors, locations, regulatory environments and ultimately different governance conditions [13]

Extended producer responsibility in the EU

The EU has several Directives and Regulations that both modify and direct the governance of EPR. While certain member states had legislation that dates back to the 1980s, EU legislation takes precedent. The key pieces of legislation are summarised below.

Waste Framework Directive 2008/98/EC and Recast 2018/851

The Waste Framework Directive (Directive (EU) 2018/850) provides the general framework of waste management requirements and waste-related definitions. This Directive also outlines the general

Table 1 *Types of responsibility identified between actors within EPR systems*

		Type of responsibility		
Stakeholder	**Role/responsibility**	**Financial**	**Organisational**	**Informational**
Producer	Set up collection schemes (individual or collective).		X	
	Finance the net costs arising from the collection, treatment and recycling of their products.	X		
PRO	Organise the collection, treatment and recycling activities under EPR on behalf of producers.		X	
Waste operator	Carry out waste collection, transport, treatment and recycling of waste on behalf of PROs.		X	
National authorities/ Member States	Responsible for transposing EU Directives into national legislation and ensuring targets imposed by the Directives are achieved.		X	
	Define in a clear way the roles and responsibilities of all relevant actors involved (WFD).		X	
	Ensure equal treatment of stakeholders.		X	
	Ensure that appropriate collection schemes are in place.		X	
	Responsible for enforcement of national EPR legislation.		X	
	Take appropriate measures to prevent waste generation and monitor and assess progress in the implementation of such measures (WFD).		X	
	Make consumers aware of their contribution to waste prevention and encourage them to participate more actively in order to improve resource efficiency (WFD).			X
	Establish adequate monitoring and enforcement framework (WFD).		X	X
Municipality	Provide and organise waste collection activities within their area.	X	X	
	Organise municipal waste collection and treatment (WFD).		X	
	Organise communication to citizens (WFD).			X
Trade association	Represent sectors of producers.		X	
Clearinghouse	Register producers and collect data on their sales volumes.		X	X
	Allocate waste collection responsibilities to PROs.		X	
	Compile information on waste collection from PROs and determine the obligations of each producer.		X	X
	Sometimes manage data reporting to national authorities.			X
	May have a registering role (referred to as national registers).		X	

minimum requirements for EPR schemes. As a result of the 2018 amendment to the Waste Framework Directive, more detailed requirements for EPR have been regulated. In this renewal, the 'EPR scheme' is defined 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". Article 8a now contains new requirements on defining the roles of all actors, including companies enabling reuse, and wider stakeholder involvement, including social enterprises. Additional aspects include reporting on the treatment methods applied, providing information about prevention and re-use, detailing control systems, auditing and transparency, and, finally, on linking the financial responsibility to recyclability.

WEEE Directives 2002/96/EC and Recast 2012/19/EU

The WEEE Directive and its recast promote the principle of EPR and are embedded in the points specified in the Waste Framework Directive. Member states have to translate the requirements and features. The key features of EPR are regulated in this Directive as follows:

- Producers can organise the collection and recovery of their products either individually or collectively via a Producer Responsibility Organisation (PRO) and can nominate a third party to fulfil this on their behalf;
- Producers are either financially and/or organisationally responsible for the WEEE they put on the market of the specific member state;
- It encourages member states to promote measures to stimulate better product design, e.g. reuse, dismantling or recycling;
- Promotes the separate collection and recovery of WEEE. Producers must collect 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. They must also Recover those collected products to the targets specified in Appendix B;
- Producers must also report certain information to authorities, including the aforementioned collection and recovery rates;
- WEEE is currently categorised under six groups (Figure 1): Temperature exchange equipment; Screens and monitors; Lamps; Large equipment; Small equipment; and Small IT and Telecommunications;
- Treatment of WEEE must be done to the best standards. A best practices treatment standard was developed (EN 45558). While this standard is voluntary, it has been made mandatory in several countries, e.g. the Netherlands;
- The legislation outlines various financial, organisational or informative (communicative) responsibilities to different actors (Table 1). Collectively, these form the governance for EPR in the respected member state.

Additional legislation that modifies the composition of WEEE

REACH EC 1907/2006 is to improve the protection of the environment and human health against chemicals.

Restrictions on the use of hazardous substances (RoHS) restrict certain hazardous substances within EEE, e.g. lead, cadmium and mercury.

EPR governance models

The OECD distinguishes four models on how to organise EPR: 1) One single Producer Responsibility Organisation (PRO)[b] with commercial and/or municipal collection and processing services; 2) Multiple PROs with the clearinghouse and commercial and/or municipal collection and processing services; 3) Governance structure for tradable credits system; and

b A PRO is a consortium of producers, importers, distributors or sellers, i.e. the person who brings the product onto the national market. They are usually grouped around a product category, e.g. white goods.

4) Government-run EPR system [4]. As a result of EU legislation, two types of organisational governance models (PROs) can generally be identified in the EU:

1. A **collective system** (monopoly) in which a dominant national system is responsible for the collection, recycling, and financing of all (or majority) of WEEE within national boundaries. This collective system is most prevalent in countries where a WEEE system was established prior to the Directives (e.g. the Netherlands) and;
2. A **clearinghouse system** (competitive) where multiple partners can provide services (e.g. Italy and France).

The governance of EPR within a circular economy

In practice, EPR requires the coordination of many actors in a complex network of actors and responsibilities shaped by policy. However, the transition to a circular economy will require the alteration of old policies such as EPR and requires new forms of organisation and collaboration.

Based on our understanding of the circular economy as two interrelated lifecycles, we argue that EPR theoretically addresses both of these lifecycles. First, through making producers financially and/or organisationally responsible for the product in the

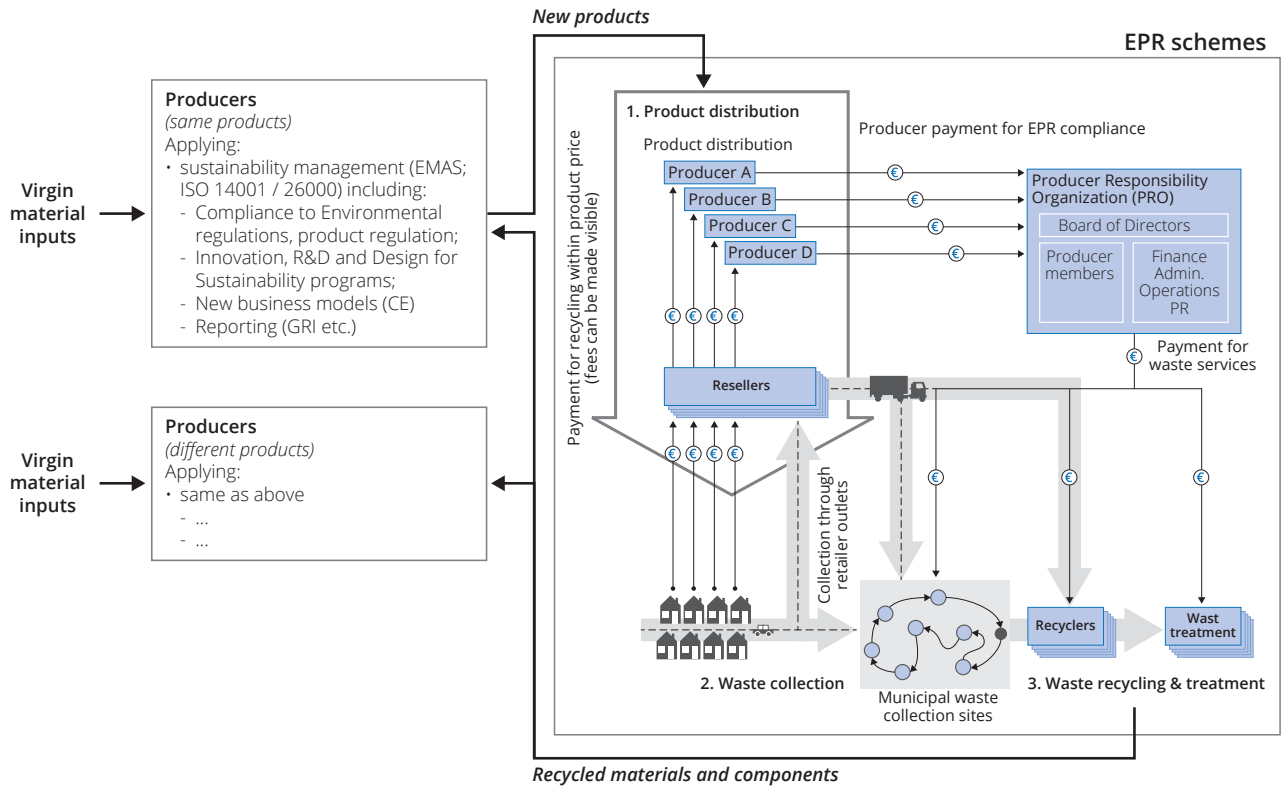


Figure 3 *EPR schemes in the context of wider policies and regulations (contextualizing the presentation by [14,15], see also Mudgal et al. 2013) (European Union Network for the Implementation and Enforcement of Environmental Law, 2019)*

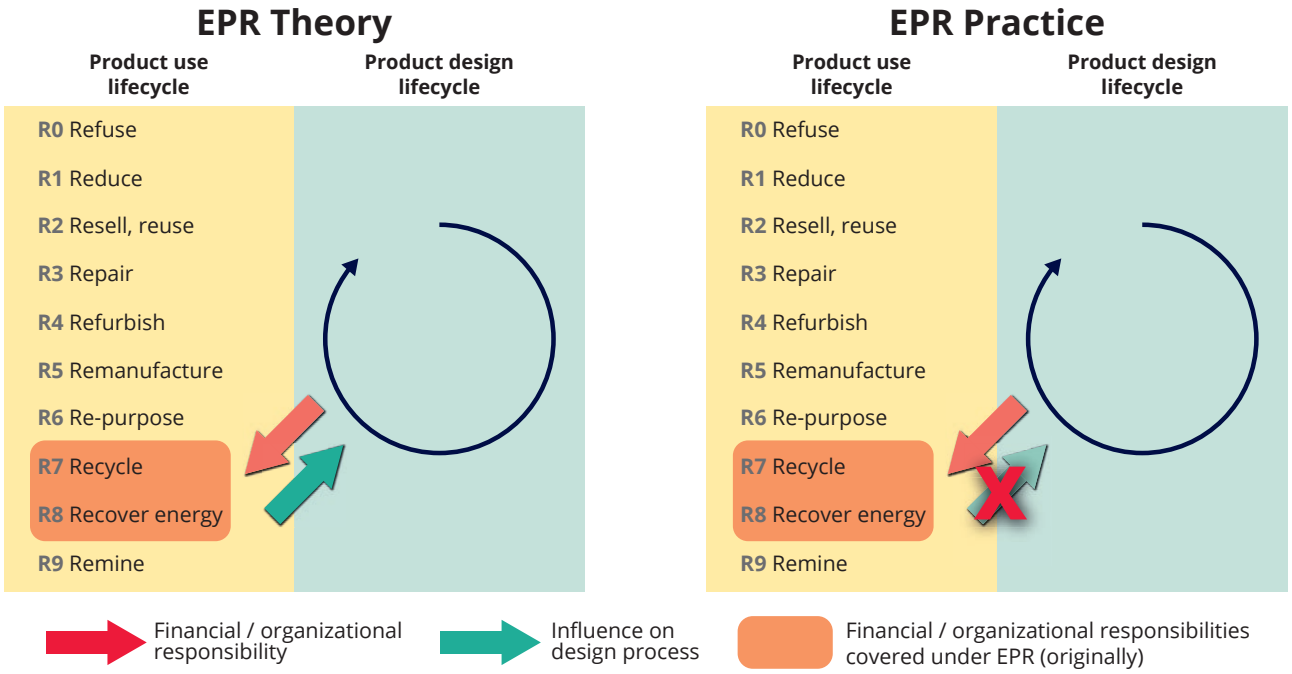


Figure 4 *The 'theory' and 'practice' of extended producer responsibility and how it relates to the two lifecycles of the circular economy. Extended producer responsibility theoretically relates to both lifecyels, with the post-user phase providing a motivation for product design. In practice, this has not materialised.*

waste stage. This primarily includes the longer R-strategies, Recycling and Energy recovery. Second, based on the first, to push producers to design their products to make them more circular or sustainable. The first is addressed via current policy. However, the second has not materialised in practice (see Figure 4). Based on this, we examine the governance and organisational features within the EU and evaluate it based on directive targets and actor perspectives. From this we examine *how* EPR could then adjusted to meet the demands of the circular economy as understood here.

3 Extended producer responsibility for WEEE: Italy, France and the Netherlands

This chapter presents the governance and performance of EPR within three EU countries: 3.1. Italy, 3.2 France and 3.3 The Netherlands. These countries were chosen because of their varied governance models and different history with WEEE management. The following section describes the history and organisation of EPR and the performance of each system compared to the targets in the WEEE Directive. Next, we analyse the strengths and weaknesses of each system as perceived by actors in it (a list of interviewees is given in the Appendix). The typology of strengths and weaknesses was drawn from a synthesis of the academic literature, and focuses on three of the core design functions for EPR: i) organising recycling, i.e. the system and organisational structures in place and related issues; ii) promoting efficiency, costs involves and the ease of monitoring and reporting data; and iii) promoting eco-design, i.e. stimulating producers to adjust or modify their products [16].

3.1 The case of Italy

The organisation of the EPR system

Italy introduced the first decree containing EPR measures in 2005, following the development of the RoHS and WEEE Directives. Since then, numerous decrees have been introduced. These decrees are based on European Directives and define the responsibilities of the actors involved, set targets, and specify procedures to measure environmental impact.

WEEE responsibilities in Italy are divided among the government (Ministries of the Environment, Regions, Provinces and Municipalities), governmental organisations (National register for stakeholders involved in WEEE management, Supervisory and Control committee on WEEE, ISPRA: *Instituto Superiore per la Protezione e la Ricerca Ambientale*), market actors (producers, retailers, and collective systems), and **the clearinghouse** (CdCRAEE: *Centro di Coordinamento Rifiuto Apparecchiature Elettriche e Elettroniche*). The clearinghouse is a **non-profit** consortium of the PROs that operates under the supervision of the Ministry for the Ecological Transition (*Ministero della Transitione Ecologica)*. CdCRAEE was established in 2007 that has the administrative role of allocating the WEEE collection centres and the quantities of WEEE that each PRO needs to manage based on their respective market share.

The EPR duties of producers are currently fulfilled by **13 PROs** that are coordinated and guided by CdCRAEE (See Figure 5). The PROs responsible for collecting household WEEE are obliged to subscribe to the CdCRAEE, while PROs responsible for professional WEEE collection do not have this obligation. The PROs fulfil the physical responsibilities of producers by collecting WEEE. Municipalities are, however, responsible for setting up the collection points. While the WEEE Directive specifies six product categories, the Italian system divides WEEE into five [c].

Figure 5 *PROs in the Italian system*

c 1: fridges, air conditioners, freezers, etc.
2: washing machines, dishwashers, ovens, etc.
3: TVs, screens, notebooks, phones, etc.
4: luminaires, PV panels, small household appliances, etc.
5: lightbulbs, all types of bulbs, etc.

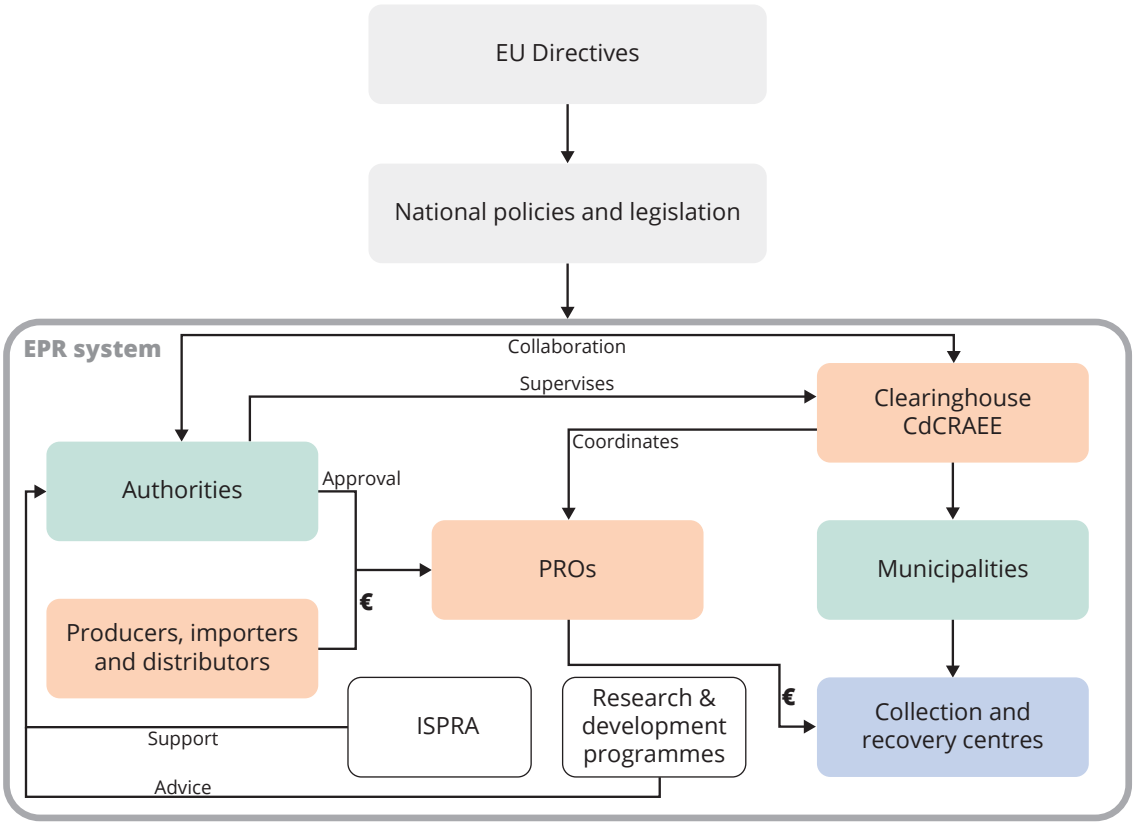


Figure 6 *The governance of EPR system in Italy*

The economic responsibilities of the EPR system are shared among distributors, municipalities, and producers. The producers pay a contribution to the PRO to cover the costs of collection and logistics. This contribution is known as the eco-contribution and is specified by each PRO for the type of product (usually in €/tonne or €/product). Eco-contributions differ per PRO based on their specific business model. This system is a competitive multi-consortium system, so prices are not publicly disclosed. However, it is indicated that the prices for EPR consist of only a very small percentage of the product price (between 0.2 and 2%, as indicated by interviewees). In addition, this eco-contribution is also influenced by market prices for metals and valuable materials that the treatment plants sell. Since material prices fluctuate, PROs raise or lower the price of the treatment activities accordingly. Ultimately, producers integrate the costs of the eco-contribution with the selling price of their products (**a non-visible fee**). Italian legislation does not specify whether this eco-contribution needs to be explicitly stated on the receipt. Consequently, the decision to communicate the size of the eco-contribution to the consumer is left to the producers. The fees may vary between PROs, but they are **not modulated** based on any specific sustainability criteria.

In addition to its administrative role, the CdCRAEE collaborates with the Ministry of the Environment (now Ministry of the Ecological Transition). Together these parties are responsible for defining the standards for WEEE treatment that processing companies need to fulfil to be part of the CdCRAEE system. These standards are specified for each of the five WEEE categories and focus on higher safety measures, higher value retention, proper stakeholder training and legislation compliance. Additionally, the CdCRAEE coordinates activities between the private and public sectors. It supports the proper implementation of laws and decrees, collaborating with legislators to improve the clarity of requirements or indicating the absence of fundamental actuation directives. The CdCRAEE also collaborates with the associations of retailers, distributors and processing companies and the national associations of Italian municipalities. The agreements taken with these stakeholders are crucial for a cohesive advancement in WEEE management of all actors involved, assuring coordination and information exchange.

The CdCRAEE also has informative responsibilities and shares knowledge and research with all Italian PROs. Finally, research institutes have a secondary role of support and control. ISPRA is the national research

institute for environmental protection and supports the ministry in monitoring performance. ISPRA also produces an annual report regarding performances, achievement of targets, encountered barriers and future challenges. Universities also advise the Italian government on WEEE and the transition to a sustainable and circular economy. An overview of the governance of the Italian EPR system is provided in Figure 6.

Performance of the Italian EPR system

Between 2015 and 2018, Italy reached most recovery and recycling targets. However, some product groups seem to be problematic see Appendix.

The general performance data for all product categories for the Italian system in 2018 are presented in Figure 7.

The collection rate for 2018[d]: 43%, meaning the target of a 65% collection (based on the average put on the market for the previous three years) has not been met. Recovery targets in 2018 have been met except in two categories (see Appendix).

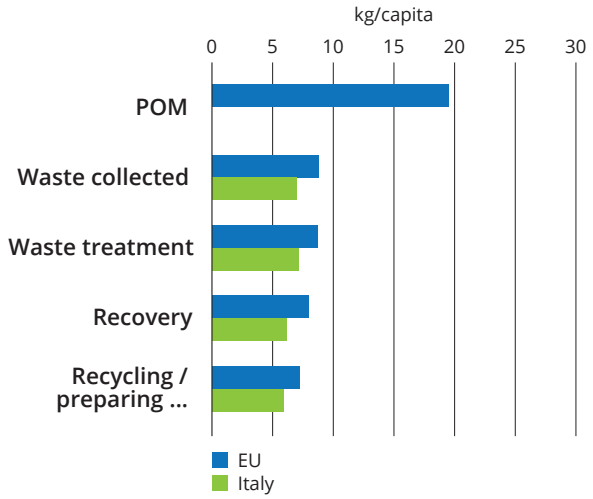


Figure 7 *Descriptive statistics of Italian EPR system in 2018*

Strengths and weaknesses of the Italian EPR system

Organising recycling

All stakeholders of the Italian EPR system interviewed were of the opinion that the legislation and allocation of responsibility lack clarity, which results in unclear responsibilities for actors (W1, 2). The reason why Italy has adopted five WEEE categories instead of the six categories specified in the WEEE Directive is also unclear (W1). Decrees are constantly instated with delays. While the allocation of responsibilities is defined in the decrees, in practice, responsibilities are shared between stakeholders and regulations are not clearly stated. However, the clearinghouse and business actors indicate that a national plan for reducing WEEE is widely adopted in all regions.

Stakeholders consider the control and sanctioning systems the biggest weakness (W1). The system leaves substantial room for free riders, improper disposal, and

Table 2 *strengths and weaknesses of the Italian EPR system as perceived by stakeholders*

	Strengths	Weaknesses
Organising recycling	• It uses the industry's managerial capacity to organise recycling markets (S1)	• Targets and standards are not harmonized, and weakly enforced and are not met everywhere (W1) • Lack of harmonized definitions (W2) • Responsibility for recycling beyond the targeted collection rates is not taken (non-separated waste, littering, orphans) (W3) • Recycling process choices need to be based on better assessments (W4)
Efficiency	• Low operation costs (2% to 0.1% of product price), but data incomplete (S2)	• Data collection and sharing are weak due to cost avoidance (W5)
Stimulating eco-design		• Low impact on eco-design (W6) • Weak incentives on eco-design, fee systems ignore eco-design efforts (W7) • The lack of harmonized legislation hinders impacts on product design (W8)

d 2020 data was not available for Italy. Collection rate is calculated as an average of the previous three years.

WEEE management (W3). Consequently, the benefits of the EPR system are jeopardized. While the CdCRAEE reports to the government where inspection should take place, these inspections are claimed to be rarely executed. Generally, a weak control system allows the development of unauthorized collectors systems that unofficially manage WEEE. Consequently, weak control systems can negatively affect the whole system.

Stakeholders do agree that overall, Italy scores relatively well on all indicators. This result is primarily related to the capabilities and active involvement of the private sector that is responsible for the practical management of WEEE (S1). CdCRAEE also positively influences the EPR system by developing a set of more ambitious and demanding requirements than the Cenelec certification.

Efficiency

Overall, stakeholders' reflections on the Italian EPR system reveal they are happy with its efficiency, i.e. costs and reporting requirements. Additionally, since multiple PROs compete, PROs lower their costs, making EPR fulfilment easier for producers. The capacity of the collective systems also facilitates improvements in management and efficiency. The low operating costs are therefore percieved as a positive aspect of the Italian EPR system. Business actors indicate they pay between 0.2 and 2% of the EEE costs in the form of the eco-contribution (S2). Although this can result in weaknesses (see W7).

The PROs also facilitate data availability and collection since collective systems are obliged to report to the clearinghouse. Usually, they also publish a sustainability or performance report annually. However, there are discrepancies between the reporting data of the CdCRAEE and ISPRA (W5). Furthermore, the division of WEEE into five product categories becomes problematic when communicating the data to the EU and Eurostat (W5). Another problem related to data involves ISPRA, the competent body for reporting. Even though ISPRAs methodology is considered less precise and incomplete, the data produced by CdCRAEE is not considered and not transmitted to the EU for unknown reasons (W4).

Stimulating eco-design

Stakeholders indicate that the goal of EPR to stimulate eco-design is not achieved (W6). While this goal is mentioned in several decrees, there are **no specific policies or strategies in place** (W8). This (it is suggested) results from the lack of coordination between the public and private sectors. The government absolves its duties by focusing almost exclusively on collection and recycling targets. Moreover, while these goals are crucial for correct disposal, **a strategy for prevention or eco-design** is lacking. Subsidies are allocated to improve the durability and reparability of products, but producers do not prioritize this. Therefore, it is unclear if these incentives properly support producers in shifting their production towards eco-design (W7).

The market for secondary raw materials is still in development, but again the legislative system seems to impede this. In addition, the absence of clear regulation on the use and reuse of materials affects the entire EPR system. Consequently, there is no recorded improvement in the eco-design of products (W 6,8).

3.2 The case of France

The organisation of the EPR system

The principle of EPR has existed in French law since 1975 but was applied in a more restricted form in the 1980s with a tax paid for base oils. Ultimately, the first scheme defined as EPR came into being in 1992 when the French authorities decided to apply EPR to tackle household packaging waste. Since then, the EPR framework has gradually developed, with the latest version of 2020, which specifies general roles and responsibilities. In France, the WFD was transposed into the general Environment Code (*code de l'environnement*), and specific decrees and articles are devised for each product chain. France has applied EPR most broadly in the EU, with over 20 different schemes at different stages. When looking specifically at WEEE, the 2012 WEEE Directive is transposed into a decree which, in turn, is supplemented by several orders that specify the application methods.

In France, producers often fulfil EPR obligations by setting up PROs collectively. These PROs are approved by the public authorities with powers to collect, dispose of, and treat or process waste. The national government oversees the operation of EPR schemes and PROs (éco-organismes) by setting operational rules and targets and arbitrating with all actors. In the case of the regulatory EPR sector (e.g. household WEEE), the PRO is approved for the general interest mission (except in the case of tires) based on specifications that set out all its obligations in terms of resources, results, and management of relations with the various players, for a period up to 6 years. PROs are individual schemes based on a private law structure that can take any legal form, e.g. non-profit, and are subject to self-monitoring. PROs are in contact with downstream stakeholders in the sector (PRPs, e.g. take-back, recycling, and treatment operators) and finance research and development programs to improve the performance of the material recovery and depolluting of sectors.

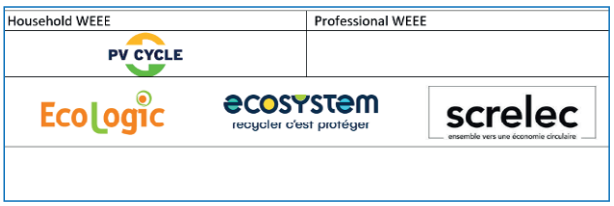


Figure 8 *PROs active in the French system*

When looking specifically at the WEEE, the criteria for distinguishing between household and professional WEEE is identical to the distinction made in Directive 2012/19/ED. As of January 2020, PROs are approved by public authorities to collect and treat household waste. Household waste can be collected either through collection points or out-of-town recovery centres. For the organisation of EPR for professional WEEE, producers can either join an approved PRO or set up an individual collection and treatment system for which they do not need approval from public authorities (unlike for household WEEE). All PROs are **non-profit organisations.**

In the household WEEE sector, as of 2020, three PROs exist (Ecologic, Ecosystem, SCRELEC). The first two are the biggest and cover most WEEE products, while Screlec is specified in racks and batteries. However, in addition to the six in the Directive, France has added a seventh category: photovoltaic panels (usually included in the Directive category "Large equipment". As a consequence, PVCycle was established bringing the total number of **PROs to four**. In 2006, the four PROs established the association OCAD3E, which is responsible for coordinating and managing relation-ships between PROs and local authorities. Local authorities have to set up separate collection facilities and sign take-back contracts with OCAD3E to receive compensation for the costs incurred for this collection. Taking on these responsibilities, OCAD3E takes on the role as the clearinghouse specifically for household WEEE.

When not assuming their responsibilities individually, producers of professional WEEE can join a PRO (Ecologic, Ecosystem, SCRELEC). The collection of professional WEEE differs from household WEEE by punctual flows, which are subject to various services from providers and PROs, e.g. on-site and on-demand collection.

Producers are responsible for financing the functioning of the EPR system. To do this, they add an eco-contribution to the selling price of their products, which is **visible** to consumers. The amount of eco-contribution paid is included in the sales invoice and reflects waste treatment costs once the product becomes WEEE. This visible contribution is made compulsory by French law. Since most producers assume their responsibilities collectively, PROs are responsible for financing the collection and treatment of WEEE according to their members' market share, regardless of when the equipment was placed on the market.

Consequently, producers choose which of the PROs they will join and pay them an eco-contribution based on the quantity of products placed on the market. The PROs are responsible for ensuring that these eco-contributions are paid to them. Since July 2020, the eco-contribution paid to the producers must be **modulated** according to environmental incentive criteria that are linked to the eco-design of products. The exact fees differ between product types based on

Table 3 *Fee modulation aspects in France*

Equipment	Contribution modulation criteria	Modulation amplitudes
Phone	Lack of standardized connections (e.g. charger).	+100%
	Lack of compatible software updates.	
Television	Provision of technical documentation to authorized repairers	-20%
	Provision of parts essential to the use (e.g. electronic cards) beyond 5 years	
	Integration of post-consumer recycled plastic (10% threshold).	
Vacuum cleaner	Presence of plastic parts (>25 g) containing brominated flame retardants.	+20%
	Failure to provide technical documentation to authorized repairers.	
	Non-availability of spare parts essential for the use.	
Lamp	LED source exclusively	-20%

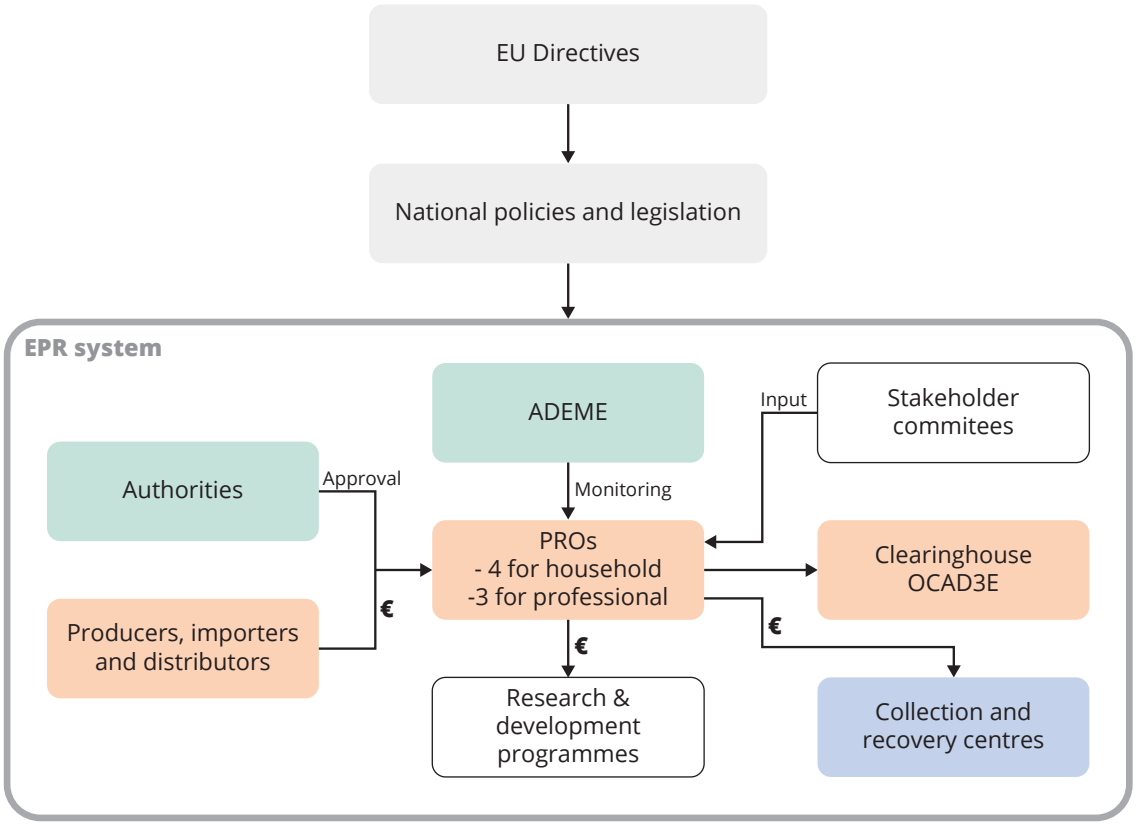


Figure 9 *The governance of the EPR system for WEEE in France*

technical aspects and criteria developed by OCAD3E (in consultation with other stakeholders) and is approved by the national government (Table 3). France is the only European country that applies **fee modulation** to WEEE specifically. the AGEC law specifies that the malus (penalty) may exceed the amount of eco-contribution necessary for waste management allowing producers to request that this amount be limited to 20% of the product selling price. The impact of these is still being explored.

Historically, the governance of EPR schemes was ensured only by companies that marketed products subject to EPR. However, to establishing more transparency in monitoring and governance, the new AGEC law of 2020 (*La Loi Anti-gaspillage pour une économie circulaire*) opens governance to other actors with the creation of stakeholder committees by the PROs. In these committees, actors other than PRO shareholders will have the possibility to express their opinion on the governance of the PROs. Each PRO is required to set up a stakeholder committee. If a PRO is approved for several EPR sectors (such as Ecologic and Ecosystem), it will have to set up a separate committee for each of these sectors in the coming years. The stakeholder committee is proposed to be made up of four colleges with an equal number of representatives such as producers, waste management operators, regional governments, and environmental protection associations. The committee is obliged to meet at least once a year to present the assessment of the PROs activity and its strategic orientations for the upcoming period. Each committee is also obliged to appoint a representative responsible for presenting this annual assessment to the inter-branch commission.

In addition to these committees, ADEME (*Agence de l'Environnement et de la Maitrise de l'Energie,* the French Agency for an Ecological Transition) monitors the EPR schemes. ADEME is a public agency under the joint authority of the Ministry for an Ecological Transition and the Ministry for Higher Education, Research and Innovation. ADEME manages the register of (WEEE) producers and carries out monitoring and observation missions of the EPR schemes. The organisation thereby also takes on some of the responsibilities of a clearinghouse. The organisation of the EPR system suggests that France has organised EPR according to the model of **multiple PROs with a clearinghouse**.

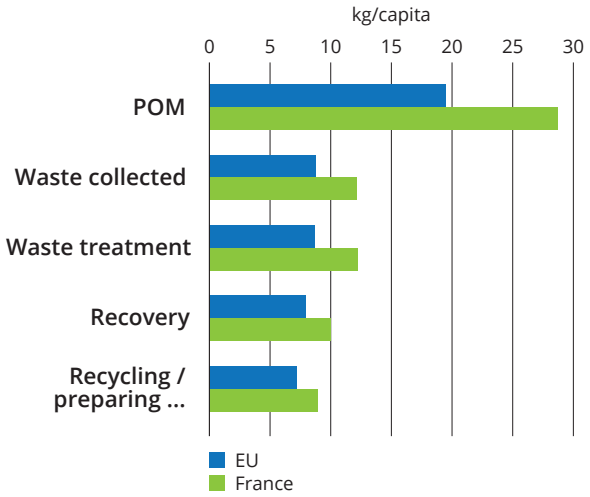


Figure 10 *Descriptive statistics of the French EPR system in 2018*

Performance of the French EPR system

France has transposed all relevant collection targets into its national regulation. It has set higher recycling and recovery targets for category 6 (version 2018: small IT equipment), specifically 70 and 80% against 55 and 75% as defined in the Directive. Additionally, France has set specific collection targets for household WEEE per equipment category in the PROs specifications. By this, France hopes to encourage the collection of equipment that is currently insufficiently collected see Appendix.

The general performance data for all product categories for the French system in 2018 are presented in Figure 10[e].

The collection rate for 2020[f]: 43%, meaning the target of a 65% collection (based on the average put on the market for the previous three years) has not been met. All recovery targets in 2018 have been met except in one category (see Appendix).

Strengths and weaknesses of the French EPR system

Organising recycling

Regarding assessment methods, French stakeholders indicate that the choices for recycling options need to be better assessed (W1). The reality that the export of waste to low-income countries prevails is also mentioned as an ongoing issue (W2). However, when reviewing Eurostat data, relatively little waste is exported outside the EU. Consequently, it could be suggested that the export of this waste does exist but primarily in illegal forms or is being exported while labelled 'second-hand' and is therefore not recognized as waste. This is a broader issue not covered within the EPR system at the EU level. An ongoing issue in organising recycling is the incorrect disposal or sorting of waste by consumers, who have no formal responsibility. One positive remark by the stakeholders is that their traceability is good once products are registered in the system. This suggests that EPR schemes use of the managerial capabilities they possess by being industry-led (S1).

Efficiency

Efficiency in terms of the operational efficiency was not directly discussed by the stakeholders. However, the literature identifies that data collection and sharing is weak due to cost avoidance, French actors indicate that

Table 4 *Strengths and weaknesses of the French EPR system as perceived by the stakeholders*

	Strengths	Weaknesses
Organising recycling	• It uses the industry's managerial capacity to organise recycling markets (S1)	• Recycling process choices need to be based on better assessments (W1) • Exports of waste to low-income countries prevail (W2)
Efficiency		• Data collection and sharing are weak due to cost avoidance (W3)
Stimulating eco-design	• Being responsible for the end-of-life is assumed to stimulate redesign of products by producers (S2) • Experimentation with fee modulation (S3)	• Low impact on eco-design (W4) • Weak incentives on eco-design, fee systems ignore eco-design efforts (W5) • The lack of harmonized legislation hinders impacts on product design (W6)

e Complete performance data from Eurostat was only available for 2018. However, the collection rate was for 2020 was possible to calculate.

f Collection rate is calculated as an average of the previous three years.

access to information is organised adequately (W3). French stakeholders further mentioned that much waste is collected by informal actors (e.g. second-hand shops). These actors are not obliged to report their data.[g]

Stimulating eco-design
In France, actors generally maintain a positive view of the role of EPR in eco-design. The majority perceives it as one of the major points of the sector and, more specifically, of the new AGEC law (S2, 3). Nevertheless, it is also recognized that the incentive to eco-design, mainly through eco-modulation, is so-far not so effective (W5). Reasons for this are the heavy administrative burden, the differences in regulations between countries (W6), and the language barriers between countries (in case of import into France). Also, for some products (e.g. smartphones) the eco-contribution is far too low to allow a positive retroaction on eco-design (W4). Moreover, stakeholders express concerns about the potential abuse or fraud of the repair fund and other unresolved issues with this fund.

3.3 The case of the Netherlands

The organisation of the EPR system
The Netherlands was an early mover in waste management policy in the 1970s and 1980s. The current Dutch waste management policy is governed by the National Waste Management Plan (*Landelijk Afvalbeheerplan (LAP)*). In 2020, the Dutch government published the latest regulation on EPR. The regulation aim is to outline the minimum requirements for existing and future EPR schemes. Also, a new regulation for the 'general binding statement' was accepted in 2020, thereby incorporating the new obligations of the amended WFD (2018) in national law. With regard to WEEE, the Dutch government responded to the 2012 recast of the WEEE Directive by transposing the directive into the AEEA Directive (*Regeling Afgedankte Elektrische en Elektronische Apparatuur*) in February 2014.

The government accounts for its responsibility to ensure that collection conditions are in place by setting this regulary framework. Consequently, it is up to the producers to execute EPR. Generally, producers in the Netherlands have the opportunity to join a collective system or assume their responsibilities individually. However, producers must join a collective EPR organisation in some cases. This obligation has been established for five product groups, one of which is WEEE (other product groups are: batteries and accumulators, end-of-life vehicles, passenger car tyres, and packaging and packaging waste). Producers of WEEE are members of one of seven associations that represent them: Fiar CE, Anstec, LightRec, Metalelektro Recycling – SMR, SVEC, NL digital and ZRN. To comply with EPR requirements, the *Nederlandse Verwijdering Metaelektro Producten* (NVMP) Association was created as the representative association for producers and importers and manages the Dutch WEEE. Since 2021 Stichting OPEN has represented all producers as a **singular PRO** that fulfils the requirements of the WEEE Directives. This was a merger of two previous PROs: WEEE Nederland and WeeCycle.

Producers pay a contribution to Stichting Open, thereby shifting their responsibilities to them. The PRO is responsible for operating collection, processing WEEE, promoting WEEE take-back, registering the producer at the National WEEE Register (*Nationaal WEEE Register*; NWR), and reporting on recycling performance. The PRO is a registered **none-profit**. The NWR was established in 2014 by the Dutch government to organise the tasks related to the registration and reporting of EEE producers and WEEE treatment operators. PROs establish partnerships with stakeholders to execute specific roles within the EPR scheme. PROs create collection points in shops, but most waste is collected under the authority of municipalities that should organise free mechanisms to collect WEEE separately. While municipalities collect WEEE from the consumer, producers or PROs are responsible for collecting WEEE from the municipal collection street. After collection, waste operators are coordinated by PROs to treat WEEE.

Until 2019, two competing PROs were involved in the Dutch collection and recycling system (Wecycle, WEEE Nederland). To strengthen the Dutch WEEE system and

Figure 11 *Producer associations and PRO active in the Netherlands*

g This is suggested to be a consequence of establishing stakeholder committees in the AGEC law which makes it easier for stakeholders to access information.

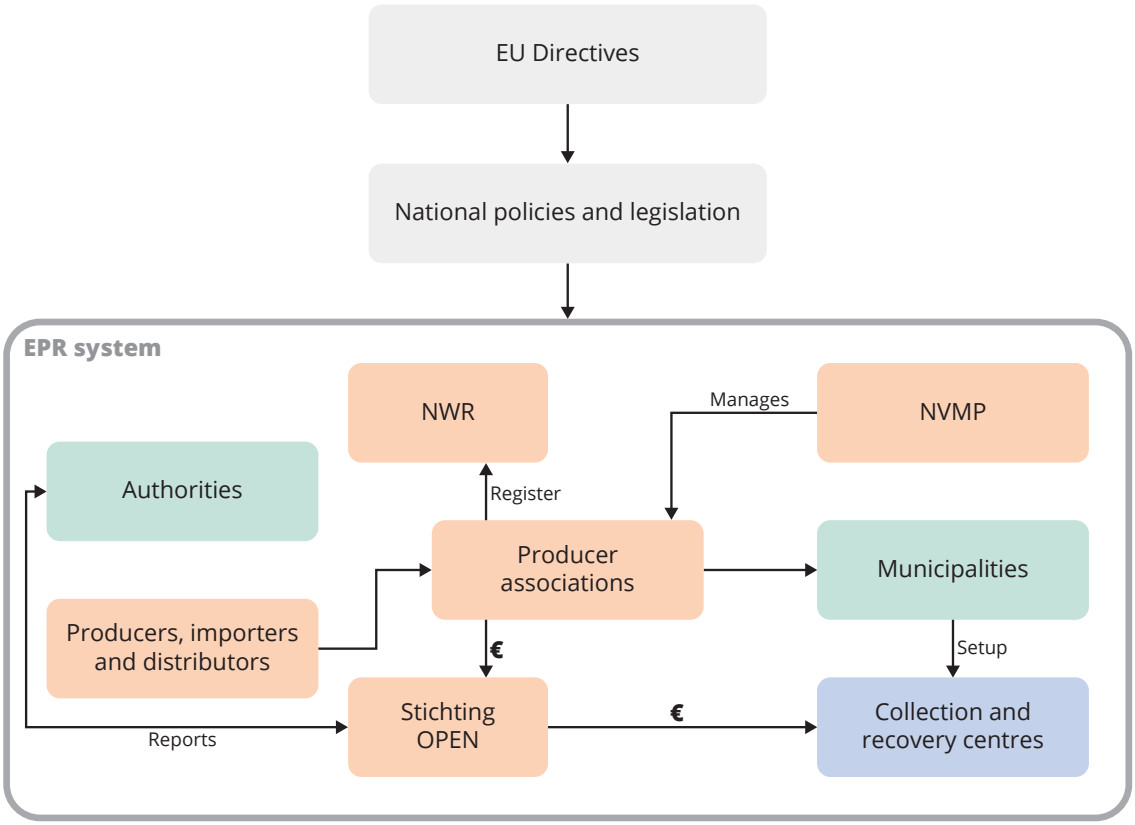


Figure 12 *The governance of the EPR system for WEEE in the Netherlands*

establish a more efficient process, in 2019, these PROs merged into a **monopolistic system**: Stichting OPEN (Organisation of Producer Responsibility for E-waste Netherlands). The foundation is responsible for all the previously involved actors and serves as a liaison partner with the government. The single organisational entity will coordinate contracts and ambition to promote more transparent operations, develop competition and promote cost efficiency. Ultimately, Stichting OPEN focuses on achieving the statutory collection targets on behalf of all producers effectively and efficiently.

As previously mentioned, the producers pay a contribution to the PRO and thereby shift their responsibilities to it. This contribution and its size is, however, not visible to consumers (**invisible fee**). The producer associations come together under the NVMP, and consequently, Stichting OPEN is responsible for organising the collection and recycling. NVMP and Stichting OPEN are non-profit organisations and are financed by producers under the EPR model. However, these organisations do not collect, treat and process WEEE. Consequently, the sorting facilities, processors, and recyclers who take on these obligations must maintain their operations and profit from it. The focus of the PRO is to fulfil the legal EU targets. However, a focus on **fee modularity** is not integrated in this system.

Performance of the Dutch EPR system

From Eurostat data, it can be concluded that in 2015 and 2016, the Netherlands has reached all recovery and recycling targets. For 2017 and 2018, some targets are not met, specifically for automatic dispensers, large household appliances, and medical devices see Appendix.

The general performance data for all product categories for the Dutch system in 2018 are presented in Figure 13[h].

h Full performance data on Eurostat was only available in 2018. The collection data was 2020 was available, and is therefore used to show the target.

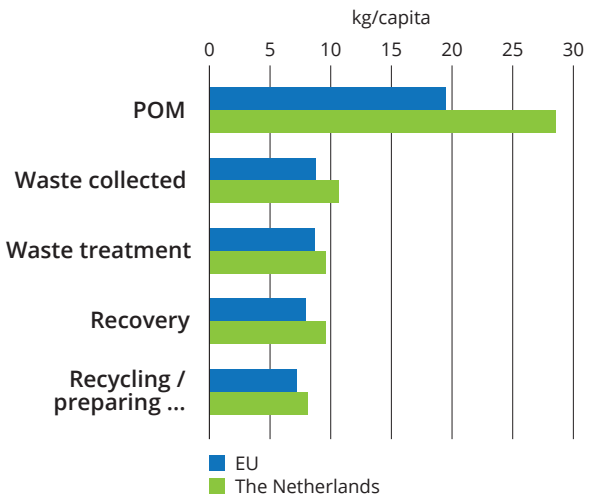


Figure 13 *Descriptive statistics of the Dutch EPR system in 2018*

The collection rate for 2020[i]: 44% (57% excluding PV panels), meaning the target of a 65% collection (based on the average put on the market for the previous three years) has not been met. All recovery targest in 2018 have been met accept in three categories (see Appendix).

Strengths and weaknesses of the Dutch EPR system

Generally, Dutch stakeholders indicate a need to integrate CE principles further in the process. However, overall the stakeholders agree that the Dutch WEEE system conducts effective work, and the current legislation addresses the main points necessary to run the system satisfactorily.

Organising recycling

A common obstacle that Dutch actors identify is tracking and collecting missing volumes. It is suggested that incorrect disposal and export matters are issues that the system would need to solve (W2). Promoting correct WEEE disposal, especially by households, is a fundamental factor for all stakeholders. NVMP also highlights that consumers have to actively contribute to achieve collection targets as established in the WEEE Directive. However, the legislative measures do not impact consumer behaviour since, e.g. no fee penalty is applied to consumers. One identified weaknesses is that the Dutch EPR promotes material recycling over reuse and other R-options (W1). Dutch stakeholders recognize the importance of promoting initiatives that guarantee products' higher value retention and specifically stress the importance of recycle and repair shops in the WEEE system. Especially processors agree that these shops should have a higher representation in the system by receiving incentives and complying with regulations. Producers indicate that different EEE types should prioritize different value retention options.

Efficiency

Producers acknowledge the efficiency of the collective solution where one stakeholder (Stichting OPEN) is responsible for communication with consumers (S1). Which, they argued, allowed for one concise communication and reporting to other stakeholders. Processors financially rely on WEEE processing and recycling, retaining value over the recovered materials or energy return which relates to the weakness of cherry-picking easy gains (W4).

Table 5 *Strengths and weaknesses of the Dutch EPR system as perceived by the stakeholders*

	Strengths	Weaknesses
Organising recycling		• EPR promotes material recycling over re-use and other R-options (W1) • Exports of waste to low-income countries prevail (W2) • The lack of harmonized legislation hinders impacts on product design (W3)
Efficiency	• In practice, both competing and single national PROs exist in different countries; views on which is most efficient are contested (S1)	• In case recycling is profitable, recycling processers compete with collective systems, cherry-picking the easy gains (W4)
Stimulating eco-design		• Producers do not see an incentive to invest in product design (W5)

i Collection rate is calculated as an average of the previous three years.

Stimulating eco-design

Meanwhile, producers do not see a financial return on investing in product design that can lead to the adoption of higher circularity options (W5). Producers indicate that it is impossible to design products that integrate all sustainability requirements since these are diverse (W3). For example, a durable design could hinder recycling. Considering the long list of design requirements, producers generally prioritize specific considerations depending on the EEE functionality. From a processor perspective, concerns on eco-design are mainly related to criteria such as value for reuse, risk in processing, recycling costs, health and safety.

3.4 Lessons for the governance of extended producer responsibility in a circular economy

The application of EPR for WEEE in the EU has resulted in a diverse array of governance practices, where public and local authorities, citizens and businesses collaborate in the disposal collections and recovery of WEEE. Reducing the generation and quantity of EEE and WEEE and increasing collection remains a significant challenge as none of the case study countries have met the targets in the Directive. Below, the key governance aspects of each of these three cases are presented in Table 6.

Key features identified in the governance of WEEE in the case studies:

- **Governance models**: the cases illustrate the diversity in the organisation of EPR and the sharing of responsibilities between the state and market. On one side is the Netherlands, with a monopolistic system, where one PRO (StichtingOpen) now fulfils all responsibilities. On the other side, Italy with multiple PROs, e.g. PV Cycle and Ecolight, and an independent clearinghouse (CdCRAEE). France sits in between, with multiple PROs, e.g. Ecologic and Ecosystem, OCAD3E acting as a Clearinghouse, but the government is more involved at the local level through stakeholder cooperation;
- **Fee visibility:** fees are either 'visible' to the consumer (France) or 'hidden' (The Netherlands and Italy). Visible fees are a more transparent means of communicating with the consumer about the additional costs;
- **Fee modularity:** despite this being recommended in the Directive, this is only systematically organised in France where there I a varying criteria to set the fees, and is tied to the 'fee visibility";
- **Collection targets:** no country has met the most recent collection targets, see Table 7;

Based on the case studies, the following strengths and weaknesses have been identified in Table 7. These provide the concrete areas for the EU to focus on in the upcoming revision of the WEEE Directive.

Transitioning to a circular economy, where fewer materials are wasted, few resources are used, and citizens alter their behaviour to consume less is needed. This requires changing EPR as a policy approach to foster less waste and showing how and where it could be changed. Next we explore such proposals.

Table 6 *Governance characteristics of EPR in Italy, France and the Netherlands*

	Italy	France	Netherlands
Governance model[4]	Multiple PROs with a clearinghouse	Multiple PROs with a clearinghouse	Monopolistic
Number of PROs	13	4	1
Status of PRO	Not-for-profit	Not-for-profit	Not-for-profit
Fee visibility	Hidden to consumers	Visible to consumers	Hidden to consumers
Fee modularity	No	Yes	No
Collection target of 65% achieved	No: 43% 2018	No: 43% 2020	No: 44% 2020
EU recovery/recycling targets achieved (see Appendix)	2 missed	1 missed	3 missed
Strengths	Competitiveness between PROs reduces prices for producers	Pushing progressive fee modulation and stakeholder committees	Communication between actors

Table 7 *Overview of key strengths and weaknesses as identified by the stakeholders*

	Organising recycling		Efficiency		Stimulating eco-design	
	Strength	**Weakness**	**Strength**	**Weakness**	**Strength**	**Weakness**
Italy	Stakeholders pleased with the organisation of the system (+)	Market for secondary materials is undeveloped (-) Legislation is not specific enough (-) Local disputes (-) Lack of sanctions (-)	Stakeholder perceive system as efficient (+)	Free riders (-)		No effect of EPR on eco-design (-)
France	Inclusion of a broad array of actors beyond market in setting targets and direction (+)	Gaps in data reporting, e.g. through secondary collection sights (-) Incorrect disposal of waste by citizens (-)	Data sharing between actors (+)	Free riders (-)	Systematic attempt to stimulate eco-design through fee modularity (+) Attempt to promote reuse through 'repair funds' (+)	Fees can still be too low (-) this might be mitigated by new AGEC Law (-/+)
The Netherlands	Inclusion of many actors, e.g. supermarkets and smaller shops (+)	Missing streams, e.g. in general waste (-)	Efficient and cost effective (+) PROs promote higher Rs (+)	Free riders (-)		No effect of EPR on eco-design (-)

4 Towards a governance of extended producer responsibilty in a circular economy

The transition to a circular economy requires new roles and responsibilities for government, private organisations and citizens. Governments have set a base level of regulatory responsibility for market actors using EPR as a policy principle. This has moved the responsibility (financial and/or organisational) for waste generally away from municipalities. However, there remain many operational issues to the governance of EPR, which are summarised in section 3.4 and in other reports [4,12].

However, what is the future of this instrument in the EU? And what direction can or should it go? The EU can propose more general guidelines (Directives) or more stringent requirements (Regulations) for member states. But new responsibilities are now required to make EPR more fit to contribute to the EU's circular economy ambitions. Below, we outline these four options that should form the basis of improving the governance of EPR for WEEE. These aspects draw on some of the strengths and weaknesses outlined above. However, they go beyond the current design function of EPR and associated measures to promote higher levels of collection and recycling. Instead, we connect EPR more explicitly to the dual lifecycles of the circular economy: product design and product use. These two aspects were covered in the original theoretical proposal of EPR, but failed to materialise in practice. Now we explicitly address *how* to redefine the instrument's scope and function with respect to these two aspects. Examples, studies and illustrations of these options are drawn from the scientific and policy literature on EPR.

1. **Introducing the modulation of fees at the European level:** the fee paid by producers for the collection and recycling of their products should be modulated, i.e. adjusted, based on the circularity and sustainability of the product in question. Fee modulation is allowed under the current EU WEEE law. However, it is not applied systematically. This is already done in France for EEE based on the standardisation of components, weight and specific materials. Fee modulation guidelines have been developed by the OECD [17]. However, the key aspect to the ability of the fees to affect product design is the size of the fee. Studies have illustrated that current fees are between 0.2 and 2% of the product price [12,17] (see Section 3.2). Higher levels of fees, e.g. more than the 2% product price, combined with a visible fee are recommended to be implemented at the EU level;
2. **Broadening the scope of which actors are included in national EPR systems while promoting high R-strategies:** the types of actors and responsibilities within the EPR schemes need to be broadened to include the short, medium-long and long loops of the circular economy (see Tables 8, 9 and 10), not just collection and recycling. This is possible under EU law and has partly been done in France, where civic actors are now included in the functioning and directing of the schemes. However, the transition to a circular economy requires the promotion of more than just recycling of EEE to the other R-strategies. This requires systematically integrating them in the design and functioning of the system, e.g. Repair, Remanufacturing etc. Examples of the new responsibilities for these actors where this has been done in EEE and beyond are provided in the tables below;
3. **Measures to promote the highest value recycling of collected WEEE:** products that reach their end-of-life they need to be effectively collected and treated to the best standard. The current targets and quality measures promote the collection and recycling of electronics based on mass, not on specific material or quality criteria. A standard for the treatment of WEEE EN 45558 is available, although it is not mandatory. We recommend this standard be made mandatory across the EU. In addition, we call for a systematic pan-EU assessment of available and future recycling technologies, possibilities for urban mining from WEEE, and funding options needed to direct this, specifically in the area of critical raw materials recovery from electronics[18]. This must inform the basis of the EEE treatment options. Several studies have shown that PROs are directly

supporting and financing innovative R&D projects. One such project for R&D was done by the French PRO ECO-TLC, which dedicated 500,000 EUR for innovative projects. Conversely, the PRO Eco-mobilizer (furniture) spends more than 1 million EUR on research on topics for recovery of wood fibres [17]. This innovative projects from PROs should become the standard;

4. **Expanding the scope of EPR beyond national borders:** the scope of extended producer responsibility schemes needs to be expanded to account for the multiple uses of the product and the responsibility when products move internationally. While EPR has shown great ability to shift WEEE away from landfilling, many sustainability impacts still occur due to the incorrect collection, transport and treatment of WEEE[3]. The complexity of these systems, rules and their enforcement between member states and beyond has led to varying national rules and issues of transparency between jurisdictions. The quantity of producers, importers, distributors and second-hand sellers makes the tracking and monitoring of WEEE within and between national jurisdictions challenging, especially for the export of collected and secondary products. In particular, this relates to the need for a solid understanding of the quantities of WEEE moving between jurisdictions and suitable mechanisms in place to finance the appropriate disposal. The highly international nature of WEEE supply chains and global trade and flows of WEEE have led some to call for a 'global EPR' or 'ultimate producer responsibility' system [19,20]the approach of an extended producer responsibility is undermined by the exports of used and waste products. This fact causes severe deficits regarding circular flows, especially of critical raw materials such as platinum group metals. With regard to global recycling there seems to be a responsibility gap which leads somehow to open ends of waste flows and a loss or down-cycling of potential secondary resources. Existing product-orientated extended producer responsibility (EPR;

Summary of the governance directions for extended producer responsibility in the European Union

WEEE represents a serious challenge due to the increasing quantities and complexities of the products in question. At the same time, the onset of the circular economy has raised the attention on the unsustainable levels of resource use and waste generation. The WEEE Directive is in need of an update to more effectively contribute to the circular economy ambitions of the EU. This requires new forms of governance, new collaborations and new responsibilities for all actors involved.

This report evaluated the governance of three EPR cases in the EU and outlined the perceived strengths and weaknesses as indicated by the actors (Section 3). From this, we outline four key areas that the next WEEE Directive must explore to address the dual aspects of circular economy: product design and product use. These go beyond measures to promote higher levels of collections and recycling and include:

1. **Introducing the modulation of fees at the European level;**
2. **Broadening the scope of which actors are included in national EPR systems while promoting high R-strategies (Tables 8, 9 and 10);**
3. **Measures to promote the highest value recycling of collected WEEE;**
4. **Expanding the scope of EPR beyond national borders.**

It is the opinion of the authors that these developments are best pursued through a stronger and more uniform set of EPR requirements from the EU. Following the success of the RoHS Directive and the REACH Regulation in terms of mandating product specifications, a more uniform and stringent approach to EPR across the EU is recommended.

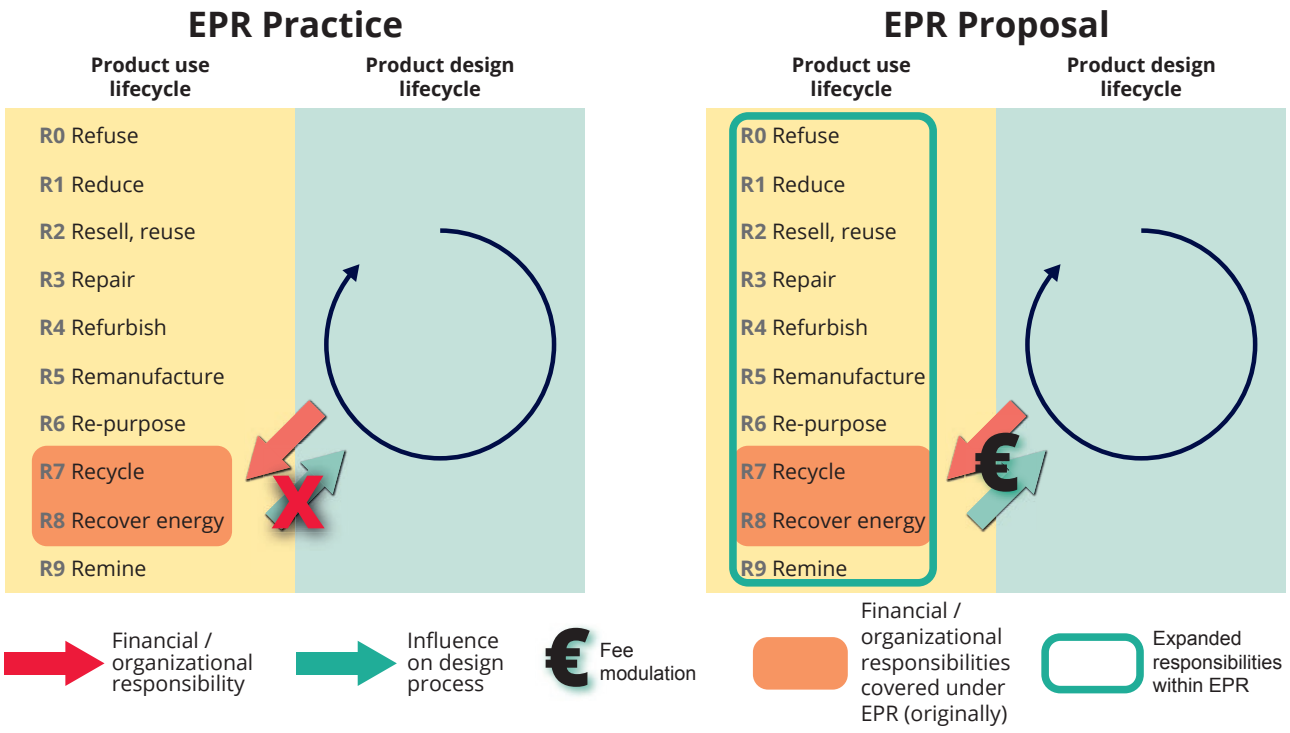


Figure 14 *New governance proposals for EPR for WEEE in the EU. This includes strengthening the link to product design through fee modulation and, among other things, broadening the responsibilities and integration of other R-actors.*

Table 8 *Governance possibilities for short loops within EPR*

R option	Description	Current producer responsibility specified and mandated in EU EPR policy	Proposed new responsibility for EPR for producers	Example and source
R0 Refuse	For consumers to buy less. Also for producers who can refuse to use specific materials or designs.	None	Producers actively promote not to purchase their products, or refuse to use certain hazardous substances. Or, governments and citizen groups actively promote non-consumerist lifestyles and purchasing habits.	*Producers* French producers pay a higher fee for selected products (vacuum cleaners, computers, and games consoles) with brominated flame retardants [17]; In 2011, the clothing brand Patagonia took out an advertisement in the New York Times stating "don't buy this jacket". In an attempt to highlight the excesses of consumer habits during the Black Friday sales; *Consumers* Consume less: examples include concepts such as simple living.
R1 Reduce	Linked to producers, stressing the importance of concept and design cycle, e.g. less material per unit of production (dematerialisation).	None	Fees paid by producers are modulated to promote dematerialization	*Governments/PROs* A one-time 8% bonus, i.e. EPR fee reduction, to producers that achieve weight reductions or that reduce the number of packaging units from the prior year, whilst maintaining ISO-material and functionality standards [21].
R2 Resell, reuse	Second consumer of a product that hardly needs any adaptation and works as good as new.	None	Producers to activity promote networks where consumers can resell.	Producers and authorities to actively promote platforms and collaborate with and fund actors who do this. An example of this exists in France, where social and solidarity actors are included in treat repair and reselling.

Table 9 *Governance possibilities for middle-long loops* within EPR

R option	Description	Current producer responsibility specified and mandated in EU EPR policy	Proposed new responsibility for EPR for producers	Example and source
R3 Repair	Bringing back into working order, by replacing items after minor defects. This can be done peer-to-peer or people in the vicinity.	None	Producers to organise promotion and options for repair for citizens	Conceptual: a white paper developed by the same authors outlined *how* repair actors could and should be integrated in the organisational aspects of EPR [12]; *PROs* Pilot studies by Norwegian PRO Norsirk that has an internal goal of 10% reuse for White goods [22]. Producers and authorities to actively promote platforms and collaborate with and fund actors who do this. An example of this exists in France, where social and solidarity actors are included in treat repair and reselling. The AGEC law in France now requires producers to communicate a list of spare parts and the length they are stored for.
R4 Refurbish	Referring to large multi-component product remains intact while components are replaced, resulting in an overall upgrade of the product.	None	Producers to organise promotion and options for refurbish for citizens	Conceptual: a white paper developed by the same authors outlined *how* repair actors could be integrated in the organisational aspects of EPR [12]; PROs Pilot studies by Norwegian PRO Norsirk that has an internal goal of 10% reuse for White goods. This could be expanded to refurbishing products [22]; Examples of product refurbishing in electronics are found in groups such as DAR Electronics Hub; Or the online marketplace for refurbished products Refurbed.

R option	Description	Current producer responsibility specified and mandated in EU EPR policy	Proposed new responsibility for EPR for producers	Example and source
R5 Re-manufacture	The full structure of a multi-component product is disassembled, checked, cleaned and when necessary replaced or repaired in an industrial process.	None	Producers to organise promotion and options for remanufacturing for citizens	Conceptual: a white paper developed by the same authors outlined *how* repair actors could be integrated in the organisational aspects of EPR [12]; *PROs* Pilot studies by Norwegian PRO Norsirk that has an internal goal of 10% reuse for White goods. This could be expanded to remanufacturing products [22]; Examples of producer remanufacturing include companies such as Samsung via trade-in schemes.
R6 Re-purpose	Popular in industrial design and artistic communities. By reusing discarded goods or components adapted for another function, the material gets a new life.	None	Producers to organise promotion and options for re-purposing for citizens	Conceptual: a white paper developed by the same authors outlined *how* repair actors could be integrated in the organisational aspects of EPR [12]; *PROs* Pilot studies by Norwegian PRO Norsirk that has an internal goal of 10% reuse for White goods. This could be expanded to repurposing products [22];

Table 10 *Governance possibilities for long loops within EPR*

R option	Description	Current producer responsibility specified and mandated in EU EPR policy	Proposed new responsibility for EPR for producers	Example and source
R7 Recycling	Processing of mixed streams of post-consumer products or post-consumer waste streams, including shredding, melting and other processes to capture (nearly) pure materials. Materials do not maintain any of their product structure and can be re-applied anywhere. Primary recycling occurs B2B, whereas secondary recycling takes place post municipal collection.	Yes- although no country has currently met targets.	Best practices for countries and PROs	For treatment standards For mandated WEEE treatment standards see here. Best practices for recycling[4,23] Recycling treatment options[24]
R8 Recovery (energy)	Capturing energy embodied in waste, linking it to incineration in combination with producing energy.	Yes		
R9 Re-mine	Capturing resources from old or existing landfills or dumpsites	None	Urban mining prospects	A database for Urban mining was developed by ProSUM in collaboration with several PROs and WEEE groups.

5 References

1. Geissdoerfer M, Savaget P, Bocken NMP, Hultink EJ. The Circular Economy – A new sustainability paradigm? *J Clean Prod*. 2017;143:757-768. doi:10.1016/j.jclepro.2016.12.048
2. European Commission. *Circular Economy Action Plan. For a Cleaner and More Competitive Europe.*; 2020. https://ec.europa.eu/environment/circular-economy/pdf/new_circular_economy_action_plan.pdf. Accessed June 3, 2020.
3. Forti V, Baldé CP, Kuehr R, Bel G. *The Global E-Waste Monitor 2020*.; 2020. http://ewastemonitor.info/.
4. OECD. *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management*. Vol 10.; 2016. doi:10.1111/jiec.12022
5. Lindhqvist T. Extended Producer Responsibility in Cleaner Production: Policy Principle to promote Environmental Improvements of Product Systems. 2000. doi:http://www.lub.lu.se/luft/diss/tec355.pdf
6. Deautche Umwelthilfe, Ecos, EEB, rreuse. Call to revise EU legislation for Waste Electrical and Electronic Equipment (WEEE). 2022;(March):1-3.
7. Kirchherr J, Reike D, Hekkert M. Conceptualizing the circular economy: An analysis of 114 definitions. *Resour Conserv Recycl*. 2017;127:221-232. doi:10.1016/j.resconrec.2017.09.005
8. Calisto Friant M, Vermeulen WJV, Salomone R. A typology of circular economy discourses: Navigating the diverse visions of a contested paradigm. *Resour Conserv Recycl*. 2020;161:104917. doi:10.1016/j.resconrec.2020.104917
9. European Environment Agency. Is Europe living within the limits of our planet. *EEA Rep*. 2020;(01):68. https://www.eea.europa.eu/publications/is-europe-living-within-the-planets-limits.
10. Reike D, Vermeulen WJV, 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. *Resour Conserv Recycl*. 2018;135(August 2017):246-264. doi:10.1016/j.resconrec.2017.08.027
11. Hanemaaijer A, Kishna M, Brink H, Koch J, Prins AG, Rood T. Netherlands Integral Circular Economy Report 2021. 2021;(January):4. https://www.pbl.nl/sites/default/files/downloads/2021-pbl-icer2021_english_summary-4228.pdf.
12. Vermeulen WJV, Backes CW, Munck MCJ de, et al. *WHITE PAPER on Pathways for Extended Producer Responsibility on the Road to a Circular Economy*.; 2021. doi:10.13140/RG.2.2.11527.93602
13. Campbell-Johnston K, Vermeulen WJV, Reike D, Bullot S. The circular economy and cascading: towards a framework. *Resour Conserv Recycl X*. 2020:100038. doi:10.1016/j.rcrx.2020.100038
14. Mayers K, Butler S. Producer Responsibility Organizations Development and Operations. *J Ind Ecol*. 2013;17(2):277-289. doi:10.1111/jiec.12021
15. Mudgal S, Tinetti B, Trigo A de P, et al. *Material-Efficiency Ecodesign Report and Module to the Methodology for the Ecodesign of Energy-Related Products (MEErP), Part 2 – Enhancing MEErP for Ecodesign. Prepared for: European Commission – DG Enterprise and Industry*.; 2013.
16. Vermeulen WJV, Campbell-Johnston K. Extended Producer Responsibility. In: Worrell E, Reuter MA, Meskers C, eds. *Handbook of Recycling: State-of-the-Art for Practitioners, Analysts, and Scientists*. 2nd ed.
17. Laubinger F, Brown A, Dubois M, Börkey P. Modulated fees for Extended Producer Responsibility schemes (EPR). 2021;(184). https://dx.doi.org/10.1787/2a42f54b-en.
18. Campbell-Johnston K, de Wall IM, Roos Lindgreen E, et al. *POLICY BRIEF on Critical Raw Materials and Their Integration in Extended Producer Responsibility and Eco-Design Policy*.; 2022. doi:10.5281/zenodo.6444189
19. Thapa K, Vermeulen WJV, Olawale O, Deutz P. *Policy Brief: Blueprint for Ultimate Producer Responsibility*.; 2022. doi:10.5281/zenodo.5957710
20. Wilts H, Bringezu S, Bleischwitz R, Lucas R, Wittmer D. Challenges of metal recycling and an international covenant as possible instrument of a globally extended producer responsibility. *Waste Manag Res*. 2011;29(9):902-910. doi:10.1177/0734242X11415311
21. CITEO. The 2020 rate for recycling household packaging. https://www.citeo.com/le- mag/le-tarif-2020-pour-le-recyclage-des-emballages/. Published 2019. Accessed May 31, 2022.

22. Dalhammar C, Wihlborg E, Milios L, et al. Enabling Reuse in Extended Producer Responsibility Schemes for White Goods: Legal and Organisational Conditions for Connecting Resource Flows and Actors. *Circ Econ Sustain*. 2021;1(2):671-695. doi:10.1007/s43615-021-00053-w
23. European Commission. *Development of Guidance on Extended Producer Responsibility (EPR).*; 2014. https://ec.europa.eu/environment/waste/pdf/target_review/Guidance on EPR – Final Report.pdf. Accessed September 30, 2019.
24. Dubois M, Graaf D de, Thieren J. Exploration of the Role of Extended Producer Responsibility for the circular economy in the Netherlands. 2016:54. http://www.ey.com/Publication/vwLUAssets/ey-exploration-role-extended-producer-responsibility-for-circular-economy-netherlands/$FILE/ey-exploration-role-extended-producer-responsibility-for-circular-economy-netherlands.pdf.

6 Appendix

A: Overview of interviewee for this study

France

Type of organisation	Actor
PRO	Ecosystem
	Ecologic
Producers	HP France
	Samsung France
	Orange
Public institutions	ADEME
	Troyes Champagne Métropole
Waste treatment operators	Artémise
	Derichebourg
Social and solidarity economy	Fédération Envie
	Réseau Emmaus
	Le Foyer Aubois
Governance body	CIFREP
Consultancy firm	Recystem pro
Corporate federation	FEDEREC

The Netherlands

Type of organisation	Actor
Producer	NA
Registration and performance	National WEEE Register
Coordination for producer centre	NVMP
Former PRO	Wecycle
Sorting/processing facility	NA

Italy

Type of organisation	Actor
Clearinghouse	CdCRAEE
Collection consortium	ERION
	ECOEM
University	Academia
Regional government	Friuli Venezia Giulia Regio
	Puglia Region
	Latina Province
	Caltanissetta Province
	Manfredonia Municipality

B: WEEE Directive recovery targets per product category

EEE product category (2015: EU-10)	Recovery targets from 15th August 2015
Large household appliances	85% recovered 80% prepared for reuse and recycled
Small household appliances	75% recovered 55% prepared for reuse and recycled
IT and telecommunications equipment	80% recovered 70% prepared for reuse and recycled
Consumer equipment and PV panels	80% recovered 70% prepared for reuse and recycled
Lighting equipment	75% recovered 55% prepared for reuse and recycled
Electrical and electronic tools	75% recovered 55% prepared for reuse and recycled
Toys, leisure, and sports equipment	75% recovered 55% prepared for reuse and recycled
Medical devices	75% recovered 55% prepared for reuse and recycled
Monitoring and control instruments	75% recovered 55% prepared for reuse and recycled
Automatic dispensers	85% recovered 80% prepared for reuse and recycled
EEE product category (2018: EU-6)	**Recovery targets from 15th August 2018**
Temperature change equipment	85% recovered 80% prepared for reuse and recycled
Screens, monitors and equipment containing screens having a surface greater than 100 cm^2	80% recovered 70% prepared for reuse and recycled
Lamps	80% recycled
Large equipment	85% recovered 80% prepared for reuse and recycled
Small equipment	75% recovered 55% prepared for reuse and recycled
Small IT and telecommunication equipment	75% recovered 55% prepared for reuse and recycled

C: Collection and recovery targets

Italy

EEE product category (EU-10)/time	2015		2016		2017		2018	
1. Large household appliances	85% recovered	93.5%	85% recovered	96.0%	85% recovered	95.7%	85% recovered	88.5%
	80% prepared reuse – recycled	89.4%	80% prepared reuse – recycled	91.4%	80% prepared reuse – recycled	90.8%	80% prepared reuse – recycled	83.2%
2. Small household appliances	75% recovered	84.2%	75% recovered	72.7%	75% recovered	93.1%	75% recovered	93.1%
	55% prepared reuse – recycled	83.8%	55% prepared reuse – recycled	72.1%	55% prepared reuse – recycled	92.2%	55% prepared reuse – recycled	92.5%
3. IT and telecommunications equipment	80% recovered	85.1%	80% recovered	83.6%	80% recovered	88.0%	80% recovered	79.2%
	70% prepared reuse – recycled	84.0%	70% prepared reuse – recycled	82.1%	70% prepared reuse – recycled	86.3%	70% prepared reuse – recycled	76.0%
4. Consumer equipment and PV panels	80% recovered	83.9%	80% recovered	95.7%	80% recovered	95.1%	80% recovered	91.5%
	70% prepared reuse – recycled	81.8%	70% prepared reuse – recycled	93.2%	70% prepared reuse – recycled	92.9%	70% prepared reuse – recycled	88.4%
5. Lighting equipment	75% recovered	86.0%	75% recovered	85.9%	75% recovered	76.1%	75% recovered	87.3%
	55% prepared reuse – recycled	84.7%	55% prepared reuse – recycled	84.0%	55% prepared reuse – recycled	73.1%	55% prepared reuse – recycled	85.1%
6. Electrical and electronic tools	75% recovered	74.0%	75% recovered	58.4%	75% recovered	60.6%	75% recovered	57.4%
	55% prepared reuse – recycled	73.8%	55% prepared reuse – recycled	58.2%	55% prepared reuse – recycled	60.4%	55% prepared reuse – recycled	56.9%
7. Toys, leisure, and sports equipment	75% recovered	83.7%	75% recovered	95.8%	75% recovered	98.1%	75% recovered	96.6%
	55% prepared reuse – recycled	82.9%	55% prepared reuse – recycled	93.4%	55% prepared reuse – recycled	95.8%	55% prepared reuse – recycled	94.4%
8. Medical devices	75% recovered	81.1%	75% recovered	79.2%	75% recovered	77.5%	75% recovered	77.2%
	55% prepared reuse – recycled	80.5%	55% prepared reuse – recycled	77.2%	55% prepared reuse – recycled	73.5%	55% prepared reuse – recycled	71.6%
9. Monitoring and control instruments	75% recovered	77.0%	75% recovered	54.7%	75% recovered	53.8%	75% recovered	84.8%
	55% prepared reuse – recycled	76.1%	55% prepared reuse – recycled	52.4%	55% prepared reuse – recycled	51.1%	55% prepared reuse – recycled	79.8%
10. Automatic dispensers	85% recovered	73.9%	85% recovered	74.2%	85% recovered	78.0%	85% recovered	85.0%
	80% prepared reuse – recycled	73.9%	80% prepared reuse – recycled	74.2%	80% prepared reuse – recycled	78.0%	80% prepared reuse – recycled	84.9%

France

EEE product category (EU-10)/time	2015		2016		2017		2018	
1. Large household appliances	85% recovered	90.0%	85% recovered	91.3%	85% recovered – **91%**	91.0%	85% recovered	90.5%
	80% prepared reuse – recycled	80.6%	80% prepared reuse – recycled	80.9%	80% prepared reuse – recycled – **82,1%**	82.1%	80% prepared reuse – recycled	80.5%
2. Small household appliances	75% recovered	85.9%	75% recovered	85.9%	75% recovered – **84,5%**	84.5%	75% recovered	84.4%
	55% prepared reuse – recycled	80.9%	55% prepared reuse – recycled	79.8%	55% prepared reuse – recycled – **77,8%**	77.8%	55% prepared reuse – recycled	76.8%
3. IT and telecommunications equipment	80% recovered	88.9%	80% recovered	88.3%	80% recovered – **86,9%**	86.9%	80% recovered	80.2%
	70% prepared reuse – recycled	83.7%	70% prepared reuse – recycled	82.6%	70% prepared reuse – recycled – **80,2%**	80.2%	70% prepared reuse – recycled	72.8%
4. Consumer equipment and PV panels	80% recovered	89.7%	80% recovered	89.2%	80% recovered – **89%**	89.0%	80% recovered	49.1%
	70% prepared reuse – recycled	83.6%	70% prepared reuse – recycled	83.9%	70% prepared reuse – recycled – **82,4%**	82.4%	70% prepared reuse – recycled	44.0%
5. Lighting equipment	75% recovered	84.8%	75% recovered	85.0%	75% recovered – **86,1%**	86.1%	75% recovered	85.9%
	55% prepared reuse – recycled	76.9%	55% prepared reuse – recycled	77.0%	55% prepared reuse – recycled – **85%**	85.0%	55% prepared reuse – recycled	83.1%
6. Electrical and electronic tools	75% recovered	86.6%	75% recovered	87.2%	75% recovered – **88,5%**	88.5%	75% recovered	86.6%
	55% prepared reuse – recycled	81.5%	55% prepared reuse – recycled	81.5%	55% prepared reuse – recycled – **83,8%**	83.8%	55% prepared reuse – recycled	80.5%
7. Toys, leisure, and sports equipment	75% recovered	85.9%	75% recovered	85.9%	75% recovered – **84,3%**	84.3%	75% recovered	84.3%
	55% prepared reuse – recycled	81.0%	55% prepared reuse – recycled	79.7%	55% prepared reuse – recycled – **77,7%**	77.7%	55% prepared reuse – recycled	76.7%
8. Medical devices	75% recovered	92.1%	75% recovered	92.1%	75% recovered – **93%**	93.0%	75% recovered	87.1%
	55% prepared reuse – recycled	85.8%	55% prepared reuse – recycled	85.8%	55% prepared reuse – recycled – **88,1%**	88.1%	55% prepared reuse – recycled	82.3%
9. Monitoring and control instruments	75% recovered	95.1%	75% recovered	94.1%	75% recovered – **89,3%**	89.3%	75% recovered	89.3%
	55% prepared reuse – recycled	92.3%	55% prepared reuse – recycled	91.0%	55% prepared reuse – recycled – **86%**	86.0%	55% prepared reuse – recycled	77.5%
10. Automatic dispensers	85% recovered	90.3%	85% recovered	91.6%	85% recovered – **90,5%**	90.5%	85% recovered	92.0%
	80% prepared reuse – recycled	90.2%	80% prepared reuse – recycled	90.3%	80% prepared reuse – recycled – **87,7%**	87.7%	80% prepared reuse – recycled	89.8%

The Netherlands

EEE product category (EU-10)/time	2015		2016		2017		2018	
1. Large household appliances	85% recovered	95.6%	85% recovered	95.9%	85% recovered	94.6%	85% recovered	87.7%
	80% prepared reuse – recycled	84.2%	80% prepared reuse – recycled	83.0%	80% prepared reuse – recycled	83.0%	80% prepared reuse – recycled	76.5%
2. Small household appliances	75% recovered	95.7%	75% recovered	95.2%	75% recovered	102.4%	75% recovered	95.3%
	55% prepared reuse – recycled	78.3%	55% prepared reuse – recycled	76.5%	55% prepared reuse – recycled	87.8%	55% prepared reuse – recycled	73.2%
3. IT and telecommunications equipment	80% recovered	95.0%	80% recovered	95.4%	80% recovered	92.5%	80% recovered	93.1%
	70% prepared reuse – recycled	79.5%	70% prepared reuse – recycled	78.5%	70% prepared reuse – recycled	80.3%	70% prepared reuse – recycled	73.9%
4. Consumer equipment and PV panels	80% recovered	97.0%	80% recovered	96.6%	80% recovered	87.7%	80% recovered	90.1%
	70% prepared reuse – recycled	82.5%	70% prepared reuse – recycled	80.4%	70% prepared reuse – recycled	76.7%	70% prepared reuse – recycled	80.8%
5. Lighting equipment	75% recovered	97.3%	75% recovered	97.5%	75% recovered	99.4%	75% recovered	114.3%
	55% prepared reuse – recycled	72.0%	55% prepared reuse – recycled	70.9%	55% prepared reuse – recycled	84.5%	55% prepared reuse – recycled	72.2%
6. Electrical and electronic tools	75% recovered	96.2%	75% recovered	96.0%	75% recovered	83.6%	75% recovered	86.3%
	55% prepared reuse – recycled	76.3%	55% prepared reuse – recycled	74.8%	55% prepared reuse – recycled	70.1%	55% prepared reuse – recycled	62.9%
7. Toys, leisure, and sports equipment	75% recovered	96.3%	75% recovered	94.2%	75% recovered	90.6%	75% recovered	88.3%
	55% prepared reuse – recycled	76.3%	55% prepared reuse – recycled	73.2%	55% prepared reuse – recycled	75.9%	55% prepared reuse – recycled	62.2%
8. Medical devices	75% recovered	92.8%	75% recovered	95.7%	75% recovered	88.1%	75% recovered	86.4%
	55% prepared reuse – recycled	74.8%	55% prepared reuse – recycled	71.8%	55% prepared reuse – recycled	71.9%	55% prepared reuse – recycled	54.3%
9. Monitoring and control instruments	75% recovered	91.2%	75% recovered	93.7%	75% recovered	87.6%	75% recovered	90.5%
	55% prepared reuse – recycled	78.5%	55% prepared reuse – recycled	77.7%	55% prepared reuse – recycled	80.6%	55% prepared reuse – recycled	79.1%
10. Automatic dispensers	85% recovered	96.0%	85% recovered	97.1%	85% recovered	48.3%	85% recovered	64.0%
	80% prepared reuse – recycled	85.3%	80% prepared reuse – recycled	87.6%	80% prepared reuse – recycled	44.0%	80% prepared reuse – recycled	45.7%