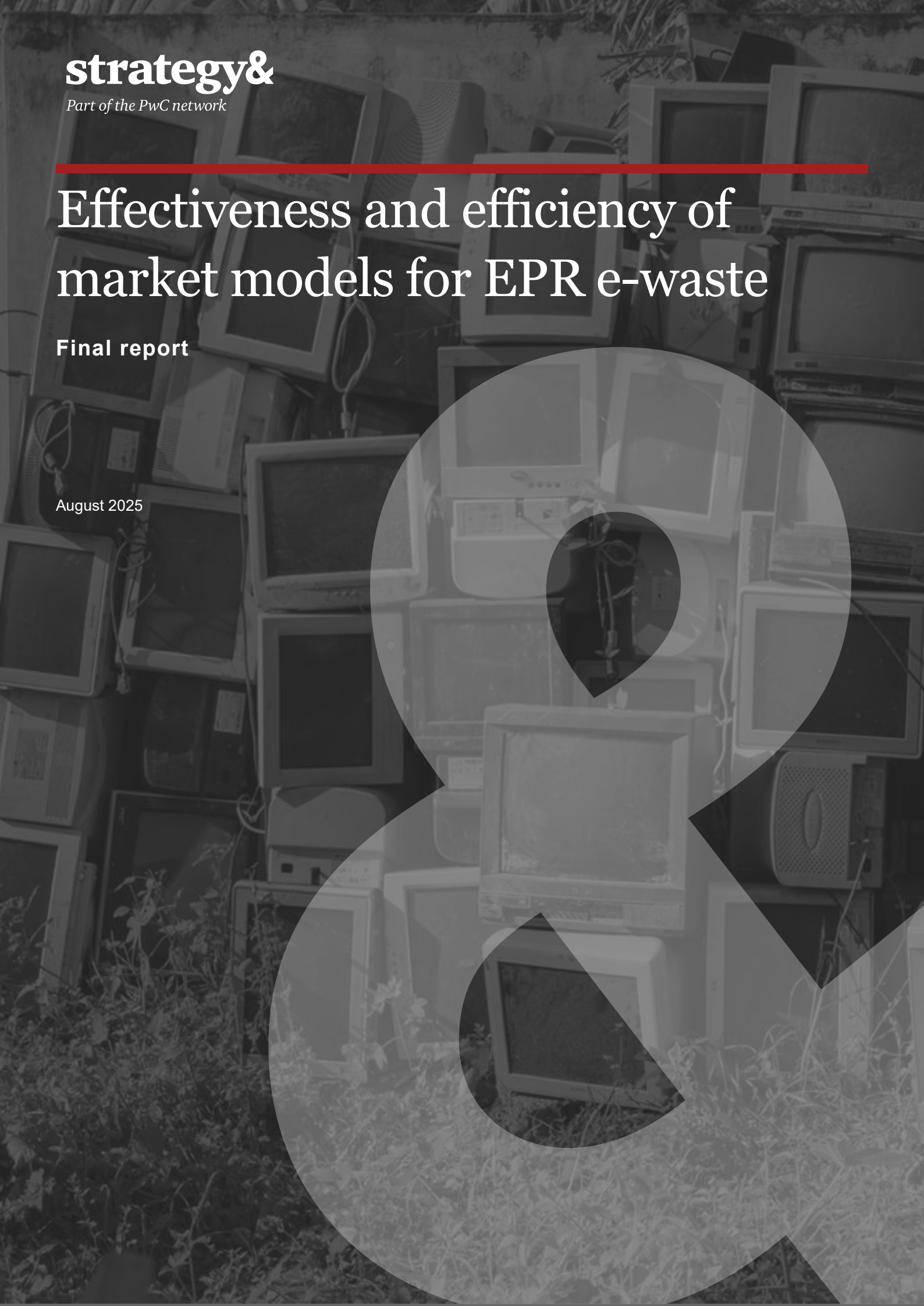




strategy&

Part of the PwC network

Effectiveness and efficiency of market models for EPR e-waste

Final report

August 2025

Important notice

PwC (hereafter: 'PwC' or 'we' or 'us') has been requested by Stichting OPEN (hereafter: the 'Client') to write a report on the role and performance of EPR systems for e-waste in Europe in terms of effectiveness and efficiency.

PwC has prepared a confidential report 'Effectiveness and efficiency of market models for EPR e-waste', dated 29 August 2025 (hereafter: the 'Report') at the request of the Client. The Report is addressed to the Client has been prepared for the sole benefit and use of the Client. The report has been prepared in accordance with our engagement letter dated 31st January 2025.

The Report is strictly confidential. You are not allowed to share the Report (either in its entirety or parts of it) with third parties. Nor are you allowed to refer to information contained in the Report in your communication with any third parties.

In preparing the Report, PwC has based itself (in part) on documents and information PwC received from various parties (including the Client) (hereafter: 'Third Party Information'). PwC has used the Third Party Information on the assumption that this information is correct, complete and not misleading. The reliability of the Third Party Information has not been verified or established by PwC. PwC has not performed an audit of the Third Party Information, nor an assessment aimed at determining its completeness and accuracy in accordance with international audit or review standards. PwC makes no representation or warranty, express or implied, as to the accuracy or completeness of the Third Party Information or related representations in the Report.

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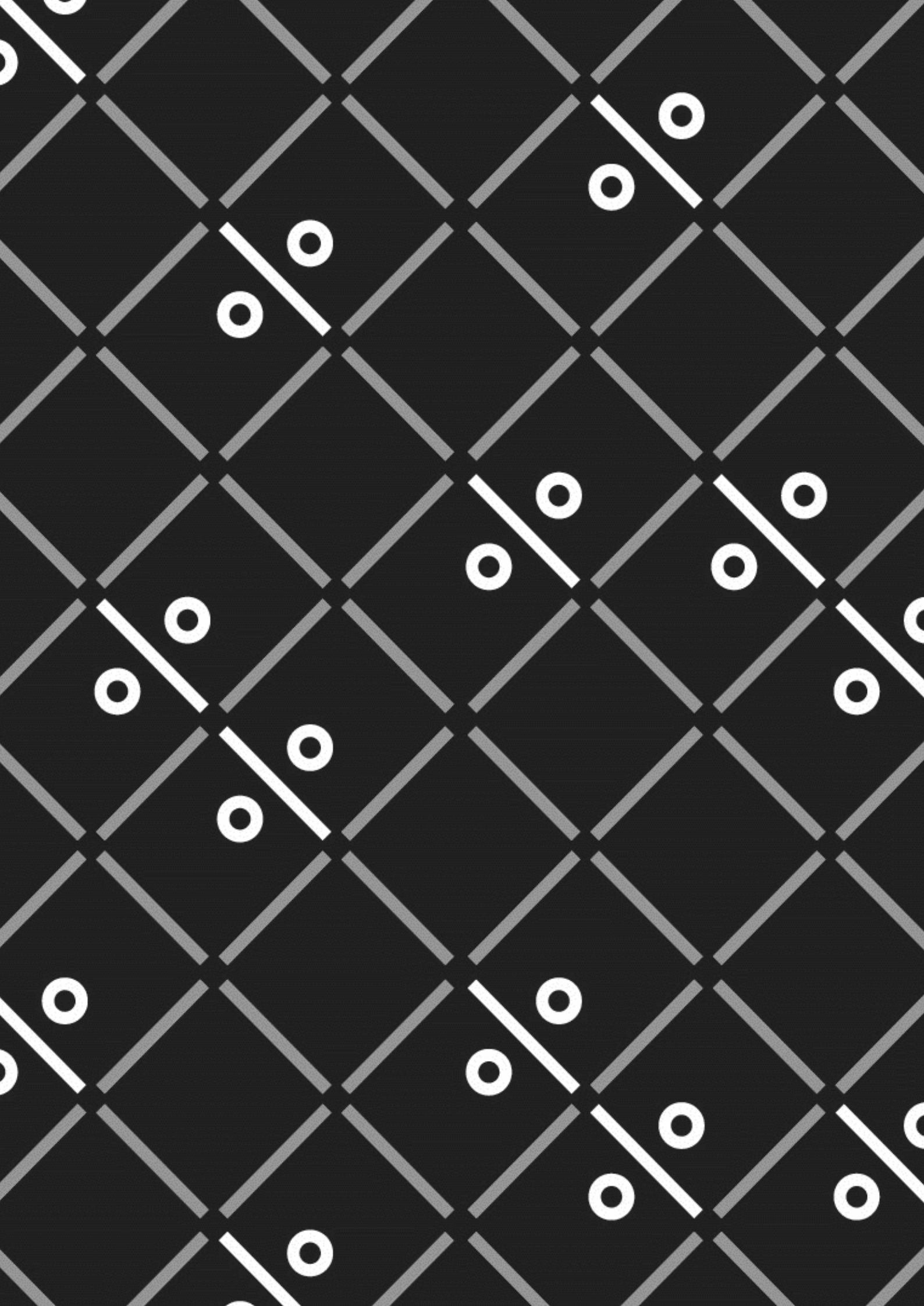
This Report and any dispute which may arise out of or in connection with it, shall be governed by and construed in accordance with the laws of the Netherlands.



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1. Executive Summary

In the Netherlands, Stichting OPEN is responsible for executing the Extended Producer Responsibility (EPR) for waste from electrical and electronic equipment (WEEE) and batteries. Initially the Dutch EPR system operated as a single scheme (monopoly) but gradually transitioned into a competitive model with multiple Producer Responsibility Organizations (PROs). In 2021 the PROs merged into a new single entity, Stichting OPEN. Stichting OPEN oversees the collection and treatment of WEEE and battery waste, aiming to achieve collection, reuse, and recycling targets at the lowest possible societal costs, with a special focus on recycling raw materials and minimizing the use of scarce resources. Although the current EPR system in the Netherlands is not up for debate, Stichting OPEN seeks to optimize it amid an evolving recycling market and growing political interest in the EPR instrument, both domestically and in Europe. Stichting OPEN has engaged Strategy& to evaluate different EPR market models in Europe, assessing their effectiveness (goals achieved) and efficiency (costs for producers and importers).

Stichting OPEN meets recycling targets across various WEEE categories, yet collection remains a challenge. In 2023, 80% of collected WEEE was recycled, and the recycling targets for all fractions were met. However, the collection rate of 43% excluding solar-PV (29% including solar-PV) in 2023 is below the 65% target, relative to the three-year average put-on-market (POM). The collection performance is strongly influenced by the characteristics of the POM. Firstly, the Netherlands boasts the highest POM per inhabitant in the EU at 44 kg, which is 50% above the EU average, making the absolute collection target more challenging. Secondly, the POM per inhabitant surged by approximately 65% between 2018 and 2023, vastly outpacing the available volumes for collection. Thirdly, the increase in POM largely stems from solar-PV expansion, which accounts for 30% of the POM. Given the lifespan of solar panels, volumes will most likely not be available for collection soon, adversely affecting the overall collection rate. The European commission is currently evaluating the WEEE Directive. Most countries in Europe currently do not meet the 65% collection target, indicating that the current collection target might not be fit for purpose. To improve the collection performance, Stichting OPEN has developed an Action Plan for 2025-2030, detailing 15 initiatives. These initiatives include establishing more collection points at construction and demolition sites, partnering with B2B waste service providers, and expanding the 'Stimuleringsregeling' to benefit large WEEE producers.

From an international perspective, the Dutch EPR system has a strong performance in terms of quality, awareness creation, and a long-term circularity perspective, albeit at a higher cost. Five case studies were examined in this study: Belgium, Ireland, Portugal, Italy and Spain. The Netherlands performs relatively well in terms of collection per inhabitant. Belgium has the highest collection rate at 60%, compared to 43% for the Netherlands. The overall recycling rate is in line with surrounding countries. The Netherlands is recognized for its high recycling quality by adhering to the strict CENELEC recycling standards. It also applies strict rules for measurement and data reporting, with an emphasis on data accuracy. Quality is optimized contractually across the entire chain, ensuring that the output from one partner seamlessly fits the input requirements of the next. Additionally, the Netherlands ensures a long-term perspective through extended contracts with treatment facilities to allow for investments in innovation. Specifically for solar PV, the Netherlands is already sourcing partners to ensure adequate investment in infrastructure for recycling 10 years from now. Furthermore, Stichting OPEN is examining new ways to increase collection through the 'Stimuleringsregeling' to encourage the scrap metal sector to recycle WEEE, and through innovative financing (e.g., provision financing).

In terms of cost efficiency, the Dutch EPR system is slightly more expensive than surrounding countries. None of the case studies outperform on both effectiveness and efficiency. Depending on the perspective – societal costs per inhabitant, collection, or recycling – different countries achieve a high efficiency.

While Stichting OPEN has established an effective EPR system, it can still learn from international best practices to further improve the collection and recycling performance

- *Marketplace compliance approach* (Belgium, Italy): Third-party sellers through online sales platforms (e.g. Amazon, eBay) form a key source of undocumented streams and free riding. Making these online sales platforms responsible for seller compliance can simplify enforcement by the PRO.
- *Export waste codes* (Germany): Improved tracking of exported e-waste can reduce undocumented exports. In Germany, P&Is are assigned a WEEE registration number. This number must be displayed in all activities related to WEEE, such as introducing products to the market or exporting them. The use of a WEEE registration number helps minimize free riding and undocumented exports. In the Netherlands this could improve tracking of export volumes for reuse.
- *Efficiency bonuses for collection points* (Italy): Offering bonuses for sorting quality and volume can encourage collection points to enhance WEEE collection and improve the recyclability of collected volumes.

By incorporating these practices, Stichting OPEN can further strengthen its EPR system, addressing key challenges in online sales compliance, export tracking, and collection point efficiency.

Across Europe various Extended Producer Responsibility (EPR) market models exist – single scheme, duopoly, multiple PROs – all aiming to enhance collection, recycling, and environmentally responsible disposal of electronic waste. The number of PROs allowed in the market is a key design feature for EPR models. EPR models in the case studies examined range from single schemes (Netherlands, Belgium) to duopolies (Portugal, Ireland), and models with multiple competing PROs in the market (Italy, Spain).

Central coordination is essential across all EPR market models as most countries have implemented central coordination entities such as central registers, clearing houses, and entities that allocate collection points. Irrespective of the number of PROs, most countries have implemented a central register, which maintains an up-to-date inventory of all producers and importers, calculates market shares, monitors compliance, and fulfills the EU's data reporting obligations. In countries with multiple PROs, the emergence of clearing houses demonstrates the need for coordination among PROs. These clearing houses typically perform a financial post-calculation function to correct for differences between a PRO's market share and actual volumes collected. In some cases, allocation of collection points among PROs is coordinated by a central entity, as is the case for Italy and Ireland. Additionally, some clearinghouses also perform typical PRO activities such as coordinating awareness campaigns. Besides coordinating entities, coordination between PROs is also evident through legislation. In Italy, legislation establishes minimum requirements for budget allocation to awareness campaigns, to create a level playing field for the 16 PROs in the market.

To improve the overall efficiency of an EPR system, competition among waste operators is more important than competition among PROs – around 80% of total EPR costs for the evaluated countries entails direct costs for contracting collection and treatment of electronic waste. Irrespective of the EPR market model, competition in the waste market itself is present across the value chain. The markets for collection, transport, and treatment of e-waste are competitive, with waste companies competing for business and government contracts. Stichting OPEN, as the single PRO in the Netherlands, leverages the competitive Dutch waste market by contracting the collection and processing of e-waste. The majority of Stichting OPEN's costs are directly related to contracting collection, sorting and recycling (ca. 80%), whereas a smaller fraction of the costs (ca. 20%) is related to the organizational and administrative functions. Therefore, competition among waste operators is far more important than competition among PROs in improving the overall EPR efficiency.

Central coordination plays a crucial role in enhancing environmental performance, ensuring structural viability, and promoting long-term investments in innovation. It guarantees consistent performance, continuity, and representation of various stakeholder interests. In the Netherlands, producers and industry actively shape the system through board positions, fostering a more collaborative and industry-aligned approach. This contrasts with countries where PROs are owned by waste management companies

or investors. Additionally, a single-scheme system provides more effective tools to tackle free riding and allows costs to be efficiently passed on to P&Is, ensuring long-term viability. This approach is vital for investments that benefit society but may not be immediately profitable. Competitive systems struggle to make such investments due to the risk of P&Is switching between PROs, potentially hindering long-term sustainability initiatives. From a broader European perspective, a single scheme system is better positioned to contribute to European goals on the recovery of critical raw materials, which require long-term investments and an aligned approach among member states. Moreover, a single scheme offers a unified interface for government interaction and places legal obligations on a single entity. Stichting OPEN can also take enforcement actions, relieving the government of this responsibility while remaining an independent organization that can contribute valuable perspectives on new policies.

EPR systems with multiple PROs are more complex and present several challenges that can hinder the effectiveness and level playing field of the EPR system. First, competition between PROs can lead to an uneven playing field, with larger companies potentially receiving preferential treatment in terms of service and pricing over smaller P&Is. Second, fragmentation of monitoring data across multiple PROs hampers transparency and consistency, making it more difficult to address free-rider issues. Different PROs might use different measurement points or standards, and fragmented data makes it more difficult to track which P&Is are evading their responsibilities. Third, PROs may be hesitant to invest in long-term awareness and prevention initiatives, as these investments increase immediate costs, but do not yield immediate results and will benefit other PROs in case P&Is switch. Furthermore, the competitive push on prices incentivizes the use of non-accredited recyclers to lower costs. Most producers are based in the US and Asia, with limited local bonding and strong focus on costs. Lastly, even within competitive EPR models, central coordinating entities such as national registers and clearing houses play a vital role in overseeing competition. In a competitive model these central coordinating entities create an additional layer of complexity and cost, requiring PROs to operate more efficiently to offset these expenses. This can divert resources from core environmental objectives and potentially reduce the overall effectiveness of the EPR system.

		 Netherlands	 Belgium	 Ireland	 Portugal	 Italy	 Spain
Characteristics	# PROs	1	1	2	2	16	12
	Coordination	○	○	◐	◐	●	●
	Collection	◐	◐	◐	●	○	○
	Transport	●	●	●	●	●	●
	Sorting	◐	-	-	◐	-	●
	Treatment	●	●	◐	◐	●	●
Additional regulation	Profit / non-profit	Non-profit	Non-profit	Non-profit	Non-profit	Non-profit	Non-profit
	Clearinghouse	None	None	Financial & allocation	Financial	Allocation	Allocation
	Standards for treatment	CENELEC-certified	EN treatment certified	EN treatment certified	Set by APA based on EU regulations	Set by CdC based on EU regulation	In accordance with EU regulation
	Set prices	Calculation method set by government	Approved by 3 regional governments	No	Approved by economic affair policy	No	No
	Visible fee for consumer	No	Yes	Yes	No	No	No
	Regulation on campaigns	No	No	No	Yes	Yes	No

Figure 1: Level of competition and regulation per country

International comparison effectiveness and efficiency

						
	Netherlands	Belgium ¹	Ireland	Portugal	Italy	Spain
Scope	B2C and B2B	B2C and B2B	B2C	B2C and B2B	B2C and B2B	B2C and B2B
Number of PROs	1	1	2	2	16	12
Inhabitants (# m)	18	12	5	11	59	49
Put-on-market 3-year average (kt)	789	338	114	228	1695	1128
Put-on-market 3y-average per inhabitant (kg/inh)	44	29	21	21	29	23
Collection points / km²	0,25	0,41	0,02	0,21	0,04	0,07
Collection points / 1000 inhabitants	0,48	1,05	0,26	1,78	0,20	0,68
Total producer contribution (€ m)	€59m	€35m ²	€16m	€16m	€100m	€90m
Collection per inhabitant (kg/inh) <i>WEEE Forum 2023</i>	12	14	10	4	8	7
Collection rate (%) <i>WEEE Forum 2023 (national reporting)</i>	28% (29%)	49%	46% (53%)	21% (20%)	29%	32%
Collection rate excl. PV (%) <i>WEEE Forum 2023 (national reporting)</i>	42% (43%)	56%	51% (53%)	21% (20%)	30%	43%
Recycling per inhabitant (kg/inh) <i>Eurostat 2022 (national reporting)</i>	8	10	10	3	8	6
Recycling rate (%) <i>Eurostat 2022 (national reporting)</i>	73% (80%)	73% (83%)	82% (80%)	57% (79%)	84%	69%
Recovery per inhabitant (kg/inh) <i>Eurostat 2022 (national reporting)</i>	10	11	12	5	8	6
Recovery rate (%) <i>Eurostat 2022 (national reporting)</i>	90% (98%)	81% (95%)	94% (95%)	100% (86%)	89%	75%
Innovation	High	High	High	Medium	Medium	Medium
Awareness	High	High	Medium	High	Medium	Medium
Producer contribution per inhabitant (€/inh)	€3,31	€2,98	€2,92	€1,54	€1,70	€1,85
Producer contribution per ton 3-year average pom (€/t)	€75	€104	€137	€72	€59	€80
Producer contribution per ton collected (€/t)	€271	€213	€297	€349	€203	€247
Producer contribution per ton recycled (€/t)	€411	€290	€288	€516	€224	€311
Producer contribution per ton recovered (€/t)	€331	€263	€252	€293	€210	€288
Free-riding (%) <i>Expert input</i>	< 5%	N/A	N/A	15-20%	< 10%	N/A

 Better than average of selected countries

(1) For Belgium POM and collection, the latest available data is 2022; (2) €25m producer contribution + €10m reserves

Figure 2: International comparison of case study countries (2022, 2023)

2. Introduction

2.1. Context and objective

Stichting OPEN is responsible for implementing the extended producer responsibility (EPR) for producers and importers (P&Is) of electric and electronic equipment (EEE) and batteries in the Netherlands. Its goal is to meet collection, reuse, and recycling targets for e-waste at the lowest possible societal cost, emphasizing recycling and minimizing the use of new raw materials. This is accomplished by organizing and financing collection, sorting, recycling, and reuse systems for both business-to-consumer and business-to-business e-waste. Stichting OPEN coordinates the waste management system by contracting these services from waste management operators, thereby contributing to a circular economy for e-waste.

For 2021-2025, the Ministry of Infrastructure and Water Management (I&W) has declared the waste management contribution agreement (ABBO) concerning waste from electric and electronic equipment (WEEE) with Stichting OPEN generally binding (AVV)¹. As a result, all P&Is of WEEE are obligated to fulfill their extended producer responsibilities through Stichting OPEN. The ABBO for bicycle accumulators with Stichting EPAC was declared legally binding by I&W for 2022-2027. Stichting EPAC and Stichting OPEN merged in 2024². The ABBO for portable batteries with Stichting OPEN has been declared legally binding by I&W for 2024-2028³. These AVVs provide the legal framework for managing WEEE, bicycle accumulators, and portable batteries in the Netherlands, collectively referred to as e-waste. Stichting OPEN thus plays a crucial role in coordinating and financing e-waste collection and recycling efforts in the Netherlands and ensures that Dutch collection and recycling targets for e-waste are met.

Concurrently, the recycling market is experiencing several changes, including evolving product portfolios, increasing volumes and targets, and growing participation of specific (sub)sectors and larger European players in sustainability. Moreover, Stichting OPEN's AVV for WEEE expires at the end of 2025, and the European Council is set to assess the necessity for a revision of the European WEEE Directive by 2026 at the latest. In light of these developments and the existence of various ERP systems for e-waste in Europe, Stichting OPEN considers it relevant to evaluate the Dutch ERP system and alternative ERP systems for effectiveness and efficiency.

Strategy& has been engaged to assess the effectiveness and efficiency of various EPR market models in Europe. The central question in this research is: How do different EPR market models for e-waste in Europe compare to the Dutch EPR system for e-waste in terms of effectiveness and efficiency? The report addresses the performance of EPR systems in the Netherlands, Belgium, Ireland, Portugal, Italy and Spain. These countries represent various market models, including single-schemes, duopolies and systems with multiple competing PROs. In addition, the report provides practical insights on European 'best practices' to further improve the performance of the Dutch EPR system.

Our report answers the central question as follows. Chapter 3 introduces the concept of EPR for e-waste. Chapter 4 describes the Dutch EPR system for e-waste, addressing the historical context, organization, and performance in terms of effectiveness and efficiency. Chapter 5 covers the performance of concrete case studies in surrounding countries. Chapter 6 provides an comparative international perspective on EPR

¹ Rijkswaterstaat. (2021). Kennisgeving van het algemeen verbindend verklaren van de overeenkomst inzake de afvalbeheerbijdrage voor AEEA, Ministerie van Infrastructuur en Waterstaat. *Staatscourant van het Koninkrijk der Nederlanden*. <https://zoek.officielebekendmakingen.nl/stcrt-2021-7385.html>

² Rijkswaterstaat. (2022). Kennisgeving van het algemeen verbindend verklaren van de overeenkomst inzake de afvalbeheerbijdrage voor fietsaccu's, Ministerie van Infrastructuur en Waterstaat. *Staatscourant van het Koninkrijk der Nederlanden*. <https://zoek.officielebekendmakingen.nl/stcrt-2022-16052.html>

³ Rijkswaterstaat. (2024). Kennisgeving van het algemeen verbindend verklaren van de overeenkomst inzake de afvalbeheerbijdrage voor draagbare batterijen, Ministerie van Infrastructuur en Waterstaat. *Staatscourant van het Koninkrijk der Nederlanden*. <https://zoek.officielebekendmakingen.nl/stcrt-2024-608.html>

market models, comparing the effectiveness and efficiency across case studies. Chapter 7 provides an overarching perspective on the advantages and disadvantages of various EPR market models.

2.2. Effectiveness and efficiency

This research primarily focuses on evaluating the performance of various EPR systems for e-waste in Europe. The different EPR systems are described in terms of effectiveness and efficiency, as illustrated in Figure 2. Effectiveness refers to the extent to which targets are achieved. Key quantitative indicators include the performance on collection and recycling. Additionally, effectiveness considers qualitative factors such as the contribution of an EPR system to stimulating innovation and increasing knowledge and awareness among disposers of e-waste.

Efficiency, on the other hand, focuses on the costs of the EPR systems in achieving these targets. A significant portion of these costs are funded by P&I contributions. These P&I contributions approximate the societal costs of the EPR system, as they cover the supply chain deficit – that part of the costs not covered by the returns from reusing and recycling e-waste. Across EPR systems, differences exist in cost and revenue structures, driven by factors such as material ownership. Consequently, it is relevant to include the total costs and revenues of an EPR system in the research to provide a comprehensive assessment of efficiency.

Performance indicators EPR system		
Effectiveness	<i>The extent to which the entity's efforts contribute to the intended objectives</i>	Collection
		Recycling
		Innovation
		Knowledge and awareness
Efficiency	<i>The extent to which objectives are achieved at the lowest possible cost</i>	Total system costs
		Material revenue
		Costs for producers and importers
		Coordination and operational costs

Figure 3: Performance indicators of EPR systems

2.3. Accountability

The research combined literature reviews, data from Stichting OPEN, and interviews with representatives from various European EPR organizations. The reviewed literature consists of (scientific) articles focused on comparative EPR studies, relevant policy studies, monitoring reports for different countries, annual reports, and websites of the EPR organizations. Interviews were conducted with various EPR organizations gather diverse perspectives: Stichting OPEN, Recupel, WEEE Ireland, Electrão, Erion and Ecotic.

3. Extended Producer Responsibility

At its core, extended producer responsibility (EPR) encourages a circular economy, striving to achieve recycling at minimal societal costs. This approach aims to shift the paradigm from a linear "take-make-dispose" model to a more sustainable, closed-loop system.

EPR is a policy tool that integrates the environmental costs associated with products throughout their lifecycle into their market value. It stipulates that producers or importers are responsible, both physically and financially, for the environmental impacts and waste generation resulting from the production process and subsequent use of their equipment, as well as for its management at the end of its life.

The primary goals of EPR are to prevent and reduce e-waste, promote recycling and reuse, and ultimately achieve maximum reusability while reducing the consumption of natural resources. P&Is are responsible for the EEE and the batteries they introduce to the market. While this responsibility is fundamentally individual, implementation is often organized collectively through one or more Producer Responsibility Organizations (PROs).

This chapter delves into the legal framework underpinning EPR, and the objectives set by the European Union. It also explores various levers shaping an EPR system, providing insight into how these mechanisms work together to promote environmental sustainability and economic efficiency in waste management.

3.1. European legislative framework

This section presents an overview of the legal framework governing EPR systems across Europe. While this introduction provides a broad perspective, the subsequent case studies and analysis in the remainder of the report will focus specifically on the EPR system for WEEE.

WEEE Directive (2002/96)

The WEEE Directive (2002/96) was Europe's first directive on WEEE management. The objective of the directive is to establish producer responsibility and to lay down the essential criteria for WEEE management at the European level, considering the rapidly growing amount of WEEE, insufficient WEEE recycling, and different national applications. It introduces the principle of producer responsibility as one means of encouraging design and production of EEE that considers their repair, disassembly, and recycling. The directive states that each producer is responsible for financing the management of waste from his own products, giving them the option to do so individually or through a collective scheme, and that by 2005 the full costs for collection, recycling and treatment of WEEE must be borne by the producers. WEEE is categorized into ten different categories. The directive introduced a collection target for WEEE of 4kg per inhabitant per year from private households by December 2006. It introduced recycling and recovery targets ranging from 50-80% depending on the category of WEEE, to be achieved by December 2006⁴.

RoHS Directive (2002/95)

Alongside the WEEE Directive, the EU adopted the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC. This legislation complemented the WEEE Directive by restricting the use of certain hazardous substances in electrical and electronic equipment, specifically lead, mercury, cadmium, hexavalent

⁴ European Union. (2002). Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) - Joint declaration of the European Parliament, the Council and the Commission relating to Article 9. *Official Journal of the European Union*. <https://eur-lex.europa.eu/eli/dir/2002/96/oj/eng>

chromium, polybrominated biphenyls (PBBs), and polybrominated diphenyl ethers (PBDEs). The latter two are brominated flame retardants, chemicals added to materials to enhance fire resistance.

The RoHS Directive was introduced to address disparities in laws implemented by member states on this topic, which had caused barriers to trade, distorted competition, and impacted the internal market. The directive recognized that even if WEEE was collected and recycled in accordance with the WEEE Directive, its content of hazardous substances would still pose a risk to the environment.

Consequently, the directive urged producers to substitute these six hazardous substances with safer materials, where economically and technically feasible. Ultimately, the RoHS Directive aimed to make recycling of WEEE less harmful and more economically profitable, while promoting environmental protection and public health throughout the product lifecycle⁵.

Battery Directive (2006/66)

The EU Battery Directive 2006/66/EC, along with its subsequent amendments, is a comprehensive set of regulations designed to address the environmental impact of batteries and accumulators throughout their lifecycle. This directive applies to all types of batteries and accumulators, regardless of their shape, volume, weight, material composition, or intended use.

The primary objectives of the EU Battery Directive are to reduce the use of hazardous substances in batteries, improve the collection and recycling of waste batteries, and enhance the overall environmental performance of batteries. To achieve these goals, the directive implements several key provisions, including restrictions on the use of mercury and cadmium in batteries, labeling requirements for battery capacity and recycling symbols, and the establishment of minimum collection rates for waste batteries.

A central aspect of the directive is the concept of producer responsibility. Manufacturers and importers are held accountable for the collection, treatment, and recycling of waste batteries. This approach encourages companies to consider the entire lifecycle of their products and take steps to minimize environmental impact.

The directive also sets specific targets for member states to achieve. For instance, countries are required to meet minimum collection rates for portable batteries, with a goal of 45% set for 2016. Additionally, the directive establishes recycling efficiency targets for different types of batteries, promoting the recovery of valuable materials and reducing waste⁶.

Waste Framework Directive (2008/98/EC)

In 2008, the EU revised its waste framework with the Waste Framework Directive 2008/98/EC. While not specific to WEEE, this directive reinforced the principles of EPR and forms the foundation of European legislation on waste management.

The directive's primary aim is twofold: to protect the environment and human health by preventing or reducing the adverse impacts of waste generation and management, and to harmonize and improve waste management practices across the EU.

To achieve these goals, the directive introduces three key concepts:

⁵ European Union. (2002). Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment. *Official Journal of the European Union*. <https://eur-lex.europa.eu/eli/dir/2002/95/oj/eng>

⁶ European Union. (2006). Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC (Text with EEA relevance). *Official Journal of the European Union*. <http://data.europa.eu/eli/dir/2006/66/oj>

1. The Waste Hierarchy: This prioritizes waste management options in order of environmental preference - prevention, re-use, recycling, recovery, and disposal.
2. The Polluter Pays Principle: This ensures that the costs for waste management are borne by the original waste producer, internalizing environmental costs.
3. Extended Producer Responsibility (EPR): This principle holds producers responsible for the entire lifecycle of their products, including take-back, recycling, and disposal.

Notably, the Waste Framework Directive introduces EPR as a general principle for waste management at the European level, marking a significant step towards more sustainable product lifecycles and waste management practices⁷.

RoHS Directive (2011/95)

The RoHS Directive was also recast in 2011 (Directive 2011/65/EU), with the most notable change being the substantial expansion of the range of EEE covered. The directive introduced new product categories such as medical devices and monitoring and control instruments and explicitly included cables and spare parts used in EEE within its scope. To allow manufacturers time to adapt, the expanded scope was implemented gradually, with different product categories being added over time. The directive also introduced mandatory CE marking to demonstrate compliance. Additionally, the recast provided clearer guidelines on conformity assessment and technical documentation requirements⁸.

WEEE Directive (2012/19)

The WEEE Directive underwent a significant revision in 2012 with Directive 2012/19/EU, addressing the challenges posed by increasing volumes of EEE in the market, shorter innovation cycles, and inconsistent national applications of the producer responsibility principle. This recast directive expanded the scope of products covered and set more ambitious collection and recycling targets. It established a collection rate of 45% of EEE sold to be applied from 2016, rising to 65% of equipment sold or 85% of WEEE generated by 2019. Additionally, it introduced more stringent recycling and recovery targets, ranging from 55-85% depending on the category, to be achieved by 2018.

The 2012 WEEE Directive also clarified the roles and responsibilities of various stakeholders in the WEEE management process. It broadened producers' responsibility by making producers financially responsible for the collection of WEEE from private households to collection facilities. It states that producers should finance at least the transport from collection facilities and the subsequent treatment, recovery and disposal of WEEE. However, it encourages producers to finance the entire waste management chain, thereby harmonizing producer financing across the EU and shifting the financial burden from taxpayers to EEE consumers. It also mandated that all producers register with the national register of the member states they operate in and submit data on products placed on market (POM), collection, and recycling.

In terms of WEEE management standards, the 2012 directive introduced more specific requirements. It mandated that all separately collected WEEE undergo proper treatment, including the removal of all fluids and selective treatment in accordance with Annex VII of the directive. The legislation also empowered the European Commission to adopt implementing acts to establish minimum quality standards for the treatment of WEEE, including recovery, recycling, and preparation for reuse.

The revised directive placed particular emphasis on certain aspects of WEEE management. It highlighted the importance of collecting and treating temperature exchange equipment and strengthened efforts to

⁷ European Union. (2008). Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (Text with EEA relevance). *Official Journal of the European Union*. <https://eur-lex.europa.eu/eli/dir/2008/98/oj/eng>

⁸ European Union. (2011). Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast) Text with EEA relevance. *Official Journal of the European Union*. <https://eur-lex.europa.eu/eli/dir/2011/65/oj/eng>

combat illegal exports of WEEE. Furthermore, it required distributors to provide for the collection of very small WEEE free of charge to end-users, with no obligation to buy new equipment. The directive also introduced the concept of authorized representatives for producers not established in a Member State where they sell EEE, ensuring better compliance across borders.⁹

Circular Economy Action Plan (2020)

Most recently, in 2020, the European Commission adopted a new Circular Economy Action Plan as part of the European Green Deal. This plan includes initiatives specific to electronics and ICT, proposing a 'Circular Electronics Initiative' to promote longer product lifetimes and improve recycling rates. This initiative encompasses a range of regulatory measures under the Ecodesign Directive to enhance the durability, repairability, and recyclability of electronic devices. Key focus areas include implementing the 'right to repair' including an obligation for manufacturers to provide timely and cost-effective repair services, standardizing chargers for mobile devices, improving waste collection and treatment systems, and potentially introducing an EU-wide take-back scheme for old electronics. The Commission is also reviewing regulations on hazardous substances in electronics and striving to align these with broader EU legislation¹⁰.

Categories of products governed by the WEEE Directive and Battery Directive

		Category	Examples
Electrical and electronic equipment	1	Temperature exchange equipment (TEE)	Refrigerators, freezers, air conditioning equipment, heat pumps, radiators
	2	Screens, monitors and equipment with screens larger than 10 cm²	Screens, televisions, LCD photo frames, monitors, laptops
	3	Lamps	Fluorescent lamps, high intensity discharge lamps, LED
	4	Large equipment (> 50cm) (LHA)	Washing machines, dish washing machines, electric stoves, solar panels
	5	Small equipment (> 50cm)	Vacuum cleaners, microwaves, toasters, clocks and watches, electric toys
	6	Small IT and telecommunication equipment	Mobile phones, telephones, GPS devices, routers, printers
Batteries	1	Portable batteries	Batteries that can be easily carried and used in household appliances and consumer electronics
	2	Light means of transport (LMT) batteries	Batteries used in electric bicycles, e-scooters, and e-mopeds
	3	Starting, lighting, and ignition (SLI) batteries	Batteries primarily used in vehicles and machinery for starting engines, lighting and ignition purposes
	4	Industrial batteries	Batteries used in industrial applications such as in factories, large machinery and backup power systems
	5	Electric Vehicle (EV) batteries	Batteries designed for use in electric vehicles

Figure 4: Products covered by the EU WEEE and Battery Directives

⁹ European Union. (2012). Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast) Text with EEA relevance. *Official Journal of the European Union*. <https://eur-lex.europa.eu/eli/dir/2012/19/oj/eng>

¹⁰ European Commission. (2020). *Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions A new Circular Economy Action Plan For a cleaner and more competitive Europe*. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52020DC0098>

Changes in collection, recovery, and recycling targets set by the WEEE Directive 2012-now

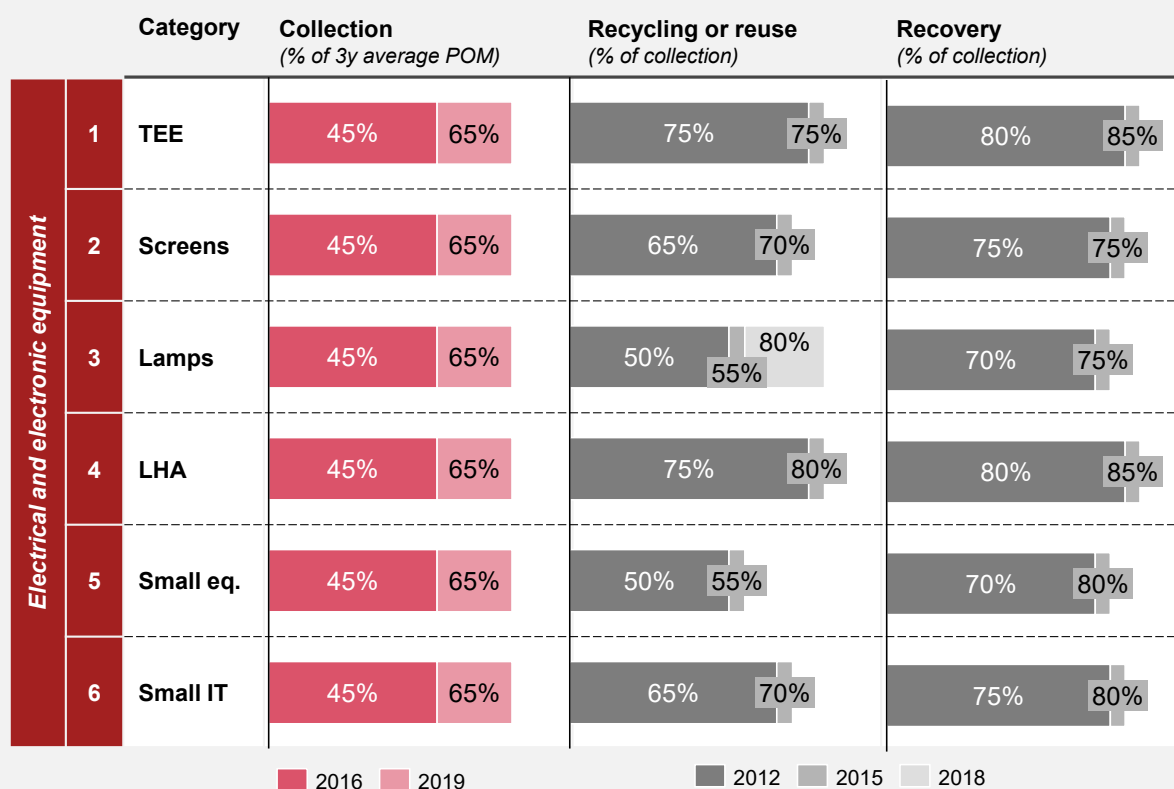


Figure 5: EU collection, recycling, and recovery targets 2016-now

Changes in collection, recovery, and recycling targets set by the Battery Directive 2012-2031

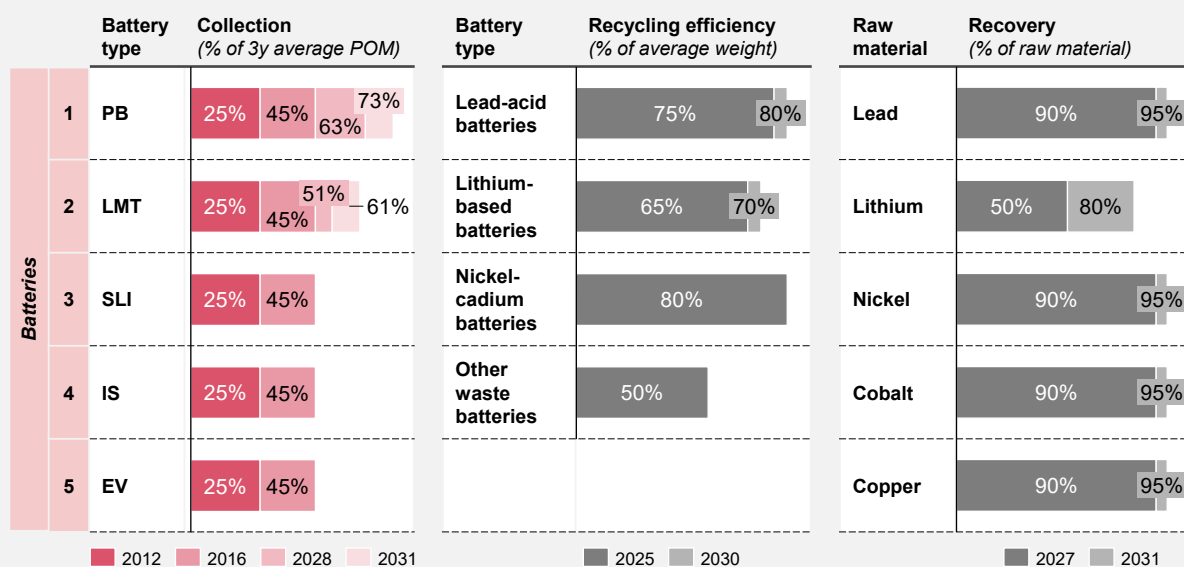


Figure 6: EU collection, recycling, and recovery targets Directives 2012-2031

3.2. EPR-organization

In principle, EPR imposes an individual obligation on producers and importers marketing products. In practice, these entities often form PROs to collectively manage this responsibility. PROs take over responsibility from individual producers and importers for the collection, sorting, recycling, and disposal of the products introduced to the market. PROs ensure the (co-)financing, organization, and coordination of the electronic waste management processes. Typical responsibilities of an EPR organization include:

- Organizing and (co-)financing e-waste collection, sorting and recycling, often collaboration with local companies and authorities
- Ensuring EU and national recycling targets are met
- Raising awareness and educating P&Is and consumers on responsible recycling practices
- Verifying the data and reports submitted by P&Is
- Reporting achieved recycling targets to national authorities

EPR systems can be structured in various ways. System level considerations include the number of PROs, the scope and segmentation, and the market structure. The responsibility for the EPR can be assigned to either one PRO or multiple PROs. PROs might manage different types of e-waste, such as WEEE and batteries, or e-waste from various sources, including households and industry. An EPR system with multiple PROs in the same market will experience competition, unlike a system with one PRO or multiple PROs for different sub-streams. Organizationally, a PRO can have a coordinating role or also be involved in operations through vertical integration. The operational responsibility may rest solely with the PRO or be shared with others, such as municipalities. The same holds for the financial responsibility, which can be with the PRO or be shared with other actors.

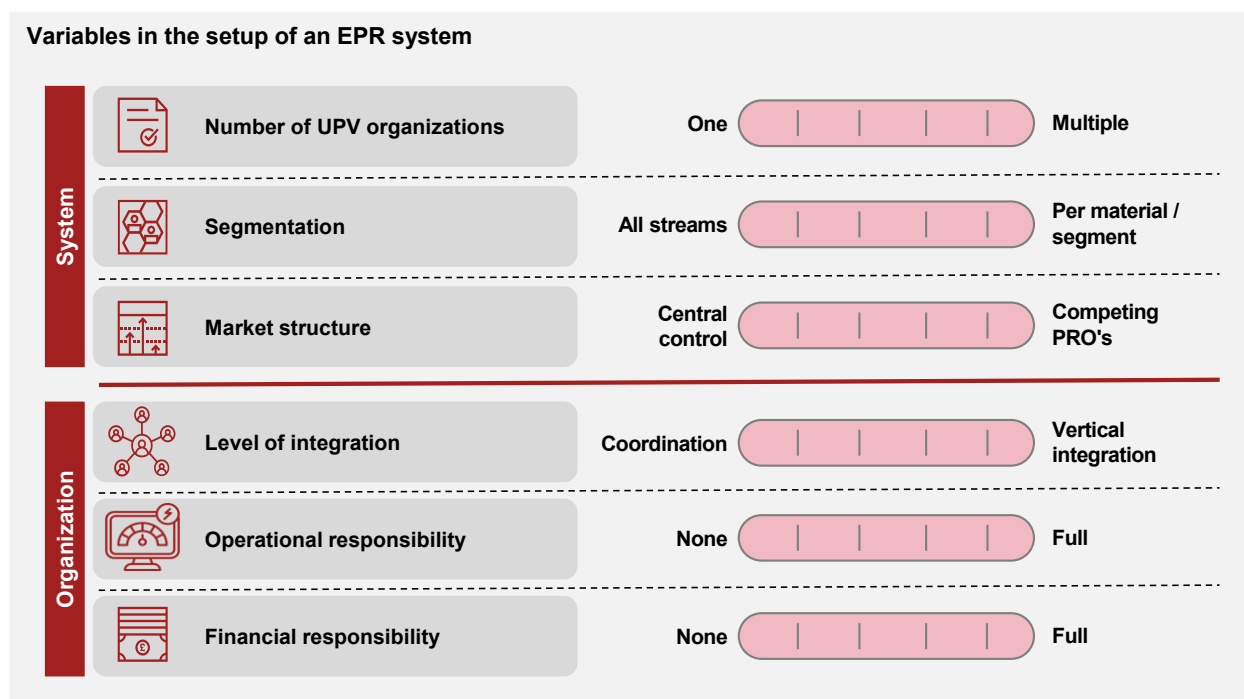


Figure 7: Variables for the setup of an EPR system

A PRO plays a role in multiple phases of the e-waste value chain in terms of collaboration, financing, and awareness. Producers and importers are often required to join a PRO. They pay a financial contribution to the PRO for the EEE or batteries they place on the market. With these contributions, the PRO organizes value chain activities to achieve collection, recycling and recovery targets. The PRO can also play a role in raising awareness and innovation among producers and importers by sharing knowledge or by driving

innovation via financial incentives (e.g. reduced fees) for easily recyclable, repairable, or upgradable products. Towards the disposer, a PRO actively raises consumer awareness about proper disposal of e-waste, reducing consumption, and consciously purchasing sustainably produced products. This is often reflected in marketing campaigns or e-waste guides. Along the value chain, PROs contract with companies, municipalities, collectors, sorters, and recyclers to manage the physical EEE and battery waste processing. See Figure 8 for an overview of the e-waste chain.

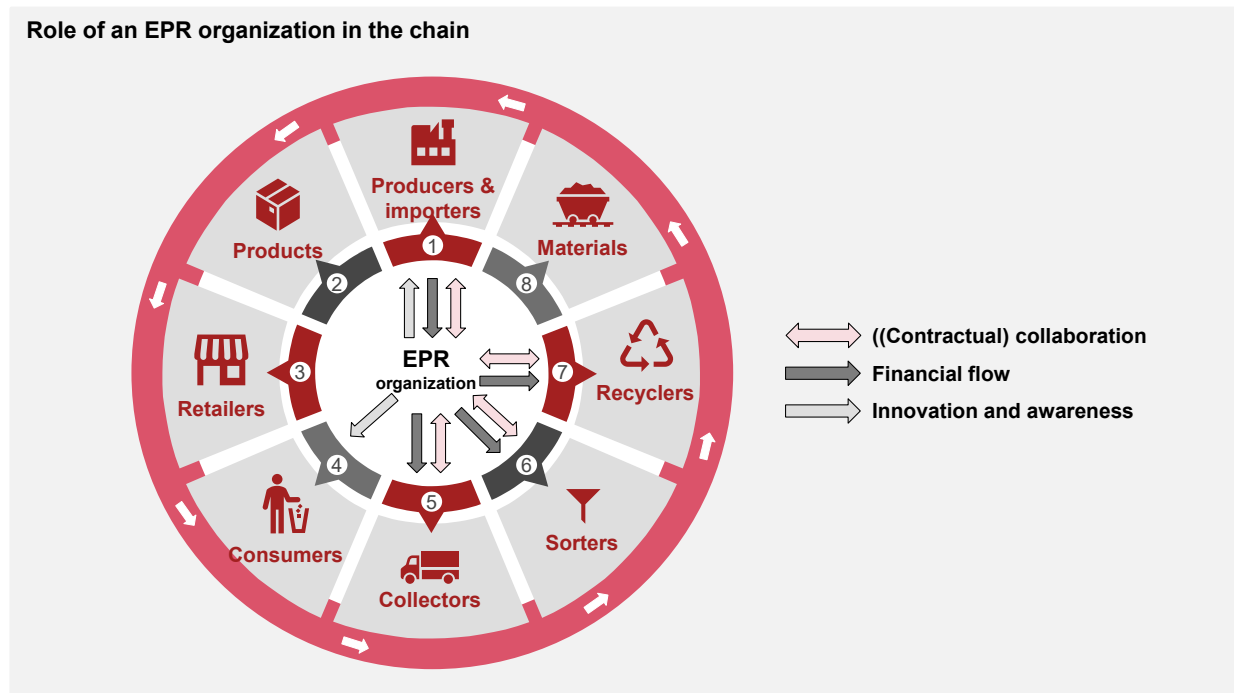


Figure 8: Role of a PRO in the e-waste value chain

4. The Dutch EPR System

In the Netherlands, the EPR system requires that all P&Is of EEE and batteries are accountable for the collection, sorting, and recycling of their products' waste. Stichting OPEN, the sole PRO for WEEE and batteries in the Netherlands, fulfils this collective responsibility on behalf of the P&Is.

This chapter examines the historical evolution and current form of the Dutch EPR system. We analyze the organization of the supply chain and evaluate the system's performance in terms of effectiveness and efficiency. Furthermore, we assess the strengths of the Dutch EPR system and identify areas for potential improvement.

	Indicator	Result 2023
Effectiveness	Achieved collection rate <i>WEEE Forum 2023 (NWR 2023)</i>	28% (29%)
	Achieved collection rate excl. PV <i>WEEE Forum 2023 (NWR 2023)</i>	42% (43%)
	Achieved recycling rate <i>Eurostat 2022 (NWR 2023)</i>	73% (80%)
	Achieved recovery rate <i>Eurostat 2022 (NWR 2023)</i>	90% (98%)
	Innovation	High
	Awareness	High
Efficiency	Total system costs	€107m
	Producer contributions	€59m
	Producer contribution per inhabitant	€3,31
	Producer contribution per ton put-on-market	€75
	Producer contribution per ton collected	€271
	Producer contribution per ton recycled	€411
	Producer contribution per ton recovered	€331
	Percentage free-riding <i>Expert input</i>	< 5%

Figure 9: Summary of the Dutch EPR system for WEEE

4.1. Historical and legislative framework

The Regulation on Waste Electrical and Electronic Equipment (AEEA) was implemented in the Netherlands on February 14, 2014. This regulation incorporated the European WEEE Directive (2012) into Dutch law, introducing several key principles. It mandated registration for producers and importers to report e-waste

to the National (W)EEE Register. This register helps monitor collection and recycling targets. The law also ensured a level playing field by setting uniform quality standards for all players¹¹.

On July 1, 2015, the Certification Obligation took effect, further enhancing e-waste management. This obligation ensured that all companies processing e-waste met high-quality standards through certification according to CENELEC standards. The regulation sought to maintain uniform quality and reduce competition between certified and non-certified processors¹².

Dutch policies aimed to meet the objectives of the revised European WEEE directive. The goal was a collection rate of 65% of the average weight of EEE placed on the market over the previous three years, starting from 2019. This target was pursued via three intermediate steps:

1. Until 2016: Collect and process at least 4 kilograms of WEEE from private households per inhabitant per year.
2. Until 2019: Increase the collection rate to 45% of devices placed on the market.
3. From 2019: Either collect and process 65% of the average weight of equipment placed on the market in the previous three years, or 85% of the weight of WEEE generated in the Netherlands in the relevant year¹³.

The AEEA regulation introduced EPR for e-waste in the Netherlands. Producers became responsible for the collection and processing of EEE they placed on the market. They could fulfill this responsibility individually or through a collective of producers (PRO). Producers were required to report the amount of EEE placed on the market and the amount of WEEE collected, recycled, recovered, or disposed of.

Municipalities and distributors also had roles in WEEE collection. Municipalities had to ensure separate collection of discarded EEE from private households, financed through the waste management contribution paid by producers and importers. Distributors were obliged to take back a similar device when delivering a new one¹⁴.

Between 2016 and 2019, the WEEE directives were strengthened, and national policy frameworks were further developed. The AEEA regulation was expanded to specify its applicability and the products it covers more precisely. Producer responsibilities were further defined to increase accountability for the entire product lifecycle. The third National Waste Management Plan (LAP3) came into effect in 2017, covering waste management for 2017-2029 and specifying minimum recycling standards¹⁵.

During this period, the EPR system in the Netherlands was fragmented. Numerous producer responsibility organizations (PROs) were responsible for various, sometimes overlapping, fractions of e-waste. For example, Stichting Lightrec Nederland handled lamps, Stichting Zonne-energie Recycling Nederland managed solar panels and Stichting Metaleko Recycling covered a variety of electrical and electronic equipment, ranging from temperature exchange equipment to medical equipment. Different PROs

¹¹ Ministerie van Infrastructuur en Milieu. (2014). Regeling van de Staatssecretaris van Infrastructuur en Milieu, van 3 februari 2014, nr. IENM/BSK-2014/14758, houdende vaststelling regels met betrekking tot afgedankte elektrische en elektronische apparatuur (Regeling afgedankte elektrische en elektronische apparatuur). *Staatscourant van het Koninkrijk der Nederlanden*. <https://zoek.officielebekendmakingen.nl/stcrt-2014-2975.html>

¹² Baldé, C. P., Van den Brink, S., Forti, V., Van der Schalk, A., & Hopstaken, F. (2021). *The Dutch WEEE Flows 2020*. United Nations Institute for Training and Research. https://ewastemonitor.info/wp-content/uploads/2021/09/Dutch_WEEE_flows_ENGNL1.pdf

¹³ Ministerie van Infrastructuur en Milieu. (2014). Regeling van de Staatssecretaris van Infrastructuur en Milieu, van 3 februari 2014, nr. IENM/BSK-2014/14758, houdende vaststelling regels met betrekking tot afgedankte elektrische en elektronische apparatuur (Regeling afgedankte elektrische en elektronische apparatuur). *Staatscourant van het Koninkrijk der Nederlanden*. <https://zoek.officielebekendmakingen.nl/stcrt-2014-2975.html>

¹⁴ Ministerie van Infrastructuur en Milieu. (2014). Regeling van de Staatssecretaris van Infrastructuur en Milieu, van 3 februari 2014, nr. IENM/BSK-2014/14758, houdende vaststelling regels met betrekking tot afgedankte elektrische en elektronische apparatuur (Regeling afgedankte elektrische en elektronische apparatuur). *Staatscourant van het Koninkrijk der Nederlanden*. <https://zoek.officielebekendmakingen.nl/stcrt-2014-2975.html>

¹⁵ Ministerie van Infrastructuur en Waterstaat. (2017). Sectorplan 71, Landelijke afvalbeheer plan 3. file:///C:/Users/aberg026/Downloads/lap3_sp71_afgedankte_eeea_ow_1-1-2025.pdf

represented interests of P&Is for specific types of equipment, organizing collection and recycling for their respective sectors.

The fragmented EPR system in the Netherlands led to several negative outcomes:

- **Management Fragmentation:** Multiple parties handled collection and recycling, creating an incoherent system. This lack of coordination hindered streamlined efforts and cohesive results.
- **Collection Target Challenges:** The fragmented market structure made it difficult to reach the 65% collection target. Free-rider issues arose, resulting in a 48% actual collection rate in 2019 (58% excluding solar panels).
- **Cost and Quality Inconsistencies:** Collection and processing often prioritized low costs over quality, compromising recycling standards and environmental objectives.
- **Cherry-Picking:** Recyclers focused on high-value e-waste items, neglecting less profitable ones. This selective approach led to incomplete recycling, environmental damage, and economic inefficiency.

Recognizing the inefficiencies of the fragmented EPR system, several PROs proposed establishing a central authority to manage and finance the collection of all types of WEEE. This approach aimed at creating a unified management structure, with a single organization overseeing WEEE collection and recycling. By implementing uniform rules and tariffs for all producers, this system would ensure a level playing field and prevent free riding. The centralized model was expected to streamline operations, improve overall efficiency, and enhance the effectiveness of e-waste management in the Netherlands.

In 2020, multiple PROs agreed to transfer WEEE management responsibilities to Stichting OPEN, which assumed control for 8 out of 10 existing producer organizations. Stichting OPEN then petitioned the Ministry of Infrastructure and Water Management (I&W) to make their Waste Management Contribution Agreement (ABBO) legally binding. This would require all relevant producers and importers to join Stichting OPEN. The request, made on behalf of 2,000 producers representing the market majority, met the necessary requirements. In 2021, the I&W granted this request, with the State Secretary declaring the WEEE waste management contribution agreement generally binding from March 1, 2021, to December 31, 2025. This decision effectively centralized WEEE management under Stichting OPEN's authority¹⁶.

The AVV (Algemeen Verbindend Verklaring) requires all producers and importers of EEE in the Dutch market to contribute proportionally to WEEE collection and processing. This mandate establishes a collective system managed by Stichting OPEN, ensuring uniform cost distribution among producers. The system effectively addresses free riding by requiring all beneficiaries of collective efforts to contribute financially. Using these contributions, Stichting OPEN collaborates with various parties to manage the entire e-waste lifecycle, including collection, transport, sorting, and processing¹⁷.

Since 2021, Stichting OPEN has assumed full responsibility for WEEE management in the Netherlands. Seven former PROs from the previous fragmented EPR system have transitioned into trade associations, now holding seats on Stichting OPEN's board. This structure ensures that P&Is' interests are represented within Stichting OPEN through their respective trade associations. The new arrangement maintains industry expertise while consolidating management under a single entity, aiming to improve efficiency and effectiveness in WEEE handling.

¹⁶ Rijkswaterstaat. (2021). Kennisgeving van het algemeen verbindend verklaren van de overeenkomst inzake de afvalbeheerbijdrage voor AEEA, Ministerie van Infrastructuur en Waterstaat. *Staatscourant van het Koninkrijk der Nederlanden*. <https://zoek.officielebekendmakingen.nl/stcrt-2021-7385.pdf>

¹⁷ Rijkswaterstaat. (2021). Kennisgeving van het algemeen verbindend verklaren van de overeenkomst inzake de afvalbeheerbijdrage voor AEEA, Ministerie van Infrastructuur en Waterstaat. *Staatscourant van het Koninkrijk der Nederlanden*. <https://zoek.officielebekendmakingen.nl/stcrt-2021-7385.pdf>

AVV for Batteries and Bicycle Batteries

Since July 1, 2022, an AVV for bicycle batteries (EPAC batteries) has been in effect, granted to Stichting Electric Powered Assistance Cycle (EPAC) until July 30, 2027. This mandate requires all producers and importers of bicycle batteries to register with Stichting EPAC and pay a waste management fee, unless exempted. At implementation, Stichting EPAC had 75 affiliated producers, with 7 other EPAC battery producers in the market (6 affiliated with another collective and 1 individual). The AVV for EPAC batteries was requested for similar reasons as Stichting OPEN's AVV for EEA: to ensure proportional financing of waste management and prevent free riding¹⁸.

On January 1, 2024, Stichting OPEN, Stichting EPAC, and Stichting Batterijen merged to create a more integrated approach to battery and electrical appliance collection and recycling. This consolidation aims to improve efficiency, strengthen producer representation, and increase policy influence¹⁹.

Additionally, an AVV for portable batteries came into effect in January 2024, granted to Stichting OPEN until December 31, 2028. This was possible as most producers (57.5%) had already joined Stichting OPEN. The AVV requires all producers and importers of portable batteries (0-3 kg) and industrial batteries (0-1 kg) to register with Stichting OPEN and pay a waste management fee, unless exempted²⁰.

Dutch collection, recycling, and recovery targets (2023)

	Total	 TEE	 Screens	 Lamps	 Large appliances	 PV	 Small equipment	 Small IT equipment
EU collection target	65%	65% across all categories						
NL collection target	65%	65% across all categories						
EU recycling and reuse target	-	80%	70%	80%	80%	80%	55%	55%
NL recycling target	-	80%	70%	80%	80%	80%	55%	55%
EU recovery target	-	85%	80%	-	85%	85%	75%	75%
NL recovery target	-	85%	80%	-	85%	85%	75%	75%

Figure 10: Dutch collection, recycling and recovery targets in 2023 (%)

4.2. Organization of EPR system

Within the Dutch EPR system for e-waste, Stichting OPEN serves as the central, non-profit organization responsible for managing the entire system. It coordinates the collection, sorting, and recycling of WEEE

¹⁸ Rijkswaterstaat. (2022). Kennisgeving van het algemeen verbindend verklaren van de overeenkomst inzake de afvalbeheerbijdrage voor fietsaccu's, Ministerie van Infrastructuur en Waterstaat. *Staatscourant van het Koninkrijk der Nederlanden*. <https://zoek.officielebekendmakingen.nl/stcrt-2022-16052.html>

¹⁹ Stichting OPEN. (n.d.). Samen zijn we open. Samen staan we sterk. <https://www.stichting-open.org/samen/>

²⁰ Rijkswaterstaat. (2024). Kennisgeving van het algemeen verbindend verklaren van de overeenkomst inzake de afvalbeheerbijdrage voor draagbare batterijen, Ministerie van Infrastructuur en Waterstaat. *Staatscourant van het Koninkrijk der Nederlanden*. <https://zoek.officielebekendmakingen.nl/stcrt-2024-608.html>

and batteries without any segmentation of waste streams. The system features limited vertical integration, with Stichting OPEN owning only 7 buses for battery collection. Both operational and financial responsibility for the WEEE and battery management system lie entirely with Stichting OPEN.

Element	Explanation
Number of PROs	1 PRO for WEEE and batteries (Stichting OPEN)
Scope	B2C and B2B WEEE
Segmentation	No segmentation
Market structure	Single scheme: 1 PRO for WEEE and batteries
Level of integration	Limited logistic assets
Operational responsibility	PRO
Financial responsibility	PRO

Table 1: Characteristics of the Dutch EPR-system

4.2.1. Roles and responsibilities

Stichting OPEN is part of a larger e-waste system and collaborates with various stakeholders, each with their own tasks and responsibilities in the chain. The main stakeholders are:

Stichting OPEN

Stichting OPEN operates within the Dutch EPR system for e-waste and is bound by the European WEEE and Battery Directives and the Dutch Regulation on WEEE (Regeling AEEA). The responsibilities of Stichting OPEN include:

- Establishing and maintaining a nationwide waste management structure and collection system for WEEE
- Regulating compliance, including registering producers/importers and providing collection channels for consumers and businesses.
- Setting tariffs, collecting contributions, and financing the setup, maintenance, and operation of the waste management structure.
- Monitoring, reporting, and annually informing the government, National WEEE Register, and society on collection, application, reuse, recycling, and market placement of electronic/electrical equipment.
- Sorting, disassembling, and safely transporting discarded devices, lamps, and batteries; ensuring recycling by CENELEC-certified processors to maintain materials in the value chain.
- Conducting research to improve processing, recycling, and environmentally responsible disposal of end-of-life products.
- Entering contracts with municipalities, retailers, and other parties for collection and processing of discarded equipment.
- Providing education, information, and research on sustainable e-waste management, circularity, and extending device lifespan in the Netherlands.
- Stimulating collection and increasing awareness of drop-off points for waste holders.

Stichting OPEN represents the interests of producers and importers through trade organizations (former PROs) that hold positions on its board. These trade organizations are ANStEC (household appliances), FIAR CE (consumer electronics), NLdigital (ICT), LightRec (lamps), SMR (professional equipment), SVEG

(electric tools) and ZRN (solar panels). As of 2024 Stibat (batteries) and EPAC (bicycle batteries) are also represented on the board²¹.

AEEA B.V., a subsidiary of Stichting OPEN, manages the procurement of WEEE collection and treatment. It contracts market parties for collection, sorting, transport, and treatment of WEEE. AEEA operates without employees and reports directly to Stichting OPEN's board²².

The 65% Alliantie is a collaborative effort among all members of the e-waste management supply chain. Its purpose is to assist in fulfilling legal responsibilities for WEEE management and achieving the national collection target. Stichting OPEN leads this alliance, which comprises a steering committee and various subcommittees (e.g., for consulting with supply chain partners and relevant government entities)²³.

Ministry of Infrastructure and Water Management (I&W)

The Ministry of Infrastructure and Water Management (I&W) is responsible for developing and enforcing policies and regulations related to e-waste. This includes the implementation of the European WEEE Directive and the Dutch Regeling AEEA. The ministry sets national collection, recycling, and recovery targets and monitors their progress. Additionally, I&W oversees compliance with these regulations by producers and other involved parties. Stichting OPEN reports annually to the ministry on the collected, recycled and recovered quantities of e-waste. I&W supports OPEN by providing policy frameworks and addressing any issues, such as system changes, in the execution of the EPR system.

Inspectorate for the Environment and Transport (ILT)

The Inspectorate for the Environment and Transport (ILT) is the supervisory body of the Ministry of Infrastructure and Water Management and is responsible for ensuring compliance with EPR regulations for e-waste. ILT checks whether producers and processors comply with laws and regulations, conducts thematic investigations, and supervises the proper processing and transport of e-waste. ILT collaborates with Stichting OPEN and other chain partners to achieve collection and recycling targets and reports on the compliance and effectiveness of the system.

Producers and Importers (P&I)

Producers and importers of e-waste are defined as those who first place electrical appliances, lamps, batteries, and/or (bicycle) accumulators on the Dutch market. They are responsible for the entire lifecycle of their products, including the waste phase. To meet these legal obligations, they must register with Stichting OPEN. This registration ensures they comply with the legal obligations of producer responsibility. Additionally, they must annually report the exact quantities (numbers and weights) of products they have placed on the market via the online portal myOPEN. Finally, producers and importers pay a waste management contribution to Stichting OPEN. This contribution is used to cover the costs of collection, transport, sorting, and recycling of e-waste. Stichting OPEN supports producers and importers in meeting their legal obligations by providing a collective implementation of producer responsibility and coordinating the practical execution of collection and recycling.

²¹ Stichting OPEN. (2023). AVV Monitoringsrapportage 2023. *Circulariekennis.nl*. https://circulariekennis.nl/wp-content/uploads/2025/03/AVV-Monitoringsrapportage-2023_publicversie.pdf

²² Stichting OPEN. (2023). AVV Monitoringsrapportage 2023. *Circulariekennis.nl*. https://circulariekennis.nl/wp-content/uploads/2025/03/AVV-Monitoringsrapportage-2023_publicversie.pdf

²³ Stichting OPEN. (2023). AVV Monitoringsrapportage 2023. *Circulariekennis.nl*. https://circulariekennis.nl/wp-content/uploads/2025/03/AVV-Monitoringsrapportage-2023_publicversie.pdf

WEEE Nederland

WEEE Nederland is an implementation organization focused on the collection, transport, sorting, and recycling of discarded EEE in the Netherlands. WEEE Nederland B.V. has a cooperation agreement with Stichting OPEN, where they act as the implementation organization for OPEN, and OPEN pays WEEE Nederland for their services. While Stichting OPEN has the central coordinating role and is responsible for the strategic aspects of the EPR system, such as managing financial contributions, WEEE Nederland carries out the practical tasks. WEEE Nederland organizes the collection of e-waste at various collection points in collaboration with other parties. They also ensure the safe transport of collected e-waste in their vans to one of their seven regional sorting centers, where the waste is disassembled and separated into mono streams. Finally, they work with CENELEC-certified processors to ensure that the materials are recycled in an environmentally friendly manner²⁴.

Wecycle

Wecycle is a brand under Stichting OPEN that focuses on the collection and recycling of EEE. They run campaigns to encourage consumers and businesses to properly dispose of their e-waste at one of the 13,000 Wecycle drop-off points. This encouragement is done through information campaigns and organizing events such as National Wecycle Week and E-waste Day to stimulate collection. Wecycle is an integral part of Stichting OPEN and serves as the communication brand towards consumers and businesses. Like WEEE Nederland, they carry out practical tasks, mainly managing their drop-off points and conducting information campaigns. Finally, they also report back to Stichting OPEN on the collected and recycled quantities of e-waste²⁵.

Municipalities

Municipalities have a duty of care for the collection of e-waste. This means they are also responsible for providing facilities where residents can dispose of their WEEE. This is done at municipal waste sites ('milieustraten'). Additionally, municipalities help by informing and raising awareness among their residents about the importance of e-waste and recycling through campaigns, information on municipal websites, and educational programs. Besides providing support and advice in setting up and improving the municipality's e-waste collection systems, Stichting OPEN also pays municipalities for collecting e-waste and handing it over to Stichting OPEN.

4.2.2. Organization of the supply chain

The Dutch EPR system covers B2C and B2B WEEE. The system is coordinated by the Stichting OPEN, which contracts collection, sorting, transport, and recycling services from waste management operators. Figure 10 shows the organization of the Dutch EPR system and the physical and financial flows between different players in the system.

²⁴ WEEE Nederland. (n.d.). Over ons. <https://www.weee.nl/over-ons/>

²⁵ Wecycle. (n.d.). Home. <https://wecycle.nl/>

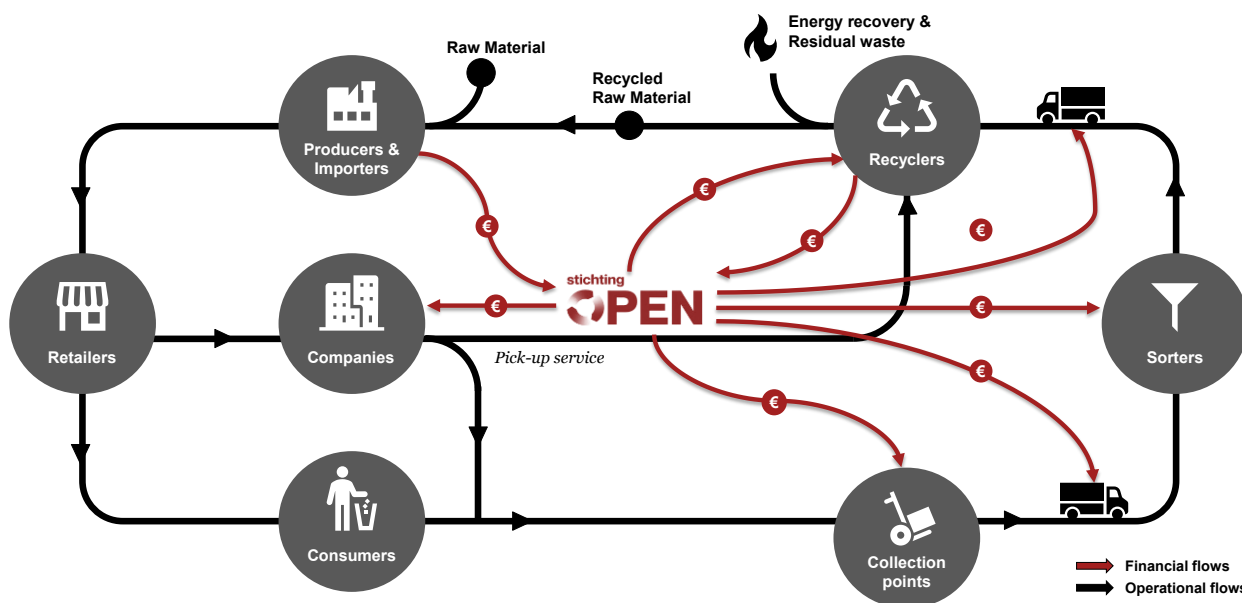


Figure 11: Organization of the Dutch Waste Processing Chain for E-Waste

Collection

E-waste collection in the Netherlands is managed through a comprehensive system of drop-off points overseen by Stichting OPEN, operating under the brand name WeCycle. These drop-off points are located across various businesses and institutions, including supermarkets, hardware stores, electronics stores, thrift shops, and even petting zoos. Municipal recycling centers in different city areas also serve as important collection points for e-waste.

To encourage collection, Stichting OPEN has implemented a compensation system. All collection points receive compensation based on the quantity and type of e-waste collected. Community drop-off points, such as petting zoos, receive an additional annual sponsorship of €250, which can be used at their discretion, along with collection bins for small electrical appliances.

While the collection system caters to both consumers and businesses, the facilities may vary to accommodate the different needs of these groups. Businesses often need to dispose of larger quantities of e-waste, which may not always be suitable for smaller drop-off points. To locate the nearest drop-off point, individuals and businesses can consult the websites of WeCycle.

For businesses, Stichting OPEN offers an additional option through the Incentive Scheme ('Stimuleringsregeling'). This program encourages businesses to keep WEEE separate, prevent further damage, and offer it to CENELEC-certified processors. These processors accept and process the e-waste according to applicable standards, then report the quantities and types of processed e-waste to Stichting OPEN. Based on this data, Stichting OPEN calculates and pays compensation directly to the businesses at the end of each month.

In some cases, businesses can also take advantage of a free pick-up service, provided they meet minimum quantity requirements. This service is offered by various recycling companies and Stichting OPEN. It often involves direct transport of e-waste from the business premises to the recycling point, streamlining the process for larger-scale e-waste disposal.

Sorting

In sorting centers, e-waste is carefully sorted and prepared for further processing. The process begins with the receipt and inspection of collected e-waste. Here, it is determined which devices are reusable and which need to be recycled. The devices are then sorted based on type and material, such as metals, plastics, glass, and other components. Devices that are still reusable are set aside and, if necessary, repaired. These devices can then be reused or sold.

Recycling

In recycling centers, e-waste undergoes a comprehensive process to recover valuable materials and safely remove harmful substances. In the Netherlands, it is mandatory for recycling facilities to be CENELEC-certified.

Non-reusable devices are prepared for recycling. This includes removing hazardous substances and disassembling devices to recover valuable materials. The sorted materials are mechanically separated, for example, by shredding, where devices are pulverized into small pieces. Metals and non-metals are then separated using magnets and other techniques. The sorted materials are eventually sent to specialized recycling companies, where they are further processed into new raw materials.

The recovery of valuable materials such as copper, gold, and silver not only conserve these resources but also saves substantial energy that would otherwise be required for primary extraction. This multi-faceted approach to e-waste recycling plays a vital role in promoting a circular economy, reducing environmental impact, and conserving natural resources.

4.3. Effectiveness

The Dutch EPR system realized a collection target of 28% in 2023, below the EU target of 65% of the 3-year average POM. Excluding solar panels, the Dutch EPR system achieved a collection rate of 42% in 2023. The Dutch EPR system met the recycling and recovery targets for most WEEE categories in 2022.

4.3.1. Realization collection and recycling targets

In 2023, the Netherlands had a total 3-year average put-on-market of 789kt of EEE. This amounts to 44 kg per inhabitant, 50% higher than the EU average of 30kg per inhabitant. In 2023, the Netherlands collected 219kt of WEEE, which amounts to 12 kg per inhabitant and a collection rate of 28% of the average POM of the three preceding years, below the EU and Dutch target of 65%. On a fraction level, the collection target was met only for small IT and telecommunication equipment²⁶.

In total, the Netherlands recycled 145kt in 2022 and recovered 180kt. For recycling, this amounts to an overall recycling rate of 73%. The Netherlands met the recycling targets for all fractions of WEEE except screens and large appliances. In total, the Netherlands recovered 90% of all WEEE collected and met the recovery targets for all fractions of WEEE²⁷. National reports deviate from Eurostat data and indicate that the Netherlands met the recycling and recovery targets for all fractions in 2023.

²⁶ WEEE Forum. (2023). Key Figures Data. Key Figures Data.

²⁷ Nationaal WEEE Register. (2023). *Rapportage 2023 NWR*. <https://nationaalweeeregister.nl/rapportage/>

Dutch put-on-market (3-year average), collection, recycling, and recovery in kt (2022, 2023)

	Total							
		TEE	Screens	Lamps	Large appliances	PV	Small equipment	Small IT equipment
Put-on-market 3-year average <i>WEEE Forum 2023</i> <i>(NWR 2023)</i>	789 (767)	107 (106)	34 (32)	4 (4)	246 (242)	267 (260)	99 (97)	31 (25)
Collection <i>WEEE Forum 2023</i> <i>(NWR 2023)</i>	219 (220)	44 (44)	13 (13)	2 (2)	86 (86)	1 (1)	50 (50)	23 (24)
Recycling <i>Eurostat 2022</i> <i>(NWR 2023)</i>	145 (176)	33 (36)	8 (10)	2 (1)	63 (71)	1 (1)	26 (38)	12 (19)
Recovery <i>Eurostat 2022</i> <i>(NWR 2023)</i>	180 (215)	40 (43)	10 (13)	2 (1)	75 (85)	1 (1)	37 (49)	15 (23)

Figure 12: Put-on-market, collection, recycling, and recovery of the Dutch EPR system in 2022, 2023 (kt)

Dutch achieved collection, recycling, and recovery rates in relation to targets (2022, 2023)

	Total							
		TEE	Screens	Lamps	Large appliances	PV	Small equipment	Small IT equipment
NL collection target	65%	65% across all categories						
Achieved collection rate <i>WEEE Forum 2023</i> <i>(NWR 2023)</i>	28% (29%)	41% (41%)	38% (42%)	38% (38%)	35% (35%)	1% (1%)	51% (52%)	76% (94%)
NL recycling target	-	80%	70%	80%	80%	80%	55%	55%
Achieved recycling rate <i>Eurostat 2022</i> <i>(NWR 2023)</i>	73% (80%)	81% (82%)	60% (73%)	100% (91%)	72% (83%)	99% (80%)	66% (75%)	75% (81%)
NL recovery target	-	85%	80%	-	85%	85%	75%	75%
Achieved recovery rate <i>Eurostat 2022</i> <i>(NWR 2023)</i>	90% (98%)	98% (98%)	80% (95%)	100% (94%)	86% (99%)	100% (100%)	94% (98%)	93% (96%)

 EU target achieved

Figure 13: Dutch results compared to national and EU targets in 2022, 2023 (%)

4.3.2. Innovation, knowledge sharing and awareness

Stichting OPEN plays an important role in promoting the circular economy by focusing on knowledge sharing, awareness, and innovation. These activities are carried out under different names to achieve specific goals. The two main names used by Stichting OPEN for these purposes are Circulaire Kennis and Wecycle. Circulaire Kennis focuses on research and knowledge sharing. This platform supports awareness through publications, reports, and educational initiatives, and collaborates with various partners to disseminate knowledge about the circular economy. Wecycle focuses on the operational aspects of recycling and awareness. This includes organizing events, campaigns, and educational programs to inform consumers and businesses about the importance of proper collection and recycling of e-waste. Below are the instruments and activities used by Stichting OPEN within these three areas.

Research and Knowledge Sharing

- **Circulaire Kennis** is the knowledge platform of OPEN. It primarily focuses on sharing knowledge and information about the circular economy of discarded electrical appliances, lamps, and batteries. This platform supports awareness through publications, reports, and educational initiatives. Circulaire Kennis collaborates with various parties such as industry associations and other platforms that share the same knowledge. In 2023 Circulaire Kennis published 98 new publications of various sorts and hosted 24 events²⁸.
- **Consumer Behavior Research:** In addition to the research conducted by Circulaire Kennis, Wecycle carries out its own studies on consumer behavior to better understand and reach consumers. They sometimes collaborate with other parties, such as the research agency Markteffect, to gather insights.

Awareness and education

- **Wecycle Campaigns:** These campaigns include King's Day campaigns and other holiday or seasonal campaigns to prevent devices from ending up in general waste after festivities. Consumers are reminded of the importance of properly disposing of old devices. The National Wecycle Week takes place annually in October and is the highlight of the awareness campaigns.
- **Educational Programs:** Wecycle organizes educational programs and workshops to spread knowledge about e-waste and the circular economy. This does not only take place in schools to raise awareness among children, but also at companies. There they organize workshops and training sessions to educate businesses on proper e-waste handling and disposal, covering topics like compliance with environmental regulations and efficient recycling processes.
- **Business Campaigns:** Wecycle conducts business campaigns via radio and trade media to inform businesses about producer responsibility and the proper disposal of e-waste. They broadcast radio spots on popular stations like 538, Veronica, SKY, and Joe, reaching a wide audience of business owners and managers. Additionally, Wecycle places advertisements and articles in trade magazines and journals, providing detailed information on legal requirements, best practices for recycling, and the advantages of partnering with Wecycle.
- **Collaborative Campaigns:** Wecycle also collaborates with municipalities and retailers to support local awareness campaigns, such as local collection actions and retail initiatives at

²⁸ Stichting OPEN. (2023). AVV Monitoringsrapportage 2023. *Circulairekennis.nl*. https://circulairekennis.nl/wp-content/uploads/2025/03/AVV-Monitoringsrapportage-2023_publicatieversie.pdf

stores. These collaborations help to increase the visibility and accessibility of recycling programs, making it easier for consumers to participate. By working with them, OPEN organizes local collection events and ensures that residents are informed about the importance of proper e-waste disposal.

- **Events:** Wecycle ensures its presence at various fairs and events such as the Huishoudbeurs and the Margriet Winterfair to directly reach consumers. For businesses, they attend specific trade fairs such as the Bouwbeurs.
- **Online and social media:** Wecycle uses online platforms and social media to reach a broad (consumer) audience. This includes active campaigns on platforms such as Facebook, Instagram, and Twitter, as well as articles and blogs on their websites to inform consumers and businesses about the latest developments. They also have online platforms such as watismijnapparaatwaard.nl, where consumers can find information on where to dispose of their old devices and how to make circular choices. Collaborations with influencers on platforms like TikTok and Instagram help spread the message about the importance of recycling.

Innovation and (international) collaboration

- **Value chain collaboration through Alliantie65%:** The 65% Alliance, initiated by Stichting OPEN, is a collaboration aimed at optimizing e-waste management in the Netherlands. It brings together diverse stakeholders including municipalities, retailers, installers, and government officials to achieve the national WEEE collection target of 65%. The alliance focuses on monitoring implementation, stimulating innovation, and ensuring accountability among partners. Through regular meetings and working groups, it addresses key aspects of e-waste management such as collection channels, communication, and regulatory compliance.
- **Collaboration with academic, industry and network partners to develop circular electronics:** Stichting OPEN actively engages in diverse partnerships with academic institutions and global corporations to drive innovation in e-waste management and circular economy practices. On a national level, the organization collaborates with amongst others the University of Leiden, TU Delft, and KPN in the Circular Circuits project, a multidisciplinary research initiative aimed at developing fully circular electronics through lifetime-extending technologies, circular designs, advanced recycling systems, and innovative business models²⁹.
- **International collaboration on securing the future availability of secondary raw materials:** Internationally, Stichting OPEN partners with WEEE Forum and UNITAR on The Future Availability of Secondary Raw Materials (FutuRaM) project, which focuses on ensuring a secure supply of secondary and critical raw materials within the European Union. This project aims to enable fact-based decision-making for material recovery and use, while disseminating generated data through an accessible knowledge base³⁰.
- **Long-term perspective and long-term contracts for innovation in the supply chain.** OPEN encourages innovation in the supply chain through their long-term contracts. Stichting OPEN's long-term partnership and guarantee of stable supplies of WEEE encouraged one of their recycling partners, Coolrec, to invest in a new electrostatic separator that can generate more high quality secondary raw materials. The machine can process about 6kt of WEEE

²⁹ Circular Circuits. (n.d.). Home. <https://circularcircuits.nl/>

³⁰ WEEE Forum. (n.d.). FutuRaM. <https://weee-forum.org/projects-campaigns/futuram/>

annually and convert it into ABS and HIPS plastic flakes with 98% purity, making these secondary granulates almost as good as primary raw materials^{31, 32}.

- **Collaboration with partners to improve environmental outcomes:** OPEN ensures they stay aligned with market trends by collaborating with innovative partners Stichting OPEN partners with TNO Vector, with which they collaborate on research into Dutch Urban Mining and the solar panel repairs. Stichting OPEN also collaborates with Road2Work in setting up a database with unique product features through which the age and recyclability of products can be determined³³. In collaboration with other companies, Stichting OPEN conducts various pilots and experiments to test new methods for reuse and recycling. For example, they have partnered with ATAG Benelux on a pilot project to explore innovative recycling solutions.
- **Takforce batterijbranden:** The taskforce batterijbranden ('battery fires') consists of BRBS Recycling, Nationaal Recycling Forum, NVRD, Stibat, Stichting OPEN, Transport en Logistiek Nederland en Vereniging Afvalbedrijven). Its objective is to increase the amount of separately collected batteries.
- **Wecycle Awards:** To stimulate innovation, Stichting OPEN annually presents the Wecycle Awards during the National Wecycle Week. These awards recognize exemplary and innovative projects within the e-waste sector.

Incentive schemes and financial planning

- **Stimuleringsregeling:** With the help of this innovative initiative, OPEN aims to improve the processing of WEEE. This scheme offers metal recyclers compensation for collecting and delivering e-waste to CENELEC-certified processors. They receive this compensation on top of the payment they negotiate with the recyclers for the material they hand in. In 2023, the compensation for boilers and light fixtures was added to the incentive scheme, which led to an increase in the collection of boilers in 2023.
- **Roadmap solar panels:** In the coming years, the Netherlands anticipates a significant increase in solar panel waste, leading to potential rapid and unpredictable rises in recycling costs. To address this, Stichting OPEN has developed a long-term provision plan until 2045, based on market input and legal requirements. Producers and importers of solar panels pay a waste management fee, which covers current recycling costs and contributes to a future processing fund. This provision aims to prevent tariff shocks and reserve funds for developing appropriate collection, sorting, and high-quality recycling infrastructure³⁴. Stichting OPEN is already searching for partners to develop a sustainable, improved recycling process for solar panels in the Netherlands. Stichting OPEN is also working on improving the recovery of valuable materials like silver, silicon, and solar panel glass to keep waste management fees manageable³⁵.

³¹ Stichting OPEN. (2021). Nieuwe scheider Coolrec zet afgedankte apparaten om in gegarandeerde kwaliteit plastics. <https://www.stichting-open.org/2021/06/16/nieuwe-scheider-coolrec-zet-afgedankte-apparaten-om-in-gegarandeerde-kwaliteit-plastics/>

³² Expert interview. (2025).

³³ Stichting OPEN. (2023). AVV Monitoringsrapportage 2023. *Circulariekennis.nl*. https://circulariekennis.nl/wp-content/uploads/2025/03/AVV-Monitoringsrapportage-2023_publicatieversie.pdf

³⁴ Stichting OPEN. (n.d.). Dossier: zonnepanelen. <https://www.stichting-open.org/dossiers/dossier-zonnepanelen/>

³⁵ Stichting OPEN. (2024). Stichting OPEN zoekt partner(s) voor toekomstbestendige recycling van zonnepanelen. <https://www.stichting-open.org/2024/05/21/stichting-open-zoekt-partners-voor-toekomstbestendige-recycling-van-zonnepanelen/>

4.4. Efficiency

The total system costs associated with the Dutch EPR system were €107 million in 2023³⁶. This sum is financed through various sources: €59 million from producer contributions, and €48 million from material revenues. This results in a total producer contribution of €3,31 per inhabitant, €75 per ton placed on the market (POM), €271 per ton collected, and €411 per ton recycled^{37, 38, 39}.

Of total system costs, €89 million (83%) are used to cover operational expenses, including payments to contracted parties for the collection, sorting, transportation and recycling of WEEE. The remaining €18 million (17%) are used to cover non-operating costs such as management, administration, awareness and communication.

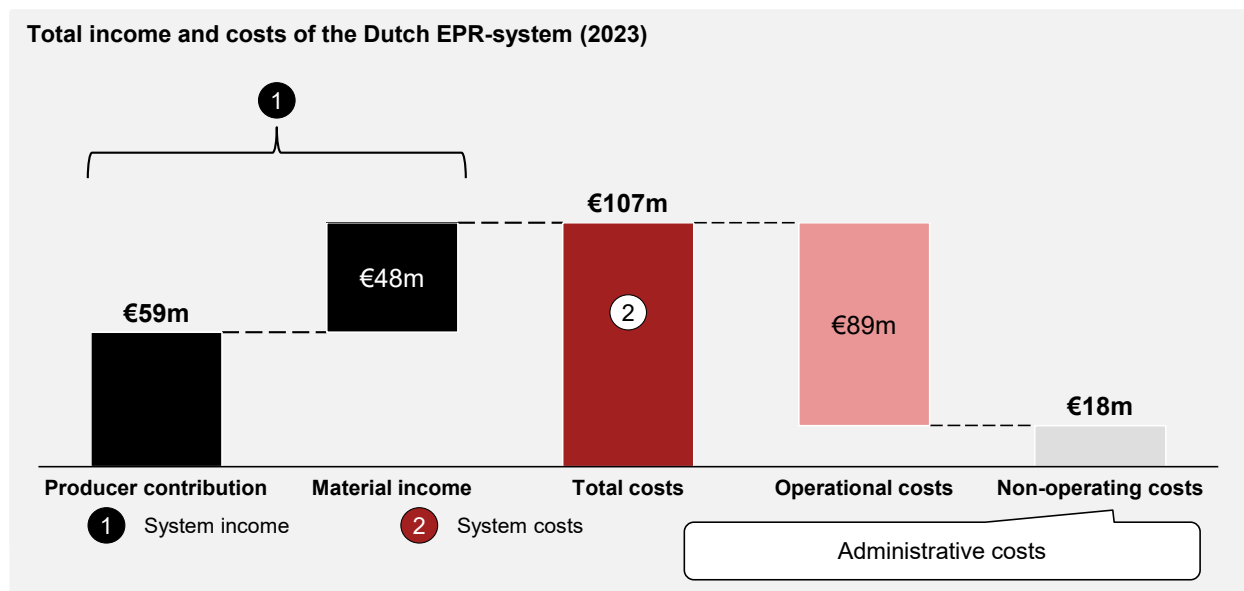


Figure 14: Income and costs of the Dutch EPR system 2023 (€m)

4.5. Strengths and challenges

Strengths of the Dutch EPR system

- **Long-term perspective and long-term contracts for innovation in the supply chain.** Stichting OPEN engages in long-term contracts or contracts with a long-term vision to promote innovation in the supply chain. In 2021, Coolrec inaugurated a new electrostatic separator to generate more types of high-quality secondary raw materials. Coolrec invested €0,5 million in the machine, which was possible, amongst others, because of its long-standing contract with Stichting OPEN, which guarantees them a stable supply of WEEE in the past and future⁴⁰. Stichting OPEN has also developed a 'Roadmap Solar PV Panels,' already securing provisions and establishing partnerships and sustainable infrastructure for when the Solar PV Panels that are currently bought, will need to be treated in 30 to 45 years⁴¹.

³⁶ Stichting OPEN. (2023). AVV Monitoringsrapportage 2023. *Circulariekennis.nl*. https://circulariekennis.nl/wp-content/uploads/2025/03/AVV-Monitoringsrapportage-2023_publicversie.pdf

³⁷ Expert interview. (2025).

³⁸ WEEE Forum. (2023). Key Figures Data.

³⁹ Eurostat. (2022). Waste electrical and electronic equipment (WEEE) by waste management operations - open scope, 6 product categories (from 2018 onwards). https://doi.org/10.2908/ENV_WASELEEOS

⁴⁰ Expert interview. (2025).

⁴¹ Stichting OPEN. (n.d.). Dossier: Zonnepanelen. <https://www.stichting-open.org/dossiers/dossier-zonnepanelen/>

- **Incentive scheme to combat parallel streams ('Stimuleringsregeling').** Since 2022, a new regulation has been introduced to encourage proper processing of e-waste by metal recyclers in the Netherlands. Under this scheme, participating metal recyclers receive compensation from Stichting OPEN for collecting e-waste and delivering it to CENELEC-certified processors. The program has been successful and will be expanded in early 2023. The compensation will increase for certain types of e-waste, and more CENELEC-certified processors will be eligible to receive e-waste under the scheme. Additionally, metal recyclers participating in the program can become official Wecycle collection points for businesses, helping to increase the number of collection sites across the country. The initiative aims to promote separate collection and proper registration of discarded appliances, which is crucial for a sustainable and circular society⁴².
- **Strong emphasis on recycling quality through CENELEC certification.** The Netherlands maintains strict WEEE recycling and processing standards. All WEEE treatment must occur at CENELEC-certified facilities, which are classified as either CENELEC-I or CENELEC-II. CENELEC-I facilities are larger, handling various WEEE types and performing complex dismantling and recycling processes. CENELEC-II facilities are more specialized, focusing on specific WEEE types or recycling stages, often conducting initial sorting or pre-processing before transferring materials to Type I facilities.
- **Efficient logistical framework through contractual agreements.** Stichting OPEN manages the entire WEEE management network in the Netherlands through a system of contracts. These agreements ensure smooth operations by specifying input and output standards for each partner, guaranteeing that the output quality of one partner meets the input requirements of the next. This approach maintains consistency and quality throughout the supply chain⁴³.
- **Transparent monitoring and data reporting.** The Netherlands implements rigorous monitoring, data reporting, and measurement practices. WEEE is weighed upon entering and leaving each partner's facility, allowing Stichting OPEN to track its movement through the chain and account for any removals. The country reports only WEEE treated in approved facilities, avoiding estimates or assumptions about metal recyclers' contributions. The reported collection volume represents the WEEE input for recycling, rather than the total collected weight, ensuring that contaminants like food residues or fluids are not included in the collection figures⁴⁴.

Challenges for the Dutch EPR system

- **Inadequate perspective on legal and illegal export volumes.** Stichting OPEN has an inadequate perspective on legal and illegal export volumes, which deteriorates the collection rate. Additionally, exported WEEE is most likely recycled at lower standards than those applied in the Netherlands, also deteriorating environmental results.
- **Inadequate network for B2B WEEE.** The current B2B waste management system is insufficient for proper WEEE handling. Lack of specific regulations for business waste streams has created a highly competitive waste market, reducing incentives to establish separate collection infrastructures for different waste types. To minimize costs, businesses often dispose of all waste together, resulting in WEEE being mixed with other waste or ending up at scrap metal recyclers. This issue is compounded by the fact that B2B WEEE only came under OPEN's responsibility recently, creating a significant backlog in addressing the problem.

⁴² Stichting OPEN (.2022). Stimuleringsregeling succes: verlenging en uitbreiding hiervan in 2023. <https://www.stichting-open.org/2022/11/18/stimuleringsregeling-succes-verlenging-en-uitbreiding-hiervan-in-2023/>

⁴³ Expert interview. (2025).

⁴⁴ Expert interview. (2025).

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- **Insufficient network to successfully capture the re-use potential of all sub streams of WEEE.** OPEN faces a challenge in establishing an effective network to maximize the potential reuse across all WEEE sub-streams. While partnerships exist for certain categories like ICT equipment and large appliances, the organization lacks comprehensive infrastructure to address the full spectrum of electronic devices. This gap hinders OPEN's ability to give a second life to a broader range of discarded electronics. To tackle this issue, OPEN aims to forge strategic partnerships and implement performance-based contracts across diverse electronic product categories. The focus is on devices currently classified as waste but with potential for refurbishment and reuse. Partners adhering to CENELEC reuse standards would be compensated for successfully refurbishing items and removing their waste status. While reuse rates are expected to remain modest, typically not exceeding 5-10% of total waste, capturing even this percentage across all WEEE sub-streams represents a significant undertaking. By addressing these challenges and expanding its program, OPEN aims to substantially increase the volume of reused electronics, thereby enhancing the circular economy in the sector⁴⁵.

⁴⁵ Expert interview. (2025).

5. International comparison – case studies

Surrounding European countries design the EPR system for e-waste in various ways. EPR systems can differ between countries based on market structure (competition), the scope of WEEE, specific legislative frameworks, responsibilities of the EPR organization, and other factors. In this chapter, we examine four selected case studies, investigating the differences between EPR systems and testing them for effectiveness and efficiency. This chapter aims to analyze and compare the effectiveness and efficiency in neighboring countries with the Dutch system. Additionally, for each case study, attention is paid to specific strengths and challenges of the EPR system.

The case studies primarily focus on WEEE rather than batteries. WEEE constitutes most of the e-waste volume (95% of total e-waste POM in the Netherlands in 2023). In addition, the scope of e-waste management varies between countries and not all countries have the same EPR system for WEEE and batteries. This approach allows for a more comprehensive and consistent comparison across different national systems while addressing the most substantial portion of the e-waste challenge.

Selection of case studies

Specifically, four case studies are elaborated: Belgium, Ireland, Portugal and Italy. Spain was included in the data analysis (Figure 14), but no full case studies has been created. For each country, the following aspects are addressed: the historical context and legal framework that shaped the EPR system, the current structure of the EPR system, the distribution of roles and responsibilities, the operational organization of the waste processing chain, the effectiveness of the system, the degree of innovation and knowledge development, the efficiency of the system, and strengths and areas for improvement per system.

Selected case studies				
Country	Since	Market structure	Scope	Organizations
 Belgium	2001	Central authority	B2C and B2B	 We maken er iets moois van
 Ireland	2005	Competition (duopoly)	B2C	
 Portugal	2006	Competition (duopoly)	B2C and B2B	 CONFIAR PARA RECICLAR
 Italy	2008	Competition (oligopoly)	B2C and B2B	
 Spain	2005	Competition (oligopoly)	B2C and B2B	

Figure 15: Overview case studies

5.1. Belgium

	Indicator	Result 2023
Effectiveness	Achieved collection rate <i>WEEE Forum 2023</i>	49%
	Achieved collection rate excl. PV <i>WEEE Forum 2023</i>	56%
	Achieved recycling rate <i>Eurostat 2022 (Recupel 2023)</i>	73% (83%)
	Achieved recovery rate <i>Eurostat 2022 (Recupel 2023)</i>	81% (95%)
	Innovation	High
	Awareness	High
Efficiency	Total system costs	€45
	Producer contributions	€35m (€25m producer contribution + €10m reserves)
	Producer contribution per inhabitant	€2,98
	Producer contribution per ton put-on-market	€104
	Producer contribution per ton collected	€213
	Producer contribution per ton recycled	€290
	Producer contribution per ton recovered	€263
	Percentage free-riding <i>Expert input</i>	N/A

Figure 16: Summary of the Belgian EPR system

5.1.1. Historical and legislative framework

Belgium established a comprehensive WEEE management system in 2001, evolving from voluntary industry-specific collection schemes to a formal EPR framework with the translation of the WEEE Directive 2002/96 into regional legislation from 2002 to 2005. Belgium was among the first countries to adopt this directive, legally obligating producers and importers to assume financial and physical responsibility for WEEE treatment, recycling, and disposal. The RoHS Directive 2002/95 was incorporated into Belgian national law by Royal Decree in 2004⁴⁶.

WEEE management in Belgium is decentralized across three administrative regions, each enacting separate regulations. Flanders implemented the directive through amendments to the Waste Prevention

⁴⁶ Health Food Chain Safety Environment. (2016). WEEE – Waste Electric and Electronic Equipment. <https://www.health.belgium.be/en/weee-waste-electric-and-electronic-equipment>

and Management Ordinance (VLAREMA) in July 2004⁴⁷. The Walloon region introduced a decree in April 2002, later amended in March 2005^{48, 49}. Brussels adopted a regional decree in September 2003⁵⁰.

In Flanders, the Flemish Regulation on Waste Prevention and Management (VLAREA) decree introduced comprehensive takeback guarantees for all WEEE. This system ensures that all involved sectors contribute to waste stream management. Municipalities and intermunicipal organizations, cooperatives that manage specific public services, collaborate in the practical implementation, with producers and importers bearing the full costs and compensating these entities for their expenses. The 2004 Regional Decree set higher targets than the EU: 90% for large household appliances and 70% for all other WEEE categories. The decree also mandates reporting requirements for producers and importers regarding EEE market placement, collection, recycling, and reuse⁵¹.

The Walloon Decree of April 2002 mandates that industries producing waste gradually assume greater responsibility for managing their waste. The decree emphasizes waste prevention, recycling, and valorization. It also incorporates the "polluter pays" principle, which requires the holder or producer of the waste-generating product to pay for its management. Under the 2002 Walloon Decree, retailers of EEE are required to accept WEEE on a one-for-one basis, and this service must be prominently communicated within the store. EEE distributors are tasked with collecting WEEE from retailers and delivering it to producers and importers (P&Is). P&Is are responsible for routinely collecting WEEE from retailers and distributors, arranging optimal transport and storage conditions, ensuring that WEEE is processed at accredited treatment facilities, and financing the entire system⁵².

The Brussels Decree of 2004 emphasizes the separate collection of different types of WEEE. It states rules for the proper storage and treatment of different types of WEEE, and conditions that treatment operators for WEEE must meet. It does not state that operational or financial responsibility for the system lies with the P&Is, nor does it explicitly mention the takeback scheme. It does refer to a 2001 agreement on takeback obligations⁵³.

The recast WEEE Directive (2012/19/EU) was incorporated into Belgian law via regional decrees. The Flanders Region updated its Materials Decree in December 2011 and introduced the Flemish Regulation on the Sustainable Management of Material Cycles and Waste (VLAREMA) in February 2012. The Walloon Region amended its existing decrees to align with the new directive, and the Brussels-Capital Region revised its waste ordinance in December 2016 to incorporate the updated EU requirements.

The new decrees expanded the scope of products covered in the EPR system, including photovoltaic panels and certain medical devices. It also introduced more challenging collection targets, requiring

⁴⁷ Ministerie van de Vlaamse Gemeenschap. (2003). *Besluit van de Vlaamse regering tot vaststelling van het Vlaams reglement inzake afvalvoorkoming en -beheer*. https://etaamb.openjustice.be/nl/besluit-van-de-vlaamse-regering-van-05-december-2003_n2004035537.html

⁴⁸ Ministerie van het Waalse Gewest. (2002). *Besluit van de Waalse Regering tot invoering van een terugnameplicht voor bepaalde afvalstoffen met het oog op de valorisatie of het beheer ervan*. https://etaamb.openjustice.be/nl/besluit-van-de-waalse-regering-van-25-april-2002_n2002027550

⁴⁹ Ministerie van het Waalse Gewest. (2002). *Besluit van de Waalse Regering tot invoering van een terugnameplicht voor bepaalde afvalstoffen met het oog op de valorisatie of het beheer ervan*. https://etaamb.openjustice.be/nl/besluit-van-de-waalse-regering-van-25-april-2002_n2002027550

⁵⁰ Ministerie van het Brusselse Hoofdstedelijke gewest (2004). *Besluit van de Brusselse Hoofdstedelijke Regering betreffende de beheerders van afgedankte elektrische en elektronische apparatuur*. <https://etaamb.openjustice.be/nl/besluit-van-de-brusselse-hoofdstedelijke-regering-van-n2005031186>

⁵¹ Ministerie van de Vlaamse Gemeenschap. (2003). *Besluit van de Vlaamse regering tot vaststelling van het Vlaams reglement inzake afvalvoorkoming en -beheer*. https://etaamb.openjustice.be/nl/besluit-van-de-vlaamse-regering-van-05-december-2003_n2004035537.html

⁵² Ministerie van het Waalse Gewest. (2002). *Besluit van de Waalse Regering tot invoering van een terugnameplicht voor bepaalde afvalstoffen met het oog op de valorisatie of het beheer ervan*. https://etaamb.openjustice.be/nl/besluit-van-de-waalse-regering-van-25-april-2002_n2002027550

⁵³ Ministerie van het Brusselse Hoofdstedelijke gewest (2004). *Besluit van de Brusselse Hoofdstedelijke Regering betreffende de beheerders van afgedankte elektrische en elektronische apparatuur*. <https://etaamb.openjustice.be/nl/besluit-van-de-brusselse-hoofdstedelijke-regering-van-n2005031186>

member states to achieve a 45% collection rate by 2016 and 65% by 2019. The recast directive placed greater emphasis on the prevention of WEEE generation, promoting reuse and refurbishment of electronics. Belgium implemented stricter standards for the treatment of WEEE, mandating that all collection and recycling facilities obtain certification to ensure proper handling and environmental protection. Retailers' responsibilities expanded to include providing information to consumers about WEEE disposal and accepting small WEEE items without the requirement of a new purchase.

The 2011 RoHS Directive was implemented by Royal Decree in 2013, which replaced the Royal Decree of 2004⁵⁴. It specifies the number of hazardous substances allowed to be present in EEE, and states it is the producer or importer's responsibility to ensure the products they bring on the Belgian market adhere to these rules⁵⁵.

Belgium's three regions share responsibility for achieving national WEEE collection targets. Regional legislation is translated into environmental conventions with PROs. The government favors a controlled single scheme for e-waste management, providing strict frameworks to ensure proper oversight and regulation. Recupel, established in 2001, facilitates collective compliance with WEEE takeback obligations for producers and importers. Initially Recupel was structured on two levels: implementation and seven product-specific management organizations. Recupel merged these entities in 2023. While Recupel remains the primary option, producers and importers retain the right to establish their own management plans.

National targets

Belgium has implemented the EU targets for the collection, recycling, and recovery of Waste Electrical and Electronic Equipment (WEEE) as national objectives. These targets have evolved over time to ensure more effective waste management.

The collection targets have progressively increased to meet growing environmental demands. Until 2016, the goal was to collect 4kg of WEEE per household annually. From 2016 to 2019, this target shifted to 45% of the average put-on-market volume from the preceding three years. As of 2019, the target has further increased to either 65% of the average put-on-market from the preceding three years or 85% of the WEEE generated that year.

Recycling and recovery targets have also seen significant increases in line with EU directives. Between 2012 and 2016, recycling targets ranged from 50% to 75%, depending on the product category, while recovery targets ranged from 70% to 80%. From 2016 to 2018, these targets were raised to 55-80% for recycling and 75-85% for recovery, varying by product category.

Current recycling and recovery targets, established in 2018, are differentiated based on equipment type. Small equipment and small IT equipment have the lowest targets, with 55% for recycling and 75% for recovery of collected WEEE. The highest targets are set for temperature exchange equipment, large household appliances, and solar PV panels, requiring 80% recycling and 85% recovery of collected WEEE.

⁵⁴ Federale overheidsdienst volksgezondheid, veiligheid van voedselketen en leefmilieu. (2020). *Koninklijk besluit tot beperking van het gebruik van bepaalde gevaarlijke stoffen in elektrische en elektronische apparatuur*. https://etaamb.openjustice.be/nl/koninklijk-besluit-van-17-maart-2013_n2013024122.html

⁵⁵ Federale overheidsdienst volksgezondheid, veiligheid van voedselketen en leefmilieu. (2020). *Koninklijk besluit betreffende afgedankte elektrische en elektronische apparatuur*. https://etaamb.openjustice.be/nl/koninklijk-besluit-van-18-maart-2020_n2020015427.html

Belgian collection, recycling, and recovery targets (2023)

	Total	 TEE	 Screens	 Lamps	 Large appliances	 PV	 Small equipment	 Small IT equipment
EU collection target	65%	65% across all categories						
BE collection target	65%	65% across all categories						
EU recycling and reuse target	-	80%	70%	80%	80%	80%	55%	55%
BE recycling target	-	80%	70%	80%	80%	80%	55%	55%
EU recovery target	-	85%	80%	-	85%	85%	75%	75%
BE recovery target	-	85%	80%	-	85%	85%	75%	75%

Figure 17: Belgian collection, recycling, and recovery targets 2023 (%)

5.1.2. Organization of the ERP system

The Belgian EPR system for WEEE operates as a single-scheme system with Recupel as the sole PRO. Recupel's scope encompasses domestic WEEE and professional WEEE. Recupel collects and treats any WEEE that can be used domestically, regardless of whether it originates from consumers or companies.

Recupel's coverage includes professional WEEE, but Recupel does not perform operational activities for professional WEEE. The collection and treatment of larger professional electronic devices, such as industrial printers and dental chairs, are handled by the private market. Recupel fees for professional EEE mainly cover administrative costs. However, Recupel maintains agreements with several entities that collect professional WEEE and provides their contact information on its website to facilitate proper disposal. Since 2025, Recupel has been increasingly involved in the collection and treatment of professional TEE and TVM equipment.

Belgium's EPR system for batteries operates independently from the WEEE system but follows a similar single-scheme structure. Since the merger of Bebat and Recybat in 2016, Bebat has been the exclusive PRO responsible for the collection and treatment of all battery types in Belgium. Belgium's EPR system for solar PV panels is also organized separately. The PRO responsible for PV panels in Belgium is PV Cycle Belgium.

The WEEE system in Belgium does not feature vertical integration. Both operational and financial responsibilities are entirely vested in the PRO.

Element	Explanation
Number of PROs	1 PRO for WEEE (Recupel), 1 PRO for batteries (Bebat), 1 PRO for PV (PV-Cycle Belgium)
Scope	Domestic and professional WEEE

Segmentation	Waste management for batteries and solar PV is organized separately
Market structure	Single scheme: 1 PRO for WEEE, 1 PRO for batteries, 1 PRO for PV
Level of integration	No integration
Operational responsibility	PRO
Financial responsibility	PRO

Table 2: Characteristics of the Belgian EPR system

5.1.2.1. Roles and responsibilities

Producers and importers

Producers and importers in Belgium are legally responsible for the financial and operational management of WEEE. They can fulfill this obligation by joining Recupel or establishing their own waste management plan. Recupel has approximately 5000 members, corresponding to circa 95% of all P&Is. Their interests are represented in Recupel's governing body and general assembly through industry representatives or federations.

Recupel

Recupel, a non-profit organization founded in 2001, is Belgium's sole PRO for e-waste. Initially, Recupel operated with a central body overseeing collection, transport, and processing, supported by seven product-specific management bodies. These bodies determined producer contributions and managed campaigns for their respective product groups. In 2023, Recupel consolidated into a single legal entity, streamlining its governance structure. The organization is now led by a governing body comprising 12 directors and various observers, including regional authorities. Complementing this is the General Assembly, which incorporates representatives from producer and importer federations. Despite the consolidation, product-specific management bodies continue to play a crucial role. The governing body sets the annual budget and allocates costs across product groups, while individual management bodies devise financing strategies and determine product-specific producer contributions for their respective categories⁵⁶.

Recupel funds, coordinates, and raises awareness for WEEE collection, reuse, and recycling. The organization manages the Recupel-contribution, a visible consumer fee that funds WEEE management. This fee is transparently published annually and flows from consumers through retailers, producers, or importers to Recupel. To execute its responsibilities, Recupel contracts commercial waste management operators for collection, transport, and treatment services. Recupel also monitors and reports the quantities of WEEE collected, reused, and recycled to the government, ensuring compliance with regulatory requirements. Additionally, Recupel conducts targeted awareness campaigns to educate consumers about the circular economy and the importance of proper WEEE management. These efforts aim to increase public participation in responsible e-waste disposal and promote sustainable consumption practices.

The Regions Flanders, Walloon and Brussels

In Belgium, each of the three regions is responsible for managing waste within its territory, including WEEE. Each region enters into an environmental agreement with Recupel, which outlines the terms of their collaboration. These agreements can vary between regions. Regional authorities monitor whether the implementation and quality of the system are upheld.

As the sole PRO for e-waste, Recupel operates under stringent regulations, with regional authorities playing an active role in oversight. The regional authorities participate as observers in Recupel's governing body

⁵⁶ Expert Interviews. (2025).

and General Assembly, approve the calculations for the Recupel contribution, and are involved in the tender processes for transportation and treatment as well as the charters governing collection and treatment. They provide feedback on Recupel's awareness campaigns and are engaged in key decisions, such as approving the annual budget, the implementation plan, strategic decisions, and Recupel's long-term management and financial plans. Moreover, regional authorities periodically consult on Recupel's strategies for reuse and countering free riding. They engage in quarterly interregional consultations to discuss the operational functioning of the WEEE management system. Finally, the regional authorities request a yearly external audit of the figures reported by Recupel, such as the total put-on-market, collection and recycling results. They also request audits of several of Recupel partners.

The regional environmental agencies

The regional environmental agencies are responsible for practical oversight of the EPR system for WEEE in Belgium. In Flanders, this role is fulfilled by the Openbare Vlaamse Afvalstoffenmaatschappij (OVAM), in Wallonia by the Soil and Waste Department (Département Sol et Déchets), and in Brussels by Bruxelles Environnement.

OVAM, an independent government agency, is charged with safeguarding the public and the environment from the adverse effects of production, usage, and management of waste and materials⁵⁷. It enforces waste management oversight by approving waste management plans from Recupel and other organizations and observing Recupel's board activities, amongst others⁵⁸. In the Walloon Region, these duties are assumed by Walloon's Soil and Waste Department, which mirrors OVAM's oversight functions. In the Brussels region, Bruxelles Environnement, a public organization, is engaged in environmental protection, animal welfare, and energy policy.

The municipalities

Municipalities in Belgium fall under one of the three regions and are each responsible for maintaining their own collection sites, known as recycling parks. These recycling parks are managed by the municipalities or by intermunicipal organizations. Intermunicipal organizations are cooperative entities that allow multiple municipalities to jointly manage public services, such as waste management, more efficiently and cost-effectively. At these parks, residents can drop off their WEEE free of charge. The infrastructure, quality of sorting, and facility logistics are consistent across regions. Recupel compensates the recycling parks to help cover their operational costs through a standardized agreement that is negotiated on a regional level.

BeWeee Tool

The BeWeee Tool was developed and launched in 2019 as a joint initiative by Recupel, PV Cycle and several other non-profit organizations to address the high volume of undocumented WEEE flows. This tool serves as national reporting platform, enabling all stakeholders in the WEEE management system to fulfill their reporting obligations. These stakeholders include producers, importers, collectors, exporters, distributors/retailers, recyclers, and electronics repair centers.

P&Is who are members of Recupel are obligated to report all their put-on-market (POM) and Out-of-Market (OOM) EEE to Recupel, which in turn reports this data to BeWeee. P&Is who are not affiliated with Recupel are required to report both their EEE POM and OOM data directly to BeWeee. For P&Is whose WEEE is not entirely covered by Recupel a dual reporting system is in place. They must report the EEE POM and

⁵⁷ Vlaanderen. (n.d.). Openbare Vlaamse Afvalstoffenmaatschappij.

<https://www.vlaanderen.be/organisaties/administratieve-diensten-van-de-vlaamse-overheid/beleidsdomein-omgeving/openbare-vlaamse-afvalstoffenmaatschappij>

⁵⁸ Ministerie van het Waalse Gewest. (2002). *Besluit van de Waalse Regering tot invoering van een terugnameplicht voor bepaalde afvalstoffen met het oog op de valorisatie of het beheer ervan*. https://etaamb.openjustice.be/nl/besluit-van-de-waalse-regering-van-25-april-2002_n2002027550

OOM data not covered by Recupel directly to BeWeee, while Recupel-covered WEEE is reported through the standard Recupel process. The same principle applies to all other partners in the waste chain, such as collectors, recyclers, repair centers and exporters. If they report all the WEEE they process to Recupel, they have no reporting obligation. If they also process WEEE outside of Recupel's system, they are obligated to report these quantities of WEEE to BeWeee.

This reporting structure ensures that the BeWeee platform captures data from all segments of the WEEE market, whether handled by Recupel or managed independently. The system increases compliance with reporting obligations across the entire WEEE management system.

5.1.2.2. Organization of the supply chain

In the Belgian EPR system, Recupel holds full operational and financial responsibility for organizing the waste management system for B2C WEEE. Recupel is not financially or operationally responsible for B2B WEEE but does offer services for P&Is or companies that are interested. WEEE is divided into two material streams:

1. B2C WEEE: This stream comprises household appliances like laptops, phones, and fridges, regardless of whether they are owned by individuals or businesses. Recupel directly manages the collection and processing of domestic WEEE.
2. B2B WEEE: This category refers to large electrical and electronic equipment used for specific professional purposes, such as large printers or medical equipment. Companies with B2B WEEE can contact Recupel Approved Contractors (RACs), which are transport or treatment operators that have established charter agreements with Recupel. These contractors ensure the proper handling and processing of professional WEEE in compliance with the standards set by Recupel.

This division allows for specialized handling of different types of WEEE, ensuring effective waste management and adherence to regulatory requirements.

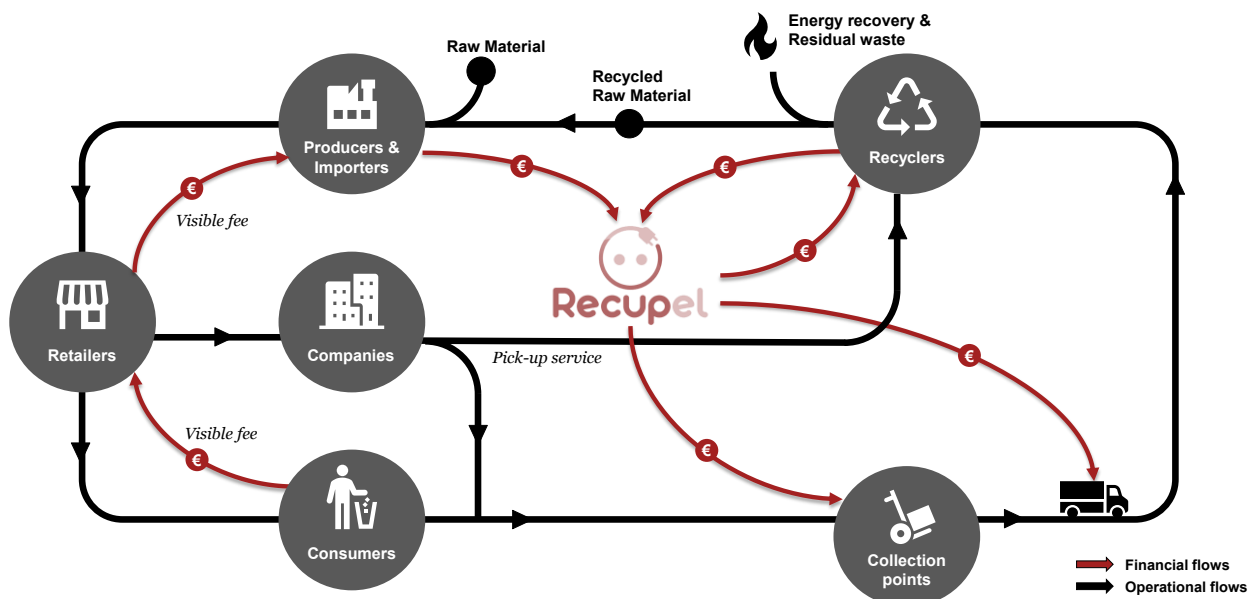


Figure 18: Set-up of the Belgian EPR system

Collection

WEEE in Belgium is collected at a broad range of collection points aimed at enhancing convenience and efficiency in waste management. Consumers can drop off their WEEE free of charge at any of the 544 municipal recycling parks or at one of the 11,728 collection points located at EEE retailers, known as Recupel-points. Legally, EEE retailers must accept WEEE on a one-for-one and one-for-zero basis, and retailers that sell EEE among other products (and have a dedicated sales area for EEE that is larger than 400m²) are also required to accept small WEEE (all dimensions below 25 cm) on a one-for-one basis. Additionally, consumers have the option to deliver their WEEE to one of the 39 thrift stores or repair centers across the country. WEEE is sorted into fractions at the time of collection, eliminating the need for sorting later in the process.

For companies looking to dispose of B2B WEEE, they can either bring it to one of the 89 charter organizations contracted by Recupel or deliver it to one of the accredited recyclers that do not have a charter agreement with Recupel. Recupel has charter agreements with 75 transporters and 14 processors. For non-recurring WEEE disposals, such as those resulting from renovations, companies can request a free pick-up service via Recupel's website. For regular disposals, companies can register as a Recupel-point.

Recupel-points may receive either a blue collection container for smaller WEEE or a box pallet for larger items. Furthermore, they are eligible for free pick-up of the collected WEEE. Recupel-points may receive economic compensation for part-time storage if they collect enough volumes. Recupel also provides free pick-up services for WEEE collected at recycling parks, which can be arranged once a minimum quantity has been accumulated. Recupel coordinates with contracted logistics partners for these pick-ups.

Second hand and repair stores partnering with Recupel benefit from various economic compensations under specific agreements. These stores must hand over all non-reusable WEEE to Recupel and are eligible for the following compensations:

- Centralization Compensation: For aggregating and storing non-reusable WEEE in the region.
- Optimization Contribution: For ensuring optimal transportation of WEEE appliances.
- Compensation for Collection for Re-use: For collecting reusable EEE, handing them over to Recupel when not sold for reuse.
- Compensation for Preparing for Re-use: Based on volumes sold in the past year for effectively preparing EEE for resale.

Processing and recycling

Once WEEE is collected, it is transported by Recupel-contracted companies to Recupel-approved treatment facilities. While CENELEC-certification is not a legal requirement in Belgium, recyclers must be certified according to European Normative Standards. Government authorities oversee this certification process, determining which recyclers meet these standards and can collaborate with Recupel.

Recupel goes a step further by requiring all treatment plants it contracts with or enters into a charter agreement with to be CENELEC-certified. This certification ensures the safe removal of hazardous elements and the utilization of cutting-edge technologies to attain optimal recycling outcomes.

Recyclers with a charter agreement with Recupel receive financial incentives for handling WEEE in a high-quality and legally compliant manner. This approach not only ensures adherence to robust environmental standards but also encourages continuous improvement in recycling practices.

5.1.3. Effectiveness

The Belgian EPR system met the collection target for three out of seven categories of WEEE in 2023, and the recycling and recovery targets for four and five out of seven, respectively, according to Eurostat. National reporting deviates from Eurostat and indicates Recupel met the recovery targets for all fractions. Recupel indicates that at the national level (including BeWEEE reporting) Recupel has also met the recycling targets for all fractions as of 2023.

Belgium invests a significant amount of its revenue, 15-20%, in awareness campaigns. For example, Belgium has several innovative projects running to increase the amount of WEEE that is re-used and/or repaired.

5.1.3.1. Realization collection and recycling targets

In 2022, Belgium had a total 3-year average put-on-market of 338kt of EEE. This amounts to 29 kg per inhabitant, around the EU average of 30kg POM per inhabitant. In 2022, Belgium collected 165kt of WEEE, which amounts to 14kg per inhabitant and a collection rate of 49% of the average POM of the three preceding years, below the EU and Belgium target of 65%. The collection target was met for three fractions of WEEE: screens, lamps and small IT and telecommunication equipment. Lamps and small IT equipment have a relatively short lifespan compared to the other categories of WEEE. This makes it easier to achieve the collection target calculated as a percentage of the three preceding years POM⁵⁹.

In total, Belgium recycled 121kt in 2022, and recovered 133kt. For recycling, this amounts to an overall recycling rate of 73%. Belgium met the recycling targets for four fractions of WEEE. In total, Belgium recovered 81% of all WEEE collected. It met the recovery targets for all fractions of WEEE except PV panels and small equipment⁶⁰. National reports indicate that Belgium met the recovery targets for all fractions in 2023.

Belgian put-on-market (3-year average), collection, recycling, and recovery in kt (2022, 2023)								
	Total	 TEE	 Screens	 Lamps	 Large appliances	 PV	 Small equipment	 Small IT equipment
Put-on-market 3-year average <i>WEEE Forum 2022</i>	338	63	15	2	109	48	89	13
Collection <i>WEEE Forum 2022 (Recupel 2023)</i>	165 (128)	27 (26)	12 (9)	1 (1)	56 (31)	2 (0)	51 (52)	15 (9)
Recycling <i>Eurostat 2022 (Recupel 2023)</i>	121 (106)	21	9	1	44	1	34	10
Recovery <i>Eurostat 2022 (Recupel 2023)</i>	133 (122)	23 (25)	10 (9)	1 (1)	48 (29)	1 (0)	38 (50)	11 (8)

Collection own reporting excl. BeWEEE Tool

Figure 19: Put-on-market, collection, recycling and recovery of the Belgian EPR system 2022, 2023 (kt)

⁵⁹ WEEE Forum. (2023). Key Figures Data.

⁶⁰ Eurostat. (2022). Waste electrical and electronic equipment (WEEE) by waste management operations - open scope, 6 product categories (from 2018 onwards). https://doi.org/10.2908/ENV_WASELEEOS

Belgian achieved collection, recycling, and recovery rates in relation to targets (2022, 2023)

	Total	TEE	Screens	Lamps	Large appliances	PV	Small equipment	Small IT equipment
BE collection target	65%	65% across all categories						
Collection rate <i>WEEE Forum 2022</i>	49%	43%	82%	80%	52%	4%	57%	118%
BE recycling target	-	80%	70%	80%	80%	80%	55%	55%
Recycling rate <i>Eurostat 2022 (Recupel 2023)</i>	73% (83%)	78%	74%	90%	79%	68%	67%	66%
BE recovery target	-	85%	80%	-	85%	85%	75%	75%
Recovery rate <i>Eurostat 2022 (Recupel 2023)</i>	81% (95%)	86% (98%)	84% (95%)	93% (94%)	86% (93%)	70% (93%)	74% (96%)	75% (96%)

 EU target achieved

Figure 20: Belgian results compared to national and EU-targets

5.1.3.2. Innovation, knowledge sharing and awareness

Belgium allocates 15-20% of its revenue to awareness campaigns, investing in initiatives that promote re-use and other sustainable waste management practices⁶¹.

- Digital Tools and Applications:** Recupel has developed several digital solutions to enhance e-waste management. The BeWeee Tool, launched in 2018 in collaboration with other non-profit organizations, aims to reduce undocumented WEEE streams by facilitating comprehensive reporting by all system actors. In 2023, Recupel introduced a scanning app that assesses EEE by providing product information, age, and repair history, aiding in repair suitability decisions and determining appropriate treatment processes for seemingly similar products like LCD and LED displays⁶².
- Financial Incentives and Structural Changes:** To improve e-waste management, Recupel has implemented various financial and structural measures. They increased incentives for scrap metal recyclers who channel electronic waste to approved facilities, aiming to increase the amount of properly treated WEEE. Starting March 2025, online marketplaces will be required to ensure EPR compliance of their sellers or assume responsibility for themselves. Platforms can meet this

⁶¹ Expert interview. (2025).

⁶² Recupel (2023). *Jaarverslag 2023 Hergebruik en herstel op zijn kop*. https://jaarverslag.recupel.be/wp-content/uploads/2024/06/Recupel_Jaarverslag_NL_2023.pdf

requirement by either verifying compliance of all P&Is selling through their platform and excluding non-compliant ones, or by assuming compliance responsibility themselves, including organizing a free takeback scheme and reporting annual EEE placed on the market and WEEE collected⁶³. To further facilitate proper WEEE disposal, Recupel offers free pick-up services for a wide range of entities including companies, organizations, and educational institutions⁶⁴.

- **Reuse and Repair Initiatives:** In 2023, Recupel shifted its focus towards fostering a circular economy centered on repair and reuse, aligning with broader policies like the European Green Deal. This resulted in a 38% increase in reuse compared to 2022. They initiated workgroups to preserve repair potential at collection sites and during transport and organized "speed dates" to connect second-hand stores, retailers, and manufacturers. Additionally, they conducted a study on the repair sector in collaboration with Mobius, which revealed that one in four Belgians repaired EEE in 2021, with the large household appliance repair sector valued at €120 million and employing 900 people⁶⁵.
- **Educational Collaborations:** Since 2013, Recupel has collaborated with GoodPlanet to create educational materials and workshops fostering a circular economic mindset among students. The "ElektroHelden" campaign in 2023 focused on repair and reuse, encouraging students to track their EEE reuse and repair actions online. Students competed to collect old mobiles, with winners receiving Technopolis tickets. The initiative also included a raw materials hunt game educating secondary school students about EEE lifespans and promoting mobile phone collection⁶⁶.
- **Public Awareness Campaigns:** Recupel's communication plan for 2022-2025 aims to enhance their brand by transitioning from solely fraction-specific awareness initiatives to a balanced approach that combines overarching Recupel campaigns with targeted, fraction-specific strategies. They introduce a role model, prioritize collection points, and focus on increasing their engagement with their B2B audience. Recupel uses its partnerships and striking stunts to increase their reach and boost visibility. Additionally, Recupel engages in creative public awareness campaigns to promote recycling. Recupel's "Mission Recyclage" initiative, in its third year, partnered with radio station Nostalgie and homeless support organization L'Ilôt, along with other non-profits, to collect and repurpose old household appliances. The program aimed to refurbish usable devices and donate them to those in need while recycling irreparable items, combining environmental sustainability with social support. Recupel also hosted an exclusive concert by Black Box Revelation at AB, where attendees exchanged two old phones for entry. Targeting younger audiences, they partnered with Studio 100 for 'De Grote Sinterklaasshow', featuring popular characters like K3, Mega Mindy, and Mega Toby to encourage Flemish children to recycle toys and WEEE in exchange for sustainable rewards⁶⁷.
- **AI tool for waste sampling:** Recupel developed an AI tool to help catalogue the WEEE from waste streams through a sampling process based on 6 pictures taken in a standardized environment. The AI system labels the WEEE into one of the 500+ appliances listed, capturing weight and size (> or < 50cm). This allows Recupel to accurately define the quantities and average weight of the product categories and capture evolutions in time. This system enables Recupel to accurately allocate costs to the different product categories, which together with their relative and absolute quantities largely

⁶³ Recupel. (2023). Registreren als beheerder van een online marktplaats. <https://www.recupel.be/nl/registreren-als-beheerder-van-een-online-marktplaats>

⁶⁴ Expert interview. (2025).

⁶⁵ Recupel (2023). *Jaarverslag 2023 Hergebruik en herstel op zijn kop*. https://jaarverslag.recupel.be/wp-content/uploads/2024/06/Recupel_Jaarverslag_NL_2023.pdf

⁶⁶ Recupel. (2023). Recupel op Scholen. <https://www.recupel.be/nl/recupel-informeert/recupel-op-scholen>

⁶⁷ Sportpaleis Antwerpen. (2023). De Grote Sinterklaasshow in het teken van duurzaamheid. <https://www.sportpaleis.be/nieuws/de-grote-sinterklaasshow-in-het-teken-van-duurzaamheid>

determines the contribution for that category. This system offers a cost-effective way to ensure a trusted, reliable cost allocation model.

5.1.4. Efficiency

The total system costs associated with Belgium's EPR system amounted to €45 million in 2023⁶⁸. This sum is financed through various sources: €25 million from producer contributions, €10 million from financial reserves accumulated in previous years, and €10 million from material revenues. This results in a total producer contribution of €2.98 per inhabitant, €104 per ton placed on the market (POM), €213 per ton collected, and €290 per ton recycled^{69, 70, 71}.

The producer contribution is facilitated through a transparent fee known as the Recupel-contribution, which producers and importers (P&Is) and retailers are required to display to consumers. This visibility enhances awareness of the need to treat e-waste, and the costs involved in the proper collection and recycling of WEEE. P&Is of B2B WEEE only pay an administrative fee, which covers POM reporting obligations.

Each year, the Recupel governing body develops an annual budget to project the total costs necessary for the efficient operation of the system. These costs are then allocated to specific product subcategories. The managing bodies of these subcategories are responsible for determining how to fund their portion of the budget, including setting the prices for different product types within their WEEE category and deciding whether to use reserve funds⁷².

Importantly, the calculations for the Recupel-contribution per product must be government-approved to ensure transparency and accountability.

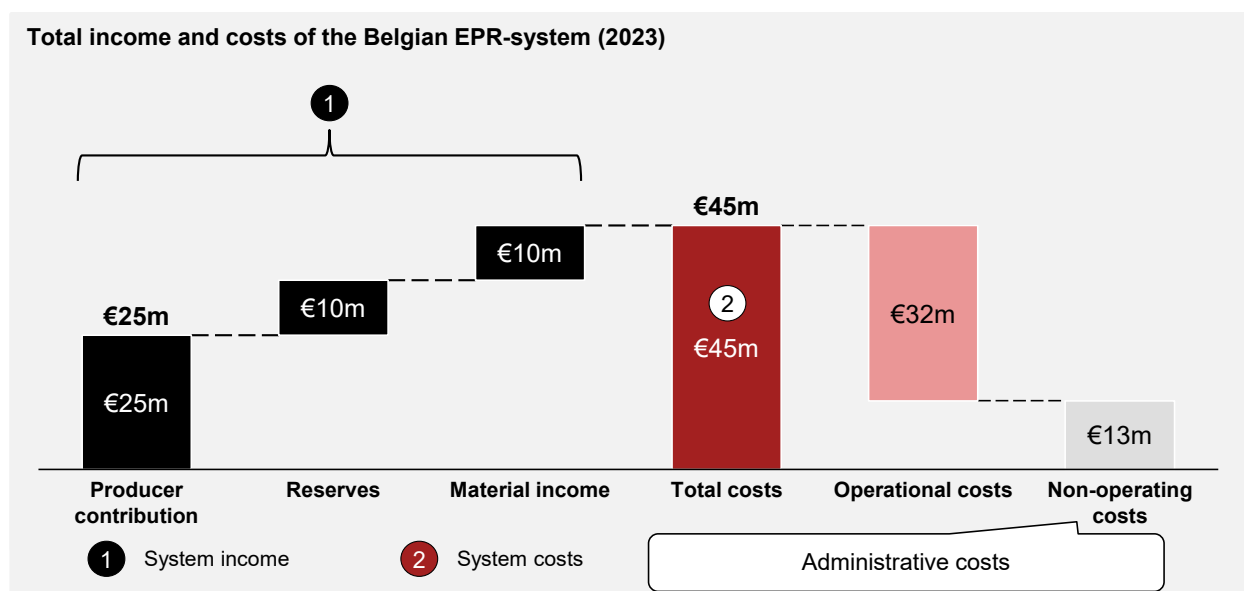


Figure 21: Total income and costs of the Belgian EPR system (€m)

⁶⁸ Recupel (2023). *Jaarverslag 2023 Hergebruik en herstel op zijn kop*. https://jaarverslag.recupel.be/wp-content/uploads/2024/06/Recupel_Jaarverslag_NL_2023.pdf

⁶⁹ Expert interview. (2025).

⁷⁰ WEEE Forum. (2023). Key Figures Data.

⁷¹ Eurostat. (2022). Waste electrical and electronic equipment (WEEE) by waste management operations - open scope, 6 product categories (from 2018 onwards). https://doi.org/10.2908/ENV_WASELEEOS

⁷² Expert interview. (2025).

5.1.5. Strengths and challenges

Strengths of the Belgian EPR System

- **Extensive Collection Network:** Belgium boasts a dense network of over 12,000 collection points, with an average of one collection point per 1,000 inhabitants. Recycling parks make up 4% of these points, while the remaining 96% are comprised of Recupel-points at EEE retailers and thrift shops⁷³.
- **BeWeeee Tool:** The BeWeeee Tool, developed by Recupel in collaboration with non-profit organizations, aids compliance by facilitating easy reporting of WEEE handled by waste management operators. This tool aims to reduce undocumented streams and increase accountability among operators.
- **Financial Robustness:** The Belgian EPR system is financially sound, thanks to precise cost allocations for different Recupel subdivisions and product types. This is supported by sampling activities and significant involvement from P&Is. Recupel performs regular audits on all partners to maintain financial transparency and system efficiency⁷⁴. Additionally, the visible Recupel-contribution makes changes in contribution cumbersome. The lack of changes in contribution, the possibility of having flexible reserves, and the stability of Recupel as organization, result in a stable producer contribution.
- **Investment in Education and Awareness:** Recupel dedicates 15-20% of its revenue to educational and awareness campaigns, the highest percentage among case study countries examined⁷⁵. This strategic investment targets raising a generation that values circular economy principles and seeks to influence older generations through their children⁷⁶.
- **Accountability of Online Marketplaces:** Recupel has pioneered an innovative approach to tackling free riding by distance sellers. The online platforms are now responsible for ensuring that the P&Is selling through them are affiliated with Recupel or have an independent waste management plan. Platforms must either deny non-compliant P&Is or assume EPR obligations themselves.
- **Uniform Recycling Parks:** All recycling parks within a region in Belgium are uniformly organized in terms of infrastructure, separation, and logistics, facilitating streamlined waste transport to treatment facilities⁷⁷.

Challenges for the Belgian EPR system

- **High Levels of Untraceable Volumes:** Belgium's small size, open borders, and proximity to international ports like Antwerp pose challenges in tracking untraceable WEEE volumes, despite the BeWeeee Tool. Significant quantities of WEEE are handled outside the EPR system and not recorded, complicating tracking efforts.

⁷³ Recupel (2023). *Jaarverslag 2023 Hergebruik en herstel op zijn kop*. https://jaarverslag.recupel.be/wp-content/uploads/2024/06/Recupel_Jaarverslag_NL_2023.pdf

⁷⁴ Expert interview. (2025).

⁷⁵ Expert interview. (2025).

⁷⁶ Recupel (2023). *Jaarverslag 2023 Hergebruik en herstel op zijn kop*. https://jaarverslag.recupel.be/wp-content/uploads/2024/06/Recupel_Jaarverslag_NL_2023.pdf

⁷⁷ Expert interview. (2025).

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- **Complex Regional Legislative Authority:** Waste management authority lies with Belgium's three regions, requiring agreements to be negotiated thrice. This complicates the alignment needed for national policies as well as the development of new initiatives, regulations, or unified approaches⁷⁸.
 - **Understated Societal Costs:** The producer contribution indicates the societal costs for WEEE recycling. In the past, Belgium's producer contributions were high, causing reserves to be built up. These reserves are now used to cover some of the waste management costs. However, this obscures the true current recycling costs. Depletion of these reserves could lead to sudden price increases for consumers.

⁷⁸ Expert interview. (2025).

5.2. Ireland

	Indicator	Result 2023
Effectiveness	Achieved collection rate <i>WEEE Forum 2023 (Annual reports 2023)</i>	46% (53%)
	Achieved collection rate excl. PV <i>WEEE Forum 2023</i>	51% (53%)
	Achieved recycling rate <i>Eurostat 2022 (Annual reports 2023)</i>	82% (80%)
	Achieved recovery rate <i>Eurostat 2022 (Annual reports 2023)</i>	94% (95%)
	Innovation	High
	Awareness	Medium
Efficiency	Total system costs	€24m
	Producer contributions	€16m
	Producer contribution per inhabitant	€2,92
	Producer contribution per ton put-on-market	€137
	Producer contribution per ton collected	€297
	Producer contribution per ton recycled	€288
	Producer contribution per ton recovered	€252
	Percentage free-riding <i>Expert input</i>	N/A

Figure 22: Summary of the Irish EPR system

5.2.1. Historical and legislative framework

The Waste Management Act of 1996 created the basis for WEEE management in Ireland. The Act allowed regulations imposing ‘producer responsibility obligations’ on producers, without immediately enforcing them. These obligations included steps to prevent, minimize, limit or recover waste related to their products, and may include targets. Regulation may require waste audits, lifecycle assessments, product designs facilitating dismantling and recovery, and take-back programs. Local Authorities and the EPA were given the power to enforce producer responsibility regulations⁷⁹.

In 2005, Ireland enacted the EU WEEE Directive (2002/96/EC) into national law through the Waste Management (Electrical and Electronic Equipment) Regulations 2005 (S.I. No. 290 and S.I. No. 340/2005). S.I. No. 290/2005 established a framework for implementing the EPR system, and S.I. No. 340/2005 introduced the specific regulations through which the EPR system was established. The legislation made

⁷⁹ Government of Ireland. (1996). *Waste Management Act, 1996*.
<https://www.irishstatutebook.ie/eli/1996/act/10/enacted/en/print#sec28>

P&Is operationally and financially responsible for financing the environmentally sound management of WEEE from private households and businesses.

P&Is are responsible for arranging collection from collection points and treatment of WEEE, and for financing the collection, treatment, recovery and environmentally sound disposal of WEEE. Retailers are also given responsibilities under the 2005 regulations, including the obligation to take back old equipment free of charge when selling new products on a one-for-one basis. Local authorities were tasked with providing civic amenity sites for WEEE collection, while the Environmental Protection Agency (EPA) was designated as the enforcement body for the regulations⁸⁰. The regulations introduced a visible Environmental Management Cost (vEMC) that could be displayed separately on product prices to cover the costs of managing historical WEEE. It also introduced specific recycling, and recovery targets for different categories of WEEE, such as large household appliances, IT equipment, and consumer electronics⁸¹.

The 2005 regulations assigned P&Is operational responsibility, allowing them to fulfill their obligations individually or by joining collective compliance schemes such as WEEE Ireland and ERP Ireland. These schemes were required to achieve collection rates of at least 4 kg per inhabitant per year from private households by December 2008.

The Waste Management (Electrical and Electronic Equipment) (Amendment) Regulations 2008 (S.I. No. 375 of 2008) introduced further changes to the WEEE management system. These amendments clarified the definition of EEE producers, strengthened the registration and reporting requirements for producers, and required and simplified the provisions for displaying the visible environmental management costs⁸².

In 2011, the EU adopted a recast WEEE Directive (2012/19/EU), which was transposed into Irish law through the European Union (Waste Electrical and Electronic Equipment) Regulations 2014 (S.I. No. 149 of 2014). This legislation expanded the scope of the regulations to cover all EEE after a transitional period. They introduced more detailed reporting requirements for producers and compliance schemes to improve data quality and traceability in the WEEE management system. The 2014 regulations enhanced the role of EEE retailers in WEEE collection, requiring them to accept very small WEEE (no external dimension more than 25 cm) free of charge and without obligation to buy new EEE. It also clarified the roles and responsibilities of online sellers and fulfilment service providers, addressing the growing importance of e-commerce in EEE sales⁸³.

Standards for WEEE collection, sorting, transport, and treatment have been progressively strengthened. The 2014 regulations introduced more stringent requirements for WEEE treatment facilities, including the need for permits and regular inspections. They also mandated the removal of specific components, substances, and mixtures from WEEE before treatment, such as mercury-containing components, batteries, and printed circuit boards⁸⁴.

The 2014 regulations set ambitious collection targets, aiming for 45% by 2016, 65% by 2019 or 85% of WEEE generated. Recycling and recovery targets for different WEEE categories were progressively increased. The 2014 regulations set new targets to be achieved from August 2015 to August 2018, ranging from 75% to 85% for recycling and from 80% to 85% for recovery, depending on the WEEE category. From

⁸⁰ Government of Ireland. (2005). *S.I. No. 340/2005 - Waste Management (Waste Electrical and Electronic Equipment) Regulations 2005*. <https://www.irishstatutebook.ie/eli/2005/si/340>

⁸¹ Government of Ireland. (2005). *S.I. No. 340/2005 - Waste Management (Waste Electrical and Electronic Equipment) Regulations 2005*. <https://www.irishstatutebook.ie/eli/2005/si/340>

⁸² Government of Ireland. (2008). *S.I. No. 375/2008 - Waste Management (Waste Electrical and Electronic Equipment) (Amendment) Regulations 2008*. <https://www.irishstatutebook.ie/eli/2008/si/375/made/en/print>

⁸³ Government of Ireland. (2014). *S.I. No. 149/2014 - European Union (Waste Electrical and Electronic Equipment) Regulations 2014*. <https://www.irishstatutebook.ie/eli/2014/si/149/made/en/print>

⁸⁴ Government of Ireland. (2014). *S.I. No. 149/2014 - European Union (Waste Electrical and Electronic Equipment) Regulations 2014*. <https://www.irishstatutebook.ie/eli/2014/si/149/made/en/print>

August 2018, these targets were further increased, with recycling rates ranging from 80% to 85% and recovery rates of 85% for most categories.

National targets

Ireland has implemented EU targets for the collection, recycling, and recovery of Waste Electrical and Electronic Equipment (WEEE) as national objectives. These targets have evolved over time to ensure more effective waste management.

The collection targets have progressively increased to meet growing environmental demands. Until 2016, the goal was to collect 4kg of WEEE per household annually. From 2016 to 2019, the collection target increased to 45% of the average put-on-market volume from the preceding three years. As of 2019, the collection target has further increased to either 65% of the average put-on-market from the preceding three years or 85% of the WEEE generated that year.

Recycling and recovery targets have also seen significant increases in line with EU directives. Between 2012 and 2016, recycling targets ranged from 50% to 75%, depending on the product category, while recovery targets ranged from 70% to 80%. From 2016 to 2018, these targets were raised to 55-80% for recycling and 75-85% for recovery, varying by product category.

Current recycling and recovery targets, established in 2018, are differentiated based on equipment type. Small equipment and small IT equipment have the lowest targets, with 55% for recycling and 75% for recovery of collected WEEE. The highest targets are set for temperature exchange equipment, large household appliances, and solar PV panels, requiring 80% recycling and 85% recovery of collected WEEE.

Irish collection, recycling, and recovery targets (2023)								
	Total	 TEE	 Screens	 Lamps	 Large appliances	 PV	 Small equipment	 Small IT equipment
EU collection target	65%	65% across all categories						
IE collection target	65%	65% across all categories						
EU recycling and reuse target	-	80%	70%	80%	80%	80%	55%	55%
IE recycling target	-	80%	70%	80%	80%	80%	55%	55%
EU recovery target	-	85%	80%	-	85%	85%	75%	75%
IE recovery target	-	85%	80%	-	85%	85%	75%	75%

Figure 23: Irish collection, recycling and recovery targets 2023 (%)

5.2.2. Organization of the ERP system

The Irish EPR system for WEEE and batteries features a duopoly with two competing PROs. The PROs manage B2C WEEE and batteries, which include any equipment in an average household with a plug or

battery. B2B WEEE, such as commercial printers and scanners, industrial dishwashers, commercial fridges, and vending machines, are not handled by the PROs. To dispose of B2B waste, businesses must contact their supplier or licensed treatment operator⁸⁵. Neither of the PROs have their own assets. PROs hold full operational and financial responsibility.

Element	Explanation
Number of PROs	2 (WEEE Ireland and ERP Ireland)
Scope	B2C WEEE
Segmentation	B2B WEEE handled separately
Market structure	Duopoly
Level of integration	No integration
Operational responsibility	PROs
Financial responsibility	PROs

Table 3: Characteristics of the Irish EPR-system

5.2.2.1. Roles and responsibilities

Producers and importers

Producers and importers bring EEE and batteries to the Irish market. They are either the manufacturers of these products, or the companies that import and sell them in Ireland. Since 2005, P&Is have operational and financial responsibility for the management of the waste from EEE and batteries. They can choose to fulfil this obligation through an individual scheme, or by joining one of the two collective schemes (PROs). Individual waste management plans must be approved by the Environmental Protection Agency (EPA). In addition to the operational and financial management of the waste system, P&Is have several other responsibilities:

- Registration: P&Is must register with the Producer Register Limited (the national registration body), to legally sell electronic and electrical equipment in Ireland.
- Take-Back Systems: P&Is must facilitate retail take-back systems to allow consumers to return their WEEE at the point of sale, on a one-to-one basis with the purchase of new equivalent products.
- Reporting: P&Is must submit regular reports to the EPA or the compliance scheme, detailing the quantities of WEEE placed on the market, collected, and treated to ensure transparency and accountability.
- Eco-Design: P&Is must incorporate eco-design principles in the manufacturing of electrical and electronic equipment to enhance product longevity and sustainability, facilitating easier recycling and recovery.
- Documentation and Labelling: P&Is must properly label products and provide documentation outlining disposal options for end-users, making information accessible regarding WEEE take-back systems.
- Consumer Awareness: P&Is must conduct consumer awareness programs to inform the public about available collection systems and the importance of proper WEEE disposal.

⁸⁵ WEEE Ireland. (n.d.). WEEE, Waste Battery & Lighting Collection/Delivery Requests. <https://www.WEEEireland.ie/retailers/collections-deliveries/commercial-collections/>

Producer Responsibility Organizations (PROs)

There are two PROs in Ireland: WEEE Ireland and ERP Ireland. WEEE Ireland is a non-profit organization established in 2005 and currently holds 78% of the WEEE and battery market (see figure 23)⁸⁶. ERP Ireland was also established in 2005 and is part of the European Recycling Platform, which is a multinational compliance scheme operating in 20 countries across Europe, America's, Asia and the Middle East⁸⁷. The European Recycling Platform is part of the Landbell Group, a global company that offers services, consulting and software to help companies achieve their environmental and chemical compliance goals⁸⁸.

Department of Environment, Climate and Communications (DECC)

In Ireland, the Department of Environment, Climate and Communications (DECC) establishes the regulatory framework for the EPR system, including drafting legislation and regulations that transpose EU directives into national law. They are also responsible for overseeing the system and coordinating the implementation of the EPR system among various agencies and stakeholders. They tie the EPR system and sustainable waste management practices to broader environmental initiatives through roadmaps such as The Waste Action Plan for a Circular Economy. Finally, they review and evaluate the effectiveness of the EPR system and make adjustment were necessary⁸⁹.

Environmental Protection Agency (EPA)

The Environmental Protection Agency (EPA) enforces compliance with the EPR regulations and manages enforcement actions for non-compliance. The EPA has the power to take enforcement action in case of non-compliance, including issuing notices, requests for information, and directing P&Is to cease certain activities, to uphold accountability within the EPR system. EPA translates legislation of DECC into technical standards for collection, sorting, transport and treatment of WEEE, and offers technical guidance and support to stakeholders in understanding and executing their responsibilities. The EPA issues licenses and permits for waste management operators such as treatment facilities. The EPA also reviews and approves the individual waste management plans of companies that choose not to join one of the collective schemes, ensuring these plans meet environmental standards. They collect data on WEEE management, assessing compliance with targets and monitoring Ireland's progress. Finally, the EPA carries out research to inform environmental policy development. They are responsible for coordinating environmental research in Ireland⁹⁰.

Producer Register Limited

The Producer Register Limited is the official registration body for producers and importers of EEE and establishes and maintains a register of all P&Is of EEE. It ensures all producers and importers are registered and compliant by checking whether they are part of a collective or individual compliance scheme, and whether they meet their financial obligations. They notify local authorities or the EPA when there is evidence of non-compliance. The register collects and maintains proper data on P&Is, facilitating compliance tracking and reporting to meet legislative requirements. They also determine the market share of individual producers and the PROs and implement annual audits of producers⁹¹. The PRL acts as a financial clearinghouse, overseeing annual reconciliations. When a PRO collects more WEEE in a fraction than its market share warrants, it effectively fulfills part of another PRO's obligation. The overachieving PRO is then

⁸⁶ WEEE Ireland. (2023). *Annual Environmental Report 2023*. <https://www.WEEEireland.ie/wp-content/uploads/pdfs/WEEE-Ireland-environmental-report-2023.pdf>

⁸⁷ European Recycling Platform. (n.d.). Join us for EPR compliance solutions. <https://erp-recycling.org/>

⁸⁸ Landbell Group. (n.d.). What we offer. <https://landbell-group.com/what-we-offer/>

⁸⁹ Department of Environment, Climate and Communications. Environment. <https://www.gov.ie/en/department-of-the-environment-climate-and-communications/policy-information/environment/#waste-policy-and-the-circular-economy>

⁹⁰ Environmental Protection Agency. (n.d.). Our services. <https://www.epa.ie/our-services/>

⁹¹ Producer Register Limited. (n.d.). What We Do. <https://www.producerregister.ie/what-we-do>

entitled to compensation from the underperforming PRO for its extra efforts, ensuring fair distribution of costs and responsibilities.

EEE Retailers

EEE retailers have specific roles and responsibilities designed to ensure that WEEE is managed in an environmentally responsible manner. All EEE retailers have a take-back obligation: Retailers are required to provide a free take-back service for customers. This means they must accept old equipment when a customer purchases a similar new item. Larger retail outlets may have to set up dedicated collection points where customers can drop off small WEEE items without any obligation to buy new products. Retailers must inform customers about the return and recycling services available to them. This can include providing information on how consumers can recycle WEEE free of charge. EEE Retailers are required to register with the relevant authorities and comply with the regulations governing WEEE. This includes keeping accurate records and reporting the weight and quantities of WEEE collected. Finally, retailers must ensure that collected WEEE is handled and stored properly to prevent any environmental damage. This includes using appropriate storage facilities and ensuring safe transport to authorized recycling facilities.

Treatment operators

Treatment operators, such as recycling facilities, must obtain the necessary environmental permits and licenses from relevant authorities, such as the Environmental Protection Agency (EPA), to legally operate their facilities. Treatment operators are required to meet specific standards for the processing of WEEE. This includes the removal of hazardous substances and components to reduce environmental damage. They must follow best practices and protocols for dismantling, depollution, and recycling. Accurate record-keeping is crucial. Operators must document the quantities of WEEE treated, the recovery rates achieved, and the methods used. These records are typically submitted to regulatory bodies to demonstrate compliance. Facilities are subject to periodic audits and inspections by the EPA or other regulatory bodies to ensure ongoing compliance with environmental and operational standards.

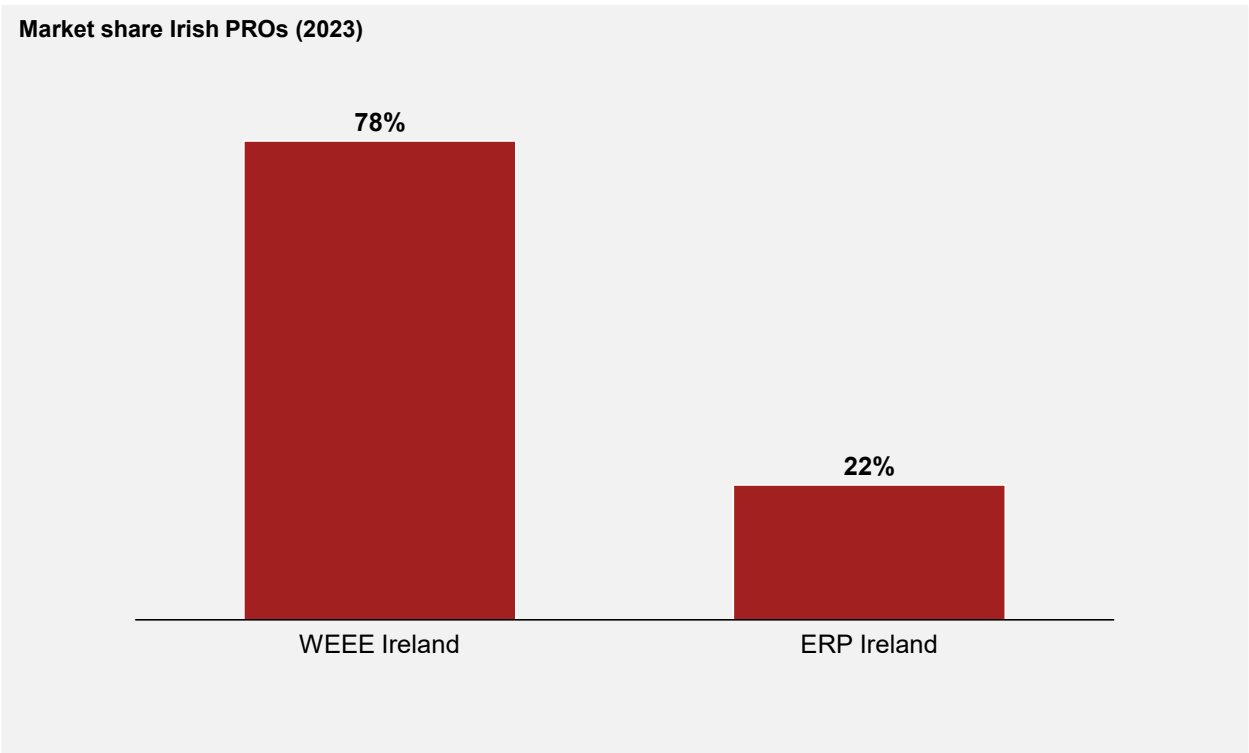


Figure 24: Market share of Irish producer responsibility organizations

5.2.2.3. Organization of the supply chain

The Irish EPR system for e-waste is coordinated by the two PROs, which contract collection, transport, and recycling services from waste management operators. Figure 24 shows the organization of the Irish EPR system and the physical and financial flows between different players in the system.

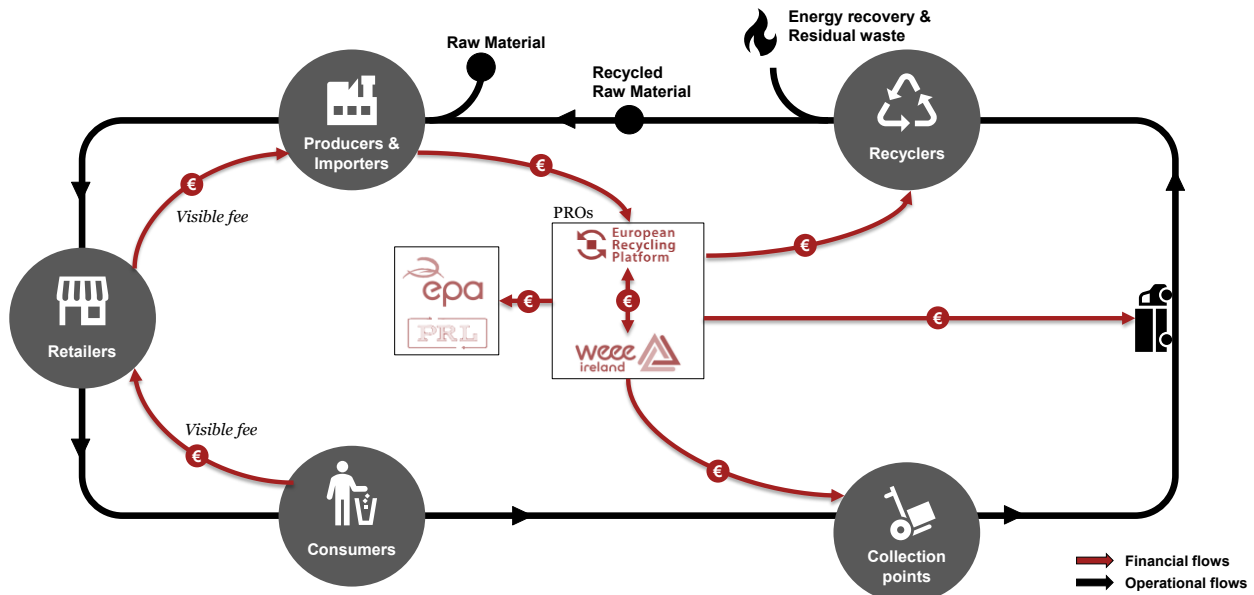


Figure 25: Organization of the Irish EPR system for WEEE

Collection

The Irish EPR system covers B2C WEEE. Consumers buy EEE from EEE retailers. Part of the price consists of a visible fee, which consumers pay to the retailers and the retailers pass on to the P&Is. If a P&I is affiliated with a PRO, it transfers these fees to the PRO to finance the waste management system. If the P&I has an individual scheme, it can use these funds to finance the system. Consumers bring their WEEE to one of the collection points. The PRO tied to the collection point finances the collection point, and once the collection point has enough (of a fraction of) WEEE, the PRO organizes transport from the collection point to the recycling facility.

There are two types of collection points in the Irish EPR system: municipal collection points and points at EEE retailers. Both collection points are geographically distributed amongst the two PROs, based on their market share for the put-on-market. Historically, the two PROs decided on the distribution of collection points amongst themselves. More recently, distribution of collection points has been determined mathematically. The formula is supposed to consider parameters such as ease of access, but criticisms have been voiced that this does not happen enough. At the end of the year, a financial reconciliation is performed. If one of the two PROs has collected more than their share of a specific subcategory of POM, the other party must pay the PRO for the financial costs incurred for these extra collection efforts. The financial reconciliation is determined by the Producer Register Limited, which functions as financial clearinghouse.

Transport

Transport is arranged through waste management operators or logistics companies that are contracted by the PROs. In some cases, the WEEE is collected by the recycling facilities themselves, eliminating the need for a dedicated transport company. The PROs contract its logistics services via tender offers.

Sorting

Sorting happens at the collection points. The WEEE is sorted into five different fractions, which are either brought to the designated recycler or collected by the recycler company.

Recycling

Recycling happens at authorized treatment facilities that are licensed by the EPA. PROs are only allowed to contract treatment with approved treatment facilities and use tenders to contract treatment services from recyclers. WEEE must be treated according to European normative requirements. Recycling typically includes several steps:

- **Sorting:** The first step in recycling is sorting the WEEE into different fractions, since different types WEEE demand different kinds of treatment.
- **Dismantling:** WEEE is manually or automatically disassembled to separate its different component parts.
- **Hazardous material removal:** Harmful substances are extracted and properly disposed of, such as mercury from fluorescent lamps or refrigerants from cooling appliances
- **Material recovery:** Valuable materials are extracted, such as precious metals from circuit boards, copper from wiring and plastic from casings.
- **Shredding and separation:** For items that cannot be easily dismantled, mechanical shredding followed by material separation techniques are used.

The recovered materials are then sent to various industries for reuse in manufacturing new products. Where possible, the remaining waste is incinerated for energy recovery. The remaining waste is disposed of in landfills.

5.2.3. Effectiveness

In 2023, the Irish EPR system achieved a 46% collection rate, below the EU and national target of 65%. Ireland achieved the recycling and recovery targets for all subcategories for WEEE except for solar PV panels.

5.2.3.1. Realization collection and recycling targets

In 2023, Ireland had a total 3-year average put-on-market of 114kt of EEE. This amounts to 21 kg per inhabitant, below the EU average of 30kg POM per inhabitant. In 2023, Ireland collected 53kt of WEEE, which amounts to 10 kg per inhabitant, and a collection rate of 46% of the average POM of the three preceding years, below the EU and Irish target of 65%. The collection target was not met for any of the subcategories of WEEE⁹².

In total, Ireland recycled 54kt in 2022 and recovered 62kt. For recycling, this amounts to an overall recycling rate of 82%. Ireland met all recycling targets for the subcategories of WEEE, except for solar PV panels. In total, Ireland recovered 94% of all WEEE collected. Recovery targets were met for all subcategories except

⁹² WEEE Forum. (2023). Key Figures Data.

for PV⁹³. National reports deviate from Eurostat data and indicate that Ireland met the recycling and recovery targets for all fractions in 2023.

Irish put-on-market (3-year average), collection, recycling, and recovery in kt (2022, 2023)								
	Total							
		TEE	Screens	Lamps	Large appliances	PV	Small equipment	Small IT equipment
Put-on-market 3-year average <i>WEEE Forum 2023</i>	114 (101)	18 (18)	9 (9)	1 (2)	45 (31)	11 (14)	26 (25)	4 (4)
Collection <i>WEEE Forum 2023</i> <i>(Annual reports '23)</i>	53 (47)	9 (9)	4 (4)	0 (0)	28 (23)	0 (7)	9 (9)	2 (2)
Recycling <i>Eurostat 2022</i> <i>(Annual reports '23)</i>	54 (43)	8 (7)	3 (3)	0 (0)	30 (19)	0 (6)	9 (6)	4 (2)
Recovery <i>Eurostat 2022</i> <i>(Annual reports '23)</i>	62 (51)	9 (9)	3 (4)	0 (0)	33 (21)	0 (6)	12 (8)	4 (2)

Own reporting calculated based on reporting and market share of Weee Ireland

Figure 26: Irish put-on-market, collection, recycling and recovery in 2022 and 2023 (kt)

⁹³ Eurostat. (2022). Waste electrical and electronic equipment (WEEE) by waste management operations - open scope, 6 product categories (from 2018 onwards). https://doi.org/10.2908/ENV_WASELEEOS

Irish achieved collection, recycling, and recovery rates in relation to targets (2022, 2023)

	Total	TEE	Screens	Lamps	Large appliances	PV	Small equipment	Small IT equipment
IE collection target	65%	65% across all categories						
Collection rate <i>WEEE Forum 2023</i> <i>(Annual reports '23)</i>	46% (53%)	51% (52%)	45% (43%)	22% (23%)	63% (72%)	0% (50%)	35% (37%)	46% (50%)
IE recycling target	-	80%	70%	80%	80%	80%	55%	55%
Recycling rate <i>Eurostat 2022</i> <i>(Annual reports '23)</i>	82% (80%)	82% (82%)	79% (72%)	83% (83%)	86% (84%)	0% (84%)	72% (68%)	85% (85%)
IE recovery target	-	85%	80%	-	85%	85%	75%	75%
Recovery rate <i>Eurostat 2022</i> <i>(Annual reports '23)</i>	94% (95%)	96% (99%)	98% (97%)	97% (98%)	93% (94%)	0% (94%)	91% (92%)	100% (99%)

EU target achieved

Own reporting calculated based on reporting and market share of Weee Ireland

Figure 27: Irish results compared to EU and national targets in 2022 and 2023 (%)

5.2.3.2. Innovation, knowledge sharing and awareness

Both Irish PROs use several instruments to promote innovation, knowledge sharing and awareness:

- **Innovation projects:** Both PROs in Ireland are actively promoting innovation in the circular economy. ERP Ireland stimulates innovation through the Landbell Group's Green Alley Award, a startup prize for circular economy initiatives that aims to identify innovative European business ideas balancing economic and ecological considerations⁹⁴. WEEE Ireland focuses its R&D projects on promoting a circular economy by extending the lifespan of products through repair and refurbishment. They supported the Close the Eloop microsite, which highlights best practices across Ireland to assist businesses in their circular transition. Additionally, WEEE Ireland backed the Circular Economy Skills Initiative (CESI), a program training students for professional careers in maintenance, repair, and reuse of white goods. CESI addresses a critical gap in the Irish market, as there had been no such training program for over a decade⁹⁵.
- **National programs:** Ireland has implemented three national programs to which both PROs contribute according to their market share. The "We'll Take It Back" Communication Program drives a unified communication strategy from key EEE retailers to inform consumers about their 1:0 takeback obligation. This fund also supports EEE retailers with costs related to proper separation

⁹⁴ ERP Ireland. (2023). *Annual Report 2023*. https://erp-recycling.org/ie/wp-content/uploads/sites/42/2024/08/FINAL-ERP-Annual-Report-2023_Public.pdf

⁹⁵ WEEE Ireland. (2023). *Annual Environmental Report 2023*. <https://www.WEEEireland.ie/wp-content/uploads/pdfs/WEEE-Ireland-environmental-report-2023.pdf>

and segregation of different types of WEEE. The Local Authority WEEE Fund compensates local and regional authorities for maintaining the collection network of over 100 Civic Amenity Sites and Bring and Recycling Centers, where consumers can drop off their WEEE free of charge⁹⁶. The EPA Enforcement and R&D fund supports WEEE and Battery regulation enforcement and guidance, as well as EPA's Research Strive Projects. Strive, which stands for Science, Technology, Research, and Innovation for the Environment, conducts policy-relevant environmental research in areas such as Climate Change, Water, and Sustainable Development⁹⁷.

- **International collaborations:** WEEE Ireland is actively involved in several international organizations. It is a member of the WEEE Forum, an international organization bringing together knowledge on technical, business, and operational aspects of WEEE management, with 53 PROs as members. WEEE Ireland also participates in EUCOBAT, a European association for national battery collection schemes promoting sustainable use, collection, and recycling of batteries in Europe. Additionally, WEEE Ireland is part of the European ECOSWEEE Campaign, supporting the European Commission's recommendations to encourage more takeback of small EEE and batteries. WEEE Ireland is leading two pilots in this campaign: one researching people's willingness to recycle batteries when linked to a charitable cause, and another studying the effect of visible fee communications at EEE retailers. WEEE Ireland also participated in International E-waste Recycling Day, focusing on "invisible waste" such as vapes, toys, and USB sticks⁹⁸. ERP Ireland, as part of the European Recycling Platform, leverages its strong global network to build optimal international solutions⁹⁹.
- **Pricing:** In 2024, a working group under the supervision of the PRL will begin assessing the feasibility of implementing modulated fees, where waste management fees for WEEE will be based on product sustainability¹⁰⁰. WEEE Ireland already practices a modest form of eco-modulation, offering discounts on producer contributions for P&Is that design and manufacture products that are easy to recycle, such as those that are easily dismantled. This approach stimulates eco-friendly designs¹⁰¹. ERP Ireland is collaborating with key producers to assess the introduction of modulated fees, researching eco-modulation across other streams and countries, and working with local stakeholders to develop a national solution for Ireland. The goal of modulated fees is to encourage manufacturers to design products that are more durable, repairable, and recyclable, thus promoting a more sustainable approach to EEE production and disposal¹⁰².
- **Awareness:** In 2023, both PROs in Ireland conducted awareness campaigns to promote proper electronic waste management and recycling behaviors. ERP Ireland and WEEE Ireland jointly supported the "Love Your Planet" study by Coyne Research, which provided insights into recycling behaviors during 2022. ERP Ireland focused on promoting proper disposal of vapes and e-cigarettes through various initiatives, including an online survey and a targeted digital campaign for millennials and Gen Z. ERP Ireland also collaborated with the sustainable music festival Body and Soul, and participation in the multi-country "I'm Not Trash" movement¹⁰³. WEEE Ireland's efforts

⁹⁶ WEEE Ireland. (2023). *Annual Environmental Report 2023*. <https://www.WEEEireland.ie/wp-content/uploads/pdfs/WEEE-Ireland-environmental-report-2023.pdf>

⁹⁷ Environmental Protection Agency. (2013). *Environmental Protection Through Research*. https://www.epa.ie/publications/research/previous-strategy-documents/EPA_STRIVE_PETR.pdf

⁹⁸ WEEE Ireland. (2023). *Annual Environmental Report 2023*. <https://www.WEEEireland.ie/wp-content/uploads/pdfs/WEEE-Ireland-environmental-report-2023.pdf>

⁹⁹ ERP Ireland. (2023). *Annual Report 2023*. https://erp-recycling.org/ie/wp-content/uploads/sites/42/2024/08/FINAL-ERP-Annual-Report-2023_Public.pdf

¹⁰⁰ ERP Ireland. (2023). *Annual Report 2023*. https://erp-recycling.org/ie/wp-content/uploads/sites/42/2024/08/FINAL-ERP-Annual-Report-2023_Public.pdf

¹⁰¹ Expert interview. (2025).

¹⁰² ERP Ireland. (2023). *Annual Report 2023*. https://erp-recycling.org/ie/wp-content/uploads/sites/42/2024/08/FINAL-ERP-Annual-Report-2023_Public.pdf

¹⁰³ ERP Ireland. (2023). *Annual Report 2023*. https://erp-recycling.org/ie/wp-content/uploads/sites/42/2024/08/FINAL-ERP-Annual-Report-2023_Public.pdf

focused on increasing repair actions. They hosted Free Public Electrical & Battery Recycling Days across 19 counties, launched a five-month Free Electrical Recycling public awareness campaign across multiple media channels, and they re-launched the Schools Battery Recycling Competition. This educational program was paired with a "Recycling for Good" campaign, where collected batteries contributed to a donation fund for LauraLynn Children's Hospice¹⁰⁴.

5.2.4. Efficiency

In 2023, Ireland's total EPR system costs amounted to ca. €24 million (see figure 27)^{105, 106, 107}. Total costs are funded through various sources: €16 million from producer contributions and €8 million from the sale of WEEE to treatment operators. This results in a total producer contribution of €2,92 per inhabitant, €137 per ton placed on the market (POM), €297 per ton collected, and €288 per ton recycled^{108, 109, 110}.

The producer contribution is financed through a visible Environmental Management Cost (vEMC), which is a mandatory visible fee that is displayed separately on the price tag or invoice for all purchases of EEE by consumers. The vEMC is not mandatory for B2B transactions, businesses have the flexibility to choose whether to show the vEMC separately or incorporate it into the overall price. The vEMCs are paid by consumers or businesses to EEE retailers. The EEE retailers transfer the fee to P&Is, which either use it to finance their individual collection scheme or transfer it as part of the producer contribution to the collective scheme they are part of. For a PRO around ⅓ of total revenues are fixed through visible fee.

The other source of income for the EPR system is generated through the sale of WEEE to treatment operators (see figure 28). This financial dynamic exists because certain types of WEEE contain valuable raw materials that can be extracted and recycled. Among these materials are precious metals like gold, silver, and palladium, as well as other valuable components such as copper and certain rare earth elements. For some WEEE, treatment operators are willing to pay the PROs to acquire the waste equipment. This arrangement creates a mutually beneficial scenario where the PROs can partially fund their operations through the sale of WEEE, while treatment operators gain access to potentially profitable materials for recycling and resale. It's important to note, however, that not all WEEE has positive economic value, and the prices paid for different types of WEEE can fluctuate based on market conditions and the specific materials contained within the equipment.

The total costs of the system consist of operating and non-operating costs. Operating costs are expenses directly associated with the day-to-day operations of collecting, transporting and recycling WEEE, and represent 72% of total costs. An example is the payments made to waste management operators to carry out these activities. Non-operating costs are costs not directly tied to the core operations of WEEE management, but necessary for the overall functioning and improvement of the system. Non-operating

¹⁰⁴ WEEE Ireland. (2023). *Annual Environmental Report 2023*. <https://www.WEEEireland.ie/wp-content/uploads/pdfs/WEEE-Ireland-environmental-report-2023.pdf>

¹⁰⁵ Expert interview. (2025).

¹⁰⁶ WEEE Ireland. (2023). *Annual Environmental Report 2023*. <https://www.WEEEireland.ie/wp-content/uploads/pdfs/WEEE-Ireland-environmental-report-2023.pdf>

¹⁰⁷ ERP Ireland. (2023). *Annual Report 2023*. https://erp-recycling.org/ie/wp-content/uploads/sites/42/2024/08/FINAL-ERP-Annual-Report-2023_Public.pdf

¹⁰⁸ Expert interview. (2025).

¹⁰⁹ WEEE Forum. (2023). Key Figures Data.

¹¹⁰ Eurostat. (2022). Waste electrical and electronic equipment (WEEE) by waste management operations - open scope, 6 product categories (from 2018 onwards). https://doi.org/10.2908/ENV_WASELEEOS

costs make up 28% of total costs and include administration and management costs, as well as R&D costs and costs incurred for public awareness campaigns.

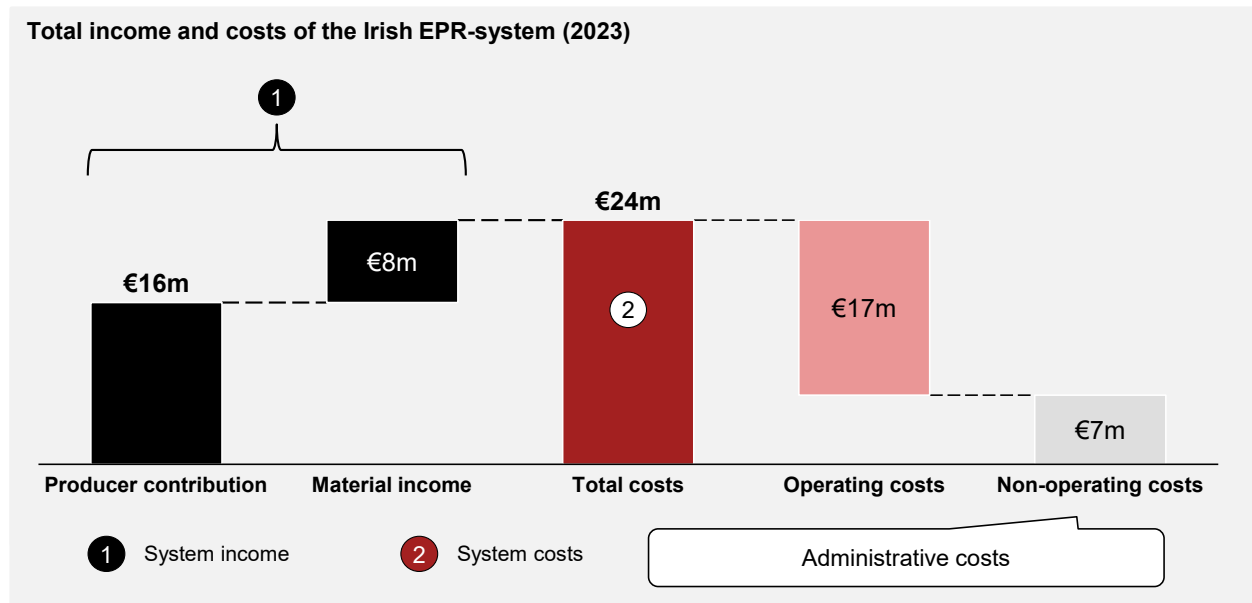


Figure 28: Total system costs and income of the Irish EPR system in 2023 (€ m)

5.2.5. Strengths and challenges

Strengths of the Irish EPR system

- **Geographic distribution of collection sites eliminates collection inefficiencies.** The geographic distribution of collection sites among the two PROs eliminates inefficiencies associated with implementing two separate collection networks in the same geographical area. For example, this approach prevents the unnecessary costs of sending multiple trucks to nearby collection sites to collect WEEE, thereby optimizing logistics and reducing overall operational expenses.
- **Financial clearing house creates a level playing field for competition.** The financial clearing house ensures that if a PRO collects more WEEE than its market share dictates, it receives financial compensation from the other PRO. This mechanism compensates the PRO for any additional costs incurred due to extra collection activities. It incentivizes both PROs to collect their designated market share and diminishes the risk of a PRO retaining the producer contribution while ensuring high margins by not implementing or underinvesting in a collection network.
- **Stimulating environmental & economic efficiencies with eco-modulation.** Ireland has initiated a modest form of eco-modulation, where the producer contribution that P&Is must pay is adjusted based on recycling costs. This approach provides an incentive for P&Is to design and manufacture products that are easier to recycle, for example, by facilitating dismantling. Although the current eco-modulation is minimal, it represents a crucial first step towards stimulating more sustainable product design.
- **Visible fee that ensures a level playing field for consumer products and creates awareness among consumers.** The visible Environmental Management Costs (vEMCs) constitute one-third of the total producer contribution and ensure that, at least for this portion of the contribution, the fee is uniform for both PROs. This transparency helps create a level playing field for consumer products and raises awareness among consumers about the environmental costs associated with electrical and electronic equipment.

Challenges for the Irish EPR system

- **Coexistence of non-profit and for-profit entities in the same market.** While both WEEE Ireland and ERP Ireland are technically non-profit organizations, ERP Ireland's affiliation with the Landbell Group through the European Recycling Platform introduces potential differences in priorities and decision-making. This disparity could lead to varying approaches in balancing environmental and economic considerations between the two PROs. As a result, the equilibrium of the EPR system may be disrupted, potentially affecting environmental performance, cost-effectiveness, and overall market dynamics.
- **Competitive push towards non-accredited recyclers to lower costs.** The dynamics between the non-profit and partially for-profit PROs in Ireland have led to a competitive push to lower costs, resulting in some WEEE being directed to non-accredited recyclers. These non-accredited recyclers are not bound by the same strict treatment standards set by the Environmental Protection Agency (EPA), allowing them to process WEEE at lower costs but potentially compromising environmental standards.
- **Geographical distribution is mathematically determined, not correcting for other factors such as ease of access.** The geographical distribution of collection sites is determined by an algorithm that is supposed to consider factors such as ease of access or availability of WEEE. However, these factors are not always sufficiently accounted for, leading to disparities in the amount of WEEE a PRO can collect and the ease (and associated costs) of collection. This mathematical approach may not fully address real-world complexities and local variations in WEEE generation and collection.

5.3. Portugal

	Indicator	Result 2023
Effectiveness	Achieved collection rate <i>WEEE Forum 2023 (Annual reports 2023)</i>	21% (20%)
	Achieved collection rate excl. PV <i>WEEE Forum 2023 (Annual reports 2023)</i>	21% (20%)
	Achieved recycling rate <i>Eurostat 2022 (Annual reports 2023)</i>	57% (79%)
	Achieved recovery rate <i>Eurostat 2022 (Annual reports 2023)</i>	100% (86%)
	Innovation	Medium
	Awareness	High
Efficiency	Total system costs	€18m
	Producer contributions	€16m
	Producer contribution per inhabitant	€1,54
	Producer contribution per ton put-on-market	€72
	Producer contribution per ton collected	€349
	Producer contribution per ton recycled	€516
	Producer contribution per ton recovered	€293
	Percentage free-riding <i>Expert input</i>	15-20%

Figure 29: Summary of the Portuguese EPR system for e-waste

5.3.1. Historical and legislative framework

Portugal began formal regulation of WEEE with Decree-Law No. 239/97, which transposed elements of the European Waste Framework Directive into national law but did not yet specifically regulate WEEE. This law introduced the notion of producer responsibility, assigning general obligations to producers for the management of waste streams, but without specifying operational mechanisms. Responsibility for waste treatment remained largely with public authorities, and no clear standards for collection, sorting, transport, or treatment of WEEE existed at this stage.

The explicit framework for WEEE management was established through Decree-Law No. 230/2004, which transposed Directive 2002/96/EC into Portuguese law. This legislation introduced EPR by requiring producers to finance and organize the collection, treatment, recovery, and environmentally sound disposal of WEEE. Producers had to either establish individual compliance systems or join collective systems licensed by the Waste Institute. Operational responsibility shifted from municipalities to producers, who were obliged to ensure the availability of collection points and to cover costs from collection onward.

Standards for WEEE management were formalized, mandating that authorized operators treat WEEE according to specific environmental and technical criteria, including the removal of hazardous components. Targets were introduced, requiring a collection rate of 4 kg per inhabitant per year from 2006 onwards, with set recycling and recovery percentages per equipment category¹¹¹.

Significant refinements to the EPR system were introduced through Decree-Law No. 67/2014, which transposed Directive 2012/19/EU. This law reinforced producers' obligations by imposing requirements for registration with the national product register, submitting annual reports on quantities placed on the market, and demonstrating financial guarantees to cover waste management costs even in the event of bankruptcy. Distributors were explicitly required to ensure the collection of WEEE from private households free of charge and to implement take-back systems at larger retail points for small equipment without a purchase obligation. The APA was made responsible for licensing and monitoring, while the Inspectorate-General for Agriculture, Sea, Environment and Spatial Planning (IGAMAOT) oversees compliance. Collection, sorting, transport, and treatment standards were tightened through the introduction of mandatory technical specifications for all facilities handling WEEE. Legislation also updated targets, gradually increasing minimum recovery and recycling rates across equipment categories, aiming for an overall collection rate equivalent to 45% of the average weight of EEE placed on the market by 2016 and 65% by 2019¹¹².

Decree-Law 152-D/2017 consolidated and simplified legislation on managing specific waste streams including WEEE, batteries, packaging, oils, and tires, to enhance transparency and ease for integrated waste management systems and waste management operators, especially smaller and medium-sized enterprises. It includes detailed specifications for the individual and integrated systems. The APA must authorize individual systems to ensure adequate means for their collection network. Legislation also outlines integrated systems requirements, including managing body, selective waste collection network, financing and licensing. It outlines the role the CAGER places in determining financial compensation between PROs active in the same waste stream. Collection, recycling and recovery targets remained unchanged from Decree-Law 67/2014¹¹³.

National targets

Portugal's national targets for collection, recycling and recovery of WEEE are aligned with the European Union's directives. Until December 31, 2015, the household WEEE collection target was 4 kg per inhabitant annually. From January 1, 2016, the collection target increased to 45% of the average put-on-market of the preceding three years. From 2016 to 2018 the objective was to gradually increase the quantity of WEEE collected to move towards the new collection rate set in 2019. From January 1st, 2019, Portugal's collection target is 65% of the average put-on-market of the three preceding years, or 85% of the weight of WEEE generated in Portugal¹¹⁴.

Portuguese national targets for recycling and recovery are also aligned with European Union's directives. For recycling and recovery, producers must achieve specific recovery and recycling targets based on equipment categories. From 31 December, 2006, producers had to achieve recycling targets between 50% (cat. 2, 5, 6, 7 and 9) and 75% (cat. 1 and 10) depending on the type of equipment. Recovery targets ranged

¹¹¹ Ministry of Environment and Spatial Planning. (2004). Decree-Law 230/2004, of 10 December. *Diários da República*. <https://dre.tretas.org/dre/179377/decreto-lei-230-2004-de-10-de-dezembro>

¹¹² Ministry of Environment, Spatial Planning and Energy. (2014). Decree-Law 67/2014, of 7 May. *Diários da República*. [Decree-Law 67/2014](#)

¹¹³ Ministry of Environment, Spatial Planning and Energy. (2014). Decree-Law 152-D/2017, of 11 December. *Diários da República*. [Decree-Law 152-D/2017](#)

¹¹⁴ European Union. (2012). Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast) Text with EEA relevance. *Official Journal of the European Union*. <https://eur-lex.europa.eu/eli/dir/2012/19/oj/eng>

between 70% (cat 2, 5, 6, 7 and 9) and 80% (cat 1 and 10)¹¹⁵. The WEEE Directive 2012/19 increased recycling and recovery targets to current levels. Recycling and recovery targets are lowest for small equipment and small IT and telecommunications equipment, with 55% for recycling and 75% for recovery respectively, and highest for large equipment (including PV), temperature exchange equipment and lamps, namely 80% for recycling and 85% for recovery, respectively¹¹⁶.

Portuguese collection, recycling, and recovery targets (2023)								
	Total							
		TEE	Screens	Lamps	Large appliances	PV	Small equipment	Small IT equipment
EU collection target	65%	65% across all categories						
PT collection target	65%	65% across all categories						
EU recycling and reuse target	-	80%	70%	80%	80%	80%	55%	55%
PT recycling target	-	80%	70%	80%	80%	80%	55%	55%
EU recovery target	-	85%	80%	-	85%	85%	75%	75%
PT recovery target	-	85%	80%	-	85%	85%	75%	75%

Figure 30: Portuguese collection, recycling, and recovery targets 2023 (%)

5.3.2. Organization of the ERP system

The Portuguese EPR system for WEEE and batteries is a duopoly with two competing PROs. There is no segmentation in the system: both PROs manage domestic and professional WEEE and batteries. There is limited vertical integration: the PROs own several sorting centers and buses to perform the door-to-door collection service, but no other assets. They are by law prohibited from owning treatment and recycling capacities¹¹⁷. PROs hold complete operational and financial responsibility for the EPR system.

Element	Explanation
Number of PROs	2 PROs for WEEE and batteries (Electrão, ERP Portugal)
Scope	B2C and B2B WEEE
Segmentation	No segmentation
Market structure	Competitive system with 2 PROs

¹¹⁵ European Union. (2002). Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) - Joint declaration of the European Parliament, the Council and the Commission relating to Article 9. *Official Journal of the European Union*. <https://eur-lex.europa.eu/eli/dir/2002/96/oj/eng>

¹¹⁶ European Union. (2012). Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast) Text with EEA relevance. *Official Journal of the European Union*. <https://eur-lex.europa.eu/eli/dir/2012/19/oj/eng>

¹¹⁷ Expert interview. (2025).

Level of integration	Own sorting and logistics assets
Operational responsibility	PROs
Financial responsibility	PROs

Table 4: Characteristics of the Portuguese EPR system

5.3.2.1. Roles and responsibilities

Producers and importers

P&Is can establish their own collection system or collaborate with either of the PROs. By law, WEEE Producers are responsible for:

1. Registering as a WEEE producer with the Portuguese Environment Agency (APA).
2. Pay for the collection and recycling of the EEE they sell. These obligations can be met by:
 - Individually bearing the costs of their waste management.
 - Joining an integrated management system responsible for managing these wastes.
3. Reporting the quantities of equipment sold in Portugal to the regulatory authorities.
4. Ensuring the correct labeling of products to inform consumers about recycling requirements.

Producer Responsibility Organizations

In Portugal, two PROs are involved in managing electronic waste: Electrão (previously known as Amb3E) and ERP Portugal. Initially, there were three PROs operating in the market, but WEEE Cycle ceased operations in 2023. Electrão was established in 2005 and is the market leader, holding a 60% market share. Electrão manages recycling systems for three waste streams: electrical equipment, batteries and accumulators, and packaging. ERP Portugal is part of the European Recycling Platform (ERP), established in December 2005 on the initiative of Procter & Gamble, Electrolux, Hewlett Packard, and Sony. In 2010, ERP Portugal extended its activity to include batteries, and in several counties, ERP Portugal also organizes the waste management for packaging¹¹⁸.

PROs must adhere to the management principles and objectives outlined in Decree-Law No. 152-D of December 11, 2017. This includes the development of a selective collection network; financing the costs associated with sorting, storage, transport, treatment, recovery, and disposal of WEEE deposited in the selective collection network; and achieving collection targets and minimum recovery objectives. Portugal's national regulation imposes a waste management fee (expressed in €/ton) as a penalty for failing to meet the PROs' collection targets. The two PROs compete to identify the best partners for e-waste collection, treatment, and transport. Each PRO has the flexibility to independently choose and contract partners. Collection partners can be municipalities, retailers, schools, companies, repair centers, public institutions, or any economic agents willing to establish a waste collection point. The collection can focus on a specific EEE stream or a combination of multiple streams.

Ministry of Environment and Energy

The Ministry of Environment and Energy is responsible for developing and enacting laws and regulations concerning the management of WEEE, ensuring they align with EU directives. It oversees compliance with WEEE regulations and has the authority to enforce compliance, including penalties, to ensure all parties adhere to the regulations. It also facilitates collaboration among various stakeholders, such as PROs, municipalities, recyclers, and manufacturers, to enhance the effectiveness of the WEEE management

¹¹⁸ ERP Portugal. (n.d.). A ERP Portugal. <https://erp-recycling.org/pt-pt/>

system. The ministry collects and analyzes data on WEEE collection, recycling rates, and overall environmental impact, to refine policies and ensure Portugal meets its national and EU reporting obligations for WEEE. The ministry supports public awareness campaigns to educate consumers and businesses about the importance of proper WEEE disposal and recycling.

Portuguese Environment Agency (APA)

The Portuguese Environment Agency (APA) is responsible for the implementation of environmental policies in Portugal. Its aim is to contribute to the protection of the environment by overseeing and ensuring successful implementation of policies related to climate, water, air and noise, and waste, and by developing and implementing instruments for environmental impact assessment and risk prevention and management. The APA has monitoring, planning and evaluation, licensing and inspection competencies, and is the main environmental regulator in Portugal¹¹⁹.

In this capacity, the APA is the National Waste Authority, responsible for overseeing and ensuring the successful implementation of the national waste strategy. It holds licensing powers, oversees waste management activities, and issues technical standards. The Regional Coordination and Development Commissions (CCDR) are responsible for implementing national policies at the regional level and focus on land use planning, environmental resource management, regional development and economic development projects. They function as Regional Waste Authorities. Technical standards are issued by the APA, and all waste management operators are licensed and monitored by either the APA as National Waste Authority or the CCDRs, as Regional Waste Authorities¹²⁰.

The APA ensures the accuracy and processing of waste-related information, validating the data necessary for implementing the economic and financial framework for waste management, particularly the Waste Management Fee (TGR)¹²¹. This fee is established to fund the collection, treatment, and recycling of different types of waste. The TGR is structured to encourage waste management practices aligned with the waste hierarchy, with fees designed to reflect those priorities. Prevention incurs no fee, repair and reuse incur small fees, and recycling and energy recovery slightly higher fees. Disposal costs most, but within disposal incineration is cheaper than landfilling, promoting more sustainable waste management choices¹²².

Register Entity SIRER (Sistema Integrado de Registo Electrónico de Resíduos)

SIRER is an electronic registration system where producers, transporters, and waste managers document their waste management activities. The system collects and stores data on waste production, collection, transport, treatment, and disposal. Its primary goal is to facilitate the monitoring and reporting of waste management activities to relevant authorities, such as the APA. Producers and importers register with SIRER, which tracks the quantity and type of waste generated. Originally established as a private national register, over the past two years SIRER has been integrated into the APA.

Waste Management Monitoring Committee (CAGER)

The Waste Management Monitoring Committee (CAGER) is responsible for monitoring waste market conditions, management operations, and systems. CAGER promotes the use of waste as secondary raw materials and encourages the adoption of the latest and best technologies available for waste management. For WEEE, CAGER functions as a financial clearinghouse and is tasked with defining, regulating, and

¹¹⁹ Agência Portuguesa do Ambiente. (n.d.). The APA. <https://apambiente.pt/en>

¹²⁰ Agência Portuguesa do Ambiente. (2024). Waste production and management. <https://apambiente.pt/residuos/producao-e-gestao-de-residuos>

¹²¹ Agência Portuguesa do Ambiente. (n.d.). Waste. <https://apambiente.pt/en>

¹²² Agência Portuguesa do Ambiente. (2021). Waste management fee. [Waste Management Fee | Portuguese Environment Agency](#)

supervising the compensation mechanism between managing entities responsible for specific waste streams¹²³.

The structure and responsibilities of the CAGER are established by Decree-Law 178/2006. Its official duties include:

- Offer advice and recommendations on waste management matters when asked.
- Review waste management plans and monitor and evaluate their implementation.
- Monitor the technical, financial, and societal factors affecting Portugal's waste market, focusing on company-managed waste streams and materials traded on waste exchanges.
- Oversee waste market operations and help supply data, encouraging inter-industry waste exchange for better recovery.
- Maintaining an online repository of dependable technical information about products created from recycled material¹²⁴

Municipalities

The municipalities are local government entities responsible for the administration and governance of cities, towns and rural areas. They handle local services like waste management, sanitation, roads, public transportation and community services. They set up municipal waste collection centers, where citizens can drop off their WEEE free of charge. Companies can also drop their WEEE for free at the municipal collection centers, up to a certain threshold volume. The municipalities partner with the PROs. PROs arrange pick-up of WEEE when the municipal collection center is full in exchange for ownership of the WEEE.

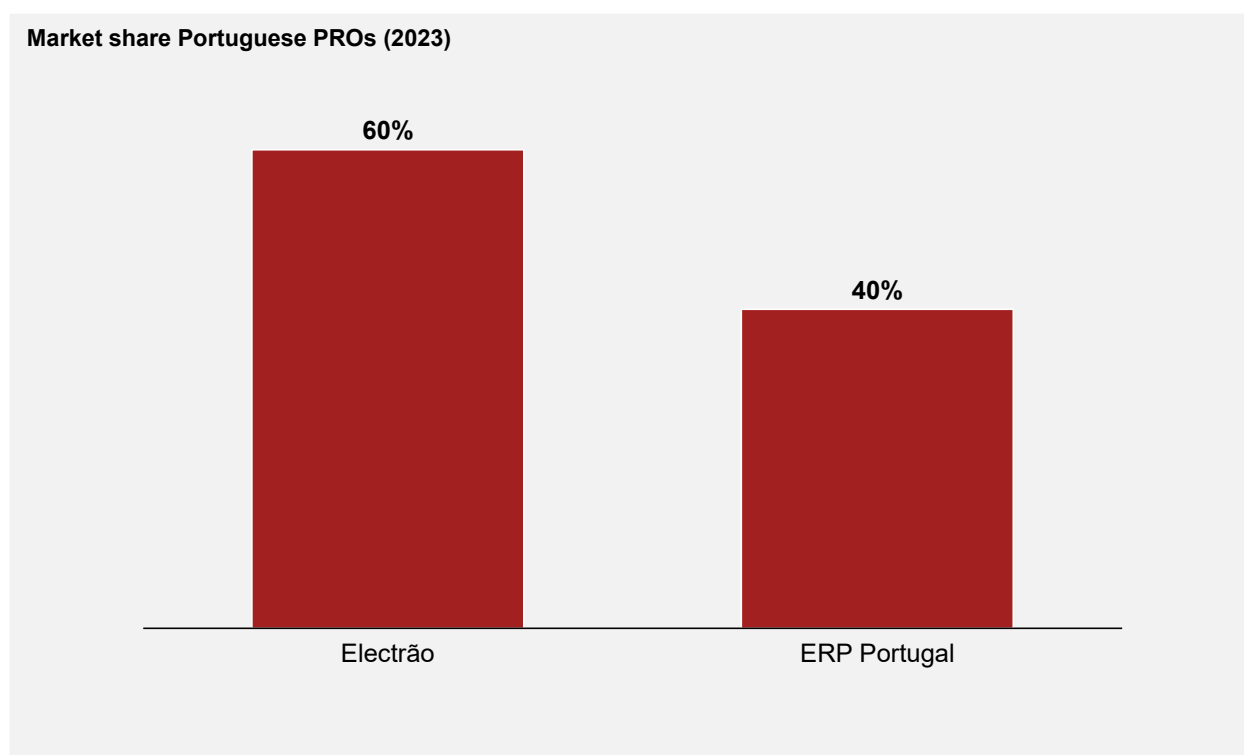


Figure 31: Market share Portuguese PROs 2023

¹²³ Agencia Portuguesa do Ambiente. (2022). Waste Management Monitoring Committee (CAGER).

<https://apambiente.pt/residuos/comissao-de-acompanhamento-da-gestao-de-residuos-cager>

¹²⁴ Ministry of the Environment, Spatial Planning and Regional Development. (2006). Decree-Law 178/2006, of 5 September. <https://www.fao.org/faolex/results/details/en/c/LEX-FAOC066276/>

5.3.2.2. Organization of the supply chain

The Portuguese EPR system covers both domestic and professional WEEE. Companies or consumers buy WEEE from EEE retailers. When companies or consumers buy EEE, they pay a fee to the retailer, which the retailer passes on to the P&Is and the P&Is pay to the PROs. It is not mandatory for retailers to make this fee visible on the receipt. The fees paid by the companies and consumers fund the EPR system. Consumers and companies can both drop their WEEE at municipal collection centers (companies if they stay below a certain volume threshold). Alternatively, consumers can drop their WEEE off at one of the other collection points, for example at EEE retailers, schools, or fire stations. The PROs also offer a pick-up service for companies and a door-to-door collection service for consumers. Once the WEEE is collected, it either goes to the sorting centers or straight to the recyclers.

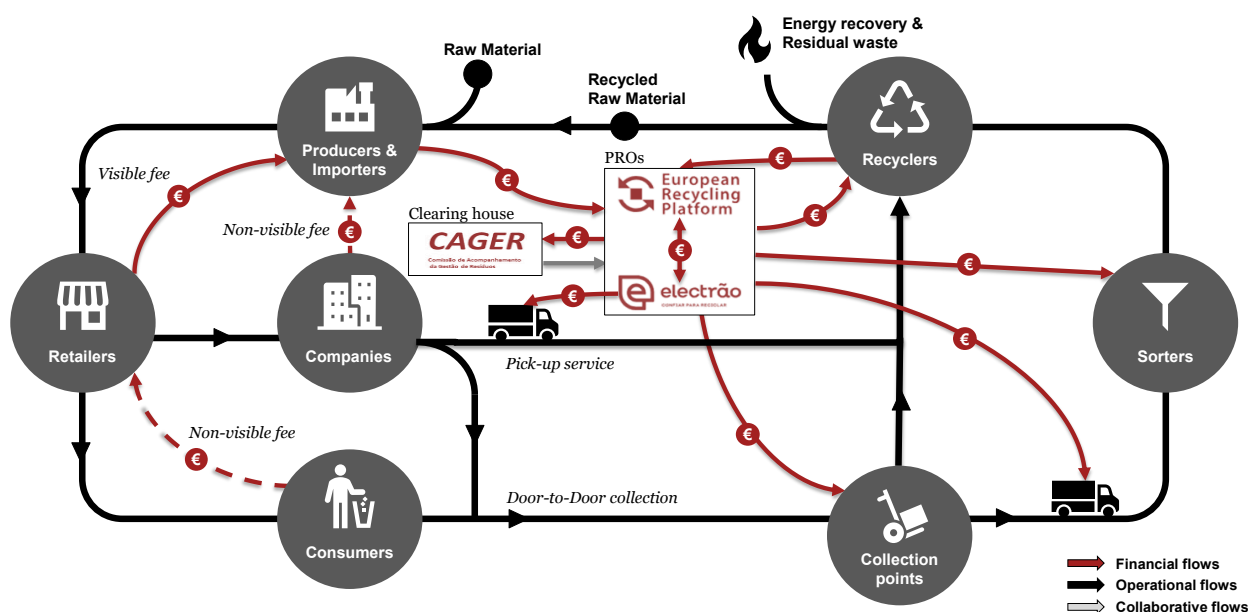


Figure 32: Organization of the Portuguese EPR system for WEEE

Collection

Individuals have four different ways to dispose of electronic waste:

1. Delivery to Municipal Collection Points: Individuals can bring their electronic waste to the designated municipal collection points.
2. Delivery to selective collection points: In addition to the municipal collection points and the collection points at EEE retailers, PROs can also set up their own selective collection network. Examples of selective collection points are collection points at fire stations, schools or sports clubs.
3. Delivery to EEE retailers: EEE retailers are obliged to take back WEEE when consumer purchases a similar product on a one-for-one basis. Larger EEE retailers are also obliged to take back smaller consumer electronics on a one-for-zero basis.
4. Door-to-Door Collection: This pilot project, developed by Electrão, offers a more convenient method for residents to dispose of large WEEE. It involves a free service where bulky electronic equipment is collected directly from citizens' homes. The service is available to residents of participating municipalities, allowing them to dispose of WEEE without traveling, ensuring it is properly recycled. The collection team handles the movement of equipment from the home, warehouse, or garage to the transport vehicle.

Organizations have three options to dispose of electronic waste:

1. Delivery to a municipal collection point: If the volume of total WEEE stays below a certain threshold, companies have the option to hand it in at municipal collection points for free.
2. Pick-up service: To use this service, organizations must register with the Electrão operating platform, specifying the facility from which they want to send waste for recycling. The minimum quantity required is 150kg or between 1 and 10 boxes.
3. Collection Site Partnership: Organizations that often need to dispose of WEE, can become a collection site partner, providing an alternative way to manage their electronic waste.

Recycling

The WEEE either goes directly from the collection facility to the treatment facility or goes from the sorting center to the treatment facility. Transport is arranged through transport companies contracted by the PROs. The PROs also set out tenders to contract treatment facilities. Standards for treatment are set by the Ministry of Environment and Energy. The Ministry is responsible for developing legislation that outlines the standards and requirements for treatment of WEEE in Portugal, in line with the EU Directives on WEEE. The APA operationalizes this legislation by translating it into guidelines and technical specifications. Treatment operators must be licensed to operate. The APA or CCDR handles facility licensing. PROs can only contract authorized treatment facilities. Tenders are awarded based 50% on price and 50% on compliance with environmental standards. The entire tender process is checked by an external auditor.

5.3.3. Effectiveness

The Portuguese EPR system realized the collection target for one of the six subcategories of WEEE, namely small IT equipment. Recycling targets were also only met for one of the subcategories, for screens. The Portuguese system invests ~7-10% of revenues towards awareness and 2-4% towards innovation.

5.3.3.1. Realization collection and recycling targets

In 2023, Portugal had a total 3-year average put-on-market of 228kt of EEE. This amounts to 21 kg per inhabitant, below the EU average of 30kg per inhabitant. In 2023, Portugal collected 47kt of WEEE, which amounts to 4,4 kg per inhabitant and a collection rate of 21% of the average POM of the three preceding years, below the EU and Portuguese target of 65%. The collection target was met for one subcategory of WEEE: small IT and telecommunication equipment¹²⁵.

In total, Portugal recycled 32kt in 2022 and recovered 56kt. For recycling, this amounts to an overall recycling rate of 57%. Portugal met the recycling target only for screens and monitors. In total, Portugal recovered 100% of all WEEE collected. This means that all WEEE that was collected served a useful purpose by replacing other materials, either being re-used, recycled or used for energy recovery¹²⁶. National reports indicate that Portugal met the recycling and recovery targets for five out of seven fractions.

¹²⁵ WEEE Forum. (2023). Key Figures Data.

¹²⁶ Eurostat. (2022). Waste electrical and electronic equipment (WEEE) by waste management operations - open scope, 6 product categories (from 2018 onwards). https://doi.org/10.2908/ENV_WASELEEOS

Portuguese put-on-market (3-year average), collection, recycling, and recovery in kt (2022, 2023)

	Total							
		TEE	Screens	Lamps	Large appliances	PV	Small equipment	Small IT equipment
Put-on-market 3-year average <i>WEEE Forum 2023</i>	228 (234)	57 (60)	10 (7)	1 (1)	111 (123)	0 (0)	38 (37)	10 (5)
Collection <i>WEEE Forum 2023</i> <i>(Annual reports '23)</i>	47 (46)	11 (11)	3 (4)	0 (0)	14 (12)	0 (0)	11 (13)	7 (6)
Recycling <i>Eurostat 2022</i> <i>(Annual reports '23)</i>	32 (37)	10 (9)	3 (3)	0 (0)	8 (12)	0 (0)	7 (6)	3 (6)
Recovery <i>Eurostat 2022</i> <i>(Annual reports '23)</i>	56 (40)	12 (10)	4 (3)	1 (0)	17 (13)	0 (0)	15 (7)	7 (6)

Own reporting calculated based on reporting and market share of Electrão

Figure 33: Portuguese put-on-market, collection, recycling, and recovery 2022 and 2023 (kt)

Portuguese achieved collection, recycling, and recovery rates in relation to targets (2022, 2023)

	Total							
		TEE	Screens	Lamps	Large appliances	PV	Small equipment	Small IT equipment
PT collection target	65%	65% across all categories						
Collection rate <i>WEEE Forum 2023</i> <i>(Annual reports '23)</i>	21% (20%)	20% (18%)	34% (51%)	39% (31%)	13% (10%)	0% (0%)	28% (34%)	68% (123%)
PT recycling target	-	80%	70%	80%	80%	80%	55%	55%
Recycling rate <i>Eurostat 2022</i> <i>(Annual reports '23)</i>	57% (79%)	78% (81%)	80% (73%)	40% (64%)	48% (82%)	65% (0%)	46% (72%)	50% (85%)
PT recovery target	-	85%	80%	-	85%	85%	75%	75%
Recovery rate <i>Eurostat 2022</i> <i>(Annual reports '23)</i>	100% (86%)	100% (91%)	100% (78%)	100% (71%)	100% (88%)	88% (0%)	100% (82%)	100% (87%)

 EU target achieved Own reporting calculated based on reporting and market share of Electrão

Figure 34: Portuguese results compared to national and EU targets 2022 and 2023 (%)

5.3.3.2. Innovation, knowledge sharing and awareness

Electrão and ERP Portugal engage in various activities to promote awareness of proper e-waste practices and innovation.

- **Knowledge Sharing and Awareness Campaigns:** Electrão and ERP Portugal have implemented a diverse array of strategies to raise public awareness about e-waste management, targeting various demographics with tailored approaches. The "Invisible Waste" campaign, part of the 6th E-Waste Day, used vox pops to assess public knowledge and educate about recyclable items, emphasizing that all items with plugs, cables, or batteries can be recycled¹²⁷. The "Electrão Scouts" campaign engaged scout groups, promoting sustainable habits that align with scout values and environmental protection. The "Do for the Planet" movement engaged various sectors of Portuguese society in a competition to identify and promote sustainable projects and initiatives. This campaign highlighted the principles of a circular economy and demonstrated the impact of individual actions on environmental sustainability. ERP Portugal's "Conversations with Energy" program, a collaboration with the EDP Foundation, fostered knowledge and dialogue on climate change, energy, and sustainability challenges among youth. In 2023, the program featured notable participants like Bordalo II, a Portuguese artist who repurposes waste in his art to critique excessive production and consumption¹²⁸. These initiatives, along with collaborations with social organizations like football clubs, aim to educate and inspire action across different demographics¹²⁹.
- **Community Engagement and Incentive Programs:** Electrão and ERP Portugal have fostered community involvement through strategic partnerships. Collaborations with firefighters incentivize fire stations to serve as collection points for WEEE and batteries, offering premiums for their efforts. Similarly, school campaigns unite communities around recycling, with contributing schools eligible for prizes. These programs not only increase collection points but also embed recycling habits into community structures.
- **Innovative Collection and Donation Services:** To improve e-waste collection and promote reuse, Electrão has introduced several innovative services. The "ondedoar.pt" platform facilitates donations of surplus stock of EEE, batteries and other products from companies to social or environmental institutions, preventing waste generation. A door-to-door collection service for large household appliances, initially launched in Lisbon, has expanded to six municipalities in the metropolitan area. Electrão has also innovated its collection infrastructure, developed anti-theft containers and designed specific containers for different waste types.
- **Integrated Waste Management and Compliance Services:** Both Electrão and ERP Portugal offer integrated waste management systems, acting as "one-stop-shops" for companies to comply with extended producer responsibilities across WEEE, batteries, and packaging. This approach simplifies compliance for businesses through unified membership, account management, and reporting. Additionally, they provide environmental compliance services, assisting members in understanding and adhering to complex regulatory requirements in the heavily regulated waste management sector.
- **Research and Pilot Studies:** To address challenges in proper WEEE treatment, Portuguese PROs have initiated research projects. An example is the pilot study aimed at

¹²⁷ WEEE Forum. (n.d.). Portugal. <https://weee-forum.org/international-waste-country/pt/>

¹²⁸ ERP Portugal. (2023). Sensitization. [Awareness - Portugal \(PT\)](#)

¹²⁹ ERP Portugal. (2023). Sensitization. [Awareness - Portugal \(PT\)](#)

characterizing components in the scrap metal waste stream. This research seeks to estimate the extent of WEEE leakage into scrap metal processing, addressing one of the main obstacles to effective e-waste management. Research is also underway to analyze the waste fractions in urban waste management processes that could be significant for recovering WEEE and batteries, and to devise a technical proposal for separating these fractions from regular waste at a national level¹³⁰.

5.3.4. Efficiency

The societal costs associated with Portugal's EPR system amount to €18,4m in 2023. 90% of the total system costs are financed by the producer contribution, which is €16,4m in total. The other €2 million originates from the sale of WEEE to treatment operators^{131, 132}. This results in a total producer contribution of €1,54 per inhabitant, €72 per ton POM, €349 per ton collected and €516 per ton recycled^{133, 134}. Approximately 70% of the total system costs are used to cover operating expenses, such as paying contractors for collection, transport, and recycling. The other 30%, or €5 million, is dedicated towards non-operating expenses of which €2 million (11%) is spent on management and support, €1 million (6%) on human resources, €1,8 million (10%) on awareness and communication and €0,7 million (4%) on R&D. In Portugal, PROs are required by law to spend 7.5% of the producer contribution to awareness and communication, and 2% on R&D.

The producer contribution is funded through fees paid by consumers and companies when buying EEE. This fee is designed to cover the costs associated with managing the waste generated by these products. The collected fee is either remitted to the PRO if the seller is affiliated with them or used to finance the P&Is own waste management plan for WEEE. Previously, Portugal mandated a fee for end consumers, but this did not significantly affect collection rates or consumer behavior. Consequently, Portugal has adopted a voluntary approach for the visible fee.

The PROs must receive approval for the producer contribution they request from the Economic Affairs Agency. The PRO is required to present the calculations underpinning the pricing for each product group. The Economic Affairs Agency will then evaluate these calculations to determine if the proposed prices are fair and reasonable¹³⁵.

¹³⁰ Electrão. (2023). *Annual Activity Report Used Electrical Equipment Management 2023*.

<https://electrao.pt/contents/report/relatorios-anuais-atividade23-electricos-resumo-compressed.pdf>

¹³¹ Electrão. (2023). *Annual Activity Report Used Electrical Equipment Management 2023*.

<https://electrao.pt/contents/report/relatorios-anuais-atividade23-electricos-resumo-compressed.pdf>

¹³² ERP Portugal. (2023). *Management and Account Report 2023*. [ERP-PT-RELATORIO-DE-GESTAO-E-CONTAS-2023_V4_27032024.pdf](https://www.erp.pt/relatorio-de-gestao-e-contas-2023-v4-27032024.pdf)

¹³³ WEEE Forum. (2023). Key Figures Data.

¹³⁴ Eurostat. (2022). Waste electrical and electronic equipment (WEEE) by waste management operations - open scope, 6 product categories (from 2018 onwards). https://doi.org/10.2908/ENV_WASELEEOS

¹³⁵ Expert interview. (2025).

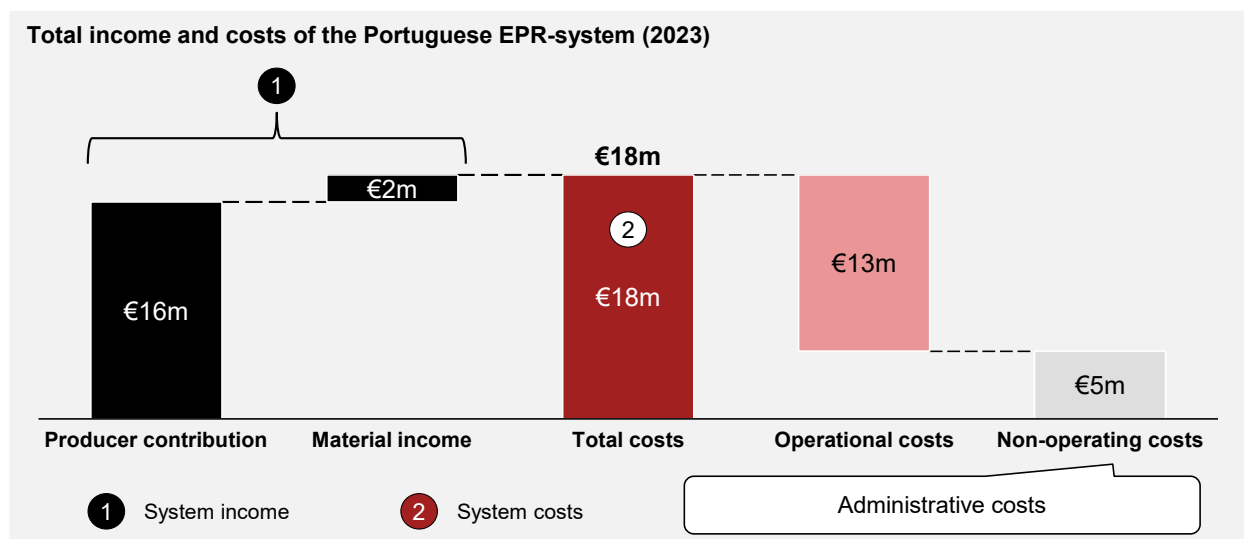


Figure 35: Total income and costs of the Portuguese EPR system for WEEE in 2023 (€m)

5.3.5. Strengths and challenges

Strengths of the Portuguese EPR system

- **Accurate and transparent reporting through end-to-end traceable waste.** Portugal meticulously tracks the WEEE in its system and ensures that only WEEE that is in the proper system counts as collected or recycled.
- **Door-to-door collection service for collection of large appliances.** Electrão has launched a pilot in which it offers free door-to-door collection of bulky appliances from consumers' houses. The pilot aims to improve the collection rates for these types of WEEE by reducing barriers to hand them in at the proper sites.
- **Large and wide network of collection points (e.g., fire stations, schools).** With an average of 1,8 collection points per 1000 inhabitants, Portugal boasts one of the widest collection networks of all our case studies. Collection points are also very diverse in nature, ranging from municipal collection sites and EEE retailers to fire stations, schools and scouts.
- **Pilot scrap metal sector to characterize the waste from scrap metal dealers.** Portugal's pilot to find out how much WEEE is treated through this informal channel is an innovative approach to a widespread problem. The aim is to track where WEEE is 'leaking' from the system, and to increase the volumes of WEEE that are properly recycled.
- **Discounts for P&I that open collection points or join public campaigns.** Electrão has implemented limited tariff differentiation, or eco-modulation, to companies that promote sustainable practices. For example, P&Is that open collection points or help with Electrão's campaigns get offered discounts.

Challenges for the Portuguese EPR system

- **No mandatory handover causes mostly fractions with negative value to enter the EPR system.** It is not mandatory to handover WEEE to the PRO in Portugal. This causes the PROs to largely handle the waste streams with less value, since those with value are sold directly to the treatment operators.

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- **Large scavenging economy, deteriorating streams (~25% of WEEE in illegal streams) and collection performance.** Portugal has a large scavenging economy; it is estimated that around 25% of all WEEE ends up in undocumented streams. A large part of the population lives in poverty and scavenges valuable waste from collection points.
 - **High administrative burden, slowing down new initiatives due to substantial amount of regulation.** The waste management sector in Portugal is highly regulated because there are only two players operating in it. This ensures high environmental standards and compliance, but also leads to a high administrative burden, which slows down new initiatives because of the rigorous reviews they must go through.
 - **Limited number of recycling plants leading to limited levers to lower treatment costs.** PROs are not allowed to own their own treatment facilities. However, the number of treatment facilities they can choose between is limited. This limits the control PROs have over the costs of treatment.

5.4. Italy

	Indicator	Result 2023
Effectiveness	Achieved collection rate <i>WEEE Forum 2023</i>	29%
	Achieved collection rate excl. PV <i>WEEE Forum 2023</i>	30%
	Achieved recycling rate <i>Eurostat 2022</i>	84%
	Achieved recovery rate <i>Eurostat 2022</i>	89%
	Innovation	Medium
	Awareness	Medium
Efficiency	Total system costs	€200m
	Producer contributions	€100m
	Producer contribution per inhabitant	€1,70
	Producer contribution per ton put-on-market	€59
	Producer contribution per ton collected	€203
	Producer contribution per ton recycled	€224
	Producer contribution per ton recovered	€210
	Percentage free-riding <i>Expert input</i>	< 10%

Figure 36: Summary of the effectiveness and efficiency of the Italian EPR system for WEEE

5.4.1. Historical and legislative framework

The European RoHS (2002/95) and WEEE Directive (2002/96) were incorporated into Italian law through the Legislative Decree No. 151 of 25 July 2005. The decree regulates waste prevention, promotes reuse and recycling, and limits hazardous substances use in EEE. The Ministry of Environment (MoE) in Italy is responsible for incorporating the WEEE Directive into national law and overseeing the implementation of the extended producer responsibility (EPR) for WEEE. They ensure that producers comply with regulations to manage and recycle electronic waste effectively¹³⁶.

Decree 151/2005 tasks municipalities with creating accessible and adequate private WEEE collection systems. Financial responsibility lies with the producers and importers (P&Is) of EEE. For professional WEEE, P&Is are responsible for products placed on the market after August 2005 and prior products when

¹³⁶ The President Of The Republic (2005). Legislative Decree no. 151 of 25 July 2005 Implementation of Directives 2002/95/EC, 2002/96/EC and 2003/108/EC on the reduction of the use of hazardous substances in electrical and electronic equipment and on the disposal of waste. *Normattiva*. [LEGISLATIVE DECREE no. 151 of 25 July 2005 - Normattiva](#)

replacing with new equipment. For all other products, responsibility lies with the owners. Distributors must implement a take-back scheme where consumers can return their old EEE on a 1-for-1 basis when purchasing new equipment¹³⁷. The decree mandates a national registry to oversee WEEE processing and define market shares for producers and importers. It stipulates that waste management system costs for WEEE must not burden public finances but should be borne by EEE producers and importers. The decree further specifies that Producer Responsibility Organizations (PROs) must establish and finance a national clearing house, Coordination Centre for WEEE (WEEE CoC or CdcRAEE), to oversee and coordinate PRO activities, ensuring consistent and uniform operations¹³⁸.

Italy's EPR system became operational in January 2008 after its managing bodies such as the National Register, the WEEE CoC, and the Steering Committee on WEEE were established by Ministerial decree n. 185 on 26 September 2007¹³⁹. Financial responsibility transferred to producers in September 2008. In November 2008, Italy introduced an optional visible fee, though producers are not obligated to include this on invoices to retailers, nor are retailers required to display it to consumers^{140, 141}.

Legislative Decree No. 49 of 14 March 2014 updated the law to align with the revised EU WEEE Directive 2012/19. It required PROs to adopt la consortium legal form with a not-for-profit objective. The decree prohibits PROs from generating profit or distributing excess income to members. Retailers, transporters, collection companies, and treatment companies may become shareholders in agreement with producers. PROs must publish their producer contributions per product group on their websites and meet standards for financial means and control bodies. The decree mandates PROs to have a minimum of 3% of the total EEE placed on the market (POM) in the preceding year, either in one subcategory or across all WEEE categories.¹⁴² Decree 49/2014 establishes standards for separate collection of various WEEE subcategories, focusing on temperature exchange equipment containing ozone-depleting substances and fluorinated greenhouse gases, mercury-containing fluorescent lamps, photovoltaic panels, and small equipment. It also allows producers to organize their own collection systems for household WEEE in addition to municipal collection points¹⁴³.

In 2018, 2022, and 2024 three new Decrees were introduced with the objective of expanding the scope, facilitating entry of new collective schemes, and enhancing the recovery and reuse of materials from WEEE, respectively. In 2018, Legislative Decree 49/2014 introduced an open scope that significantly expanded the categories of products subject to EEE legislation. This new classification categorizes products based on size rather than type. In 2022, the requirements for the introduction of new collective schemes for WEEE were updated. The amendment stipulates that these schemes now only need to demonstrate a minimum

¹³⁷ The President Of The Republic. Legislative Decree no. 151 of 25 July 2005 Implementation of Directives 2002/95/EC, 2002/96/EC and 2003/108/EC on the reduction of the use of hazardous substances in electrical and electronic equipment and on the disposal of waste. *Normattiva*. [LEGISLATIVE DECREE no. 151 of 25 July 2005 - Normattiva](#)

¹³⁸ The President Of The Republic (2005). Legislative Decree no. 151 of 25 July 2005 Implementation of Directives 2002/95/EC, 2002/96/EC and 2003/108/EC on the reduction of the use of hazardous substances in electrical and electronic equipment and on the disposal of waste. *Normattiva*. [LEGISLATIVE DECREE no. 151 of 25 July 2005 - Normattiva](#)

¹³⁹ The Minister of the Environment and Protection of Land and Sea (2007). Ministerial Decree no. 185 of 25 September 2007. *Normattiva*. [DECREE no. 185 of 25 September 2007 - Normattiva](#)

¹⁴⁰ Baldé, C. P, Wagner, M., lattoni, G., Kuehr, R. (2020). In-depth review of the WEEE Collection Rates and Targets in the EU-28, Norway, Switzerland, and Iceland. Unitar. <https://www.scycle.info/wp-content/uploads/2020/11/In-depth-review-WEEE-Collection-Targets-and-Rates-UNITAR-2020-Final.pdf>

¹⁴¹ The President Of The Republic. Legislative Decree no. 151 of 25 July 2005 Implementation of Directives 2002/95/EC, 2002/96/EC and 2003/108/EC on the reduction of the use of hazardous substances in electrical and electronic equipment and on the disposal of waste. *Normattiva*. [LEGISLATIVE DECREE no. 151 of 25 July 2005 - Normattiva](#)

¹⁴² The President Of The Republic. (2014). Legislative Decree no. 49 of 14 March 2014. Implementation of Directive 2012/19/EU on waste electrical and electronic equipment (WEEE). *Normattiva*. [DECRETO LEGISLATIVO 14 marzo 2014, n. 49 - Normattiva](#)

¹⁴³ The President Of The Republic. (2014). Legislative Decree no. 49 of 14 March 2014. Implementation of Directive 2012/19/EU on waste electrical and electronic equipment (WEEE). *Normattiva*. [DECRETO LEGISLATIVO 14 marzo 2014, n. 49 - Normattiva](#)

1% market share in any of the designated WEEE categories to be considered eligible. Law No. 166 of 14 November 2024 amends Legislative Decree 49/2014 to enhance the recovery and reuse of valuable materials from WEEE. It aims to simplify WEEE collection and deposit by enforcing distributors to implement 1-1 and 1-0 takeback schemes and obligating them, including online distributors, to clearly inform consumers about these free takeback services. Additionally, Law No. 166 requires PROs to spend at least 3% of the previous year's revenues on communication programs to inform citizens about the importance of separate WEEE collection and its environmental and economic benefits^{144, 145}.

National targets

Italy's national targets for WEEE collection, recycling and recovery align EU directives. Until December 31, 2015, the household collection target was 4 kg per inhabitant annually. From the 1st of January 2016, the minimum collection target changed to 45% of the average put-on-market of the preceding three years. From 2016 to 2018 the objective was to gradually increase the quantity of WEEE collected to move towards the new collection rate set in 2019. From January 1, 2019, Italy's collection target is 65% of the average put-on-market of the three preceding years, or 85% of the weight of WEEE generated in Italy¹⁴⁶.

Italy's targets for recycling and recovery align with EU directives. For recycling and recovery, producers must achieve specific recovery and recycling targets based on equipment categories. From December 31, 2006, producers had to achieve recycling targets between 50% to 75% depending on the type of equipment. Recovery targets ranged between 70% and 80%¹⁴⁷. The WEEE Directive 2012/19 increased recycling and recovery targets to current levels. Recycling and recovery targets are lowest for small equipment and small IT and telecommunications equipment, 55% for recycling and 75% for recovery respectively, and highest for large equipment (including PV), temperature exchange equipment and lamps, namely 80% for recycling and 85% for recovery, respectively¹⁴⁸.

¹⁴⁴ Erion. (n.d.). Italian legislation. <https://erionWEEE.it/en/legislation/italian-legislation/>

¹⁴⁵ ERP Italy. (2025). Italy: New law concerning e-waste and e-commerce platforms published. <https://erp-recycling.org/news-and-events/2025/01/new-law-concerning-e-waste-and-e-commerce/>

¹⁴⁶ European Union. (2012). Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast) Text with EEA relevance. *Official Journal of the European Union*. <https://eur-lex.europa.eu/eli/dir/2012/19/oj/eng>

¹⁴⁷ European Union. (2002). Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) - Joint declaration of the European Parliament, the Council and the Commission relating to Article 9. *Official Journal of the European Union*. <https://eur-lex.europa.eu/eli/dir/2002/96/oj/eng>

¹⁴⁸ European Union. (2002). Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE) - Joint declaration of the European Parliament, the Council and the Commission relating to Article 9. *Official Journal of the European Union*. <https://eur-lex.europa.eu/eli/dir/2002/96/oj/eng>

Italian collection, recycling, and recovery targets (2023)

	Total	 TEE	 Screens	 Lamps	 Large appliances	 PV	 Small equipment	 Small IT equipment
EU collection target	65%	65% across all categories						
IT collection target	65%	65% across all categories						
EU recycling and reuse target	-	80%	70%	80%	80%	80%	55%	55%
IT recycling target	-	80%	70%	80%	80%	80%	55%	55%
EU recovery target	-	85%	80%	-	85%	85%	75%	75%
IT recovery target	-	85%	80%	-	85%	85%	75%	75%

Figure 37: Italian WEEE collection, recycling and recovery targets 2023

5.4.2. Organization of the ERP system

Italy has a competitive EPR system with multiple, competing PROs. 16 Italian PROs affiliate with the WEEE CoC, of which 12 focus on all types of domestic WEEE, two focus on solar PV panels, one focuses on professional WEEE, and one focuses on air-conditions. PROs share operational responsibility with the government. The government is responsible for building enough, easily accessible, municipal collection sites, and is responsible for achieving the Italian collection target. Financial responsibility for the system lies entirely with PROs.

Element	Explanation
Number of PROs	16 PROs affiliated with WEEE CoC
Scope	Domestic and professional WEEE
Segmentation	Some PROs focus on specific sub streams of WEEE, batteries are separate
Market type	Competition between PROs
Organizational structure	Several PROs have their own treatment facilities
Operational responsibility	Collection: government, all subsequent steps: PROs ¹⁴⁹
Financial responsibility	PROs

Table 5: Characteristics of the Italian EPR system

¹⁴⁹ Baldé, C. P, Wagner, M., Iattoni, G., Kuehr, R. (2020). In-depth review of the WEEE Collection Rates and Targets in the EU-28, Norway, Switzerland, and Iceland. Unitar. <https://www.scycle.info/wp-content/uploads/2020/11/In-depth-review-WEEE-Collection-Targets-and-Rates-UNITAR-2020-Final.pdf>

5.4.2.1. Roles and responsibilities

Producers & Importers of EEE

Producers and importers (P&Is) of EEE place electrical and electronic equipment on the Italian market and are responsible by law for the financial and operational management of WEEE. The WEEE management system is coordinated by the WEEE CoC. P&Is fulfill their obligations by either joining collective systems (PROs) or establishing individual systems for managing WEEE. Management costs are allocated according to market share. P&Is are only allowed to place products on the Italian market after registering with the Chamber of Commerce and the National Register^{150, 151}. P&Is participate in the system coordinated by the WEEE CoC by:

- Signing program agreements with collection and distribution companies, the National Association of Italian Municipalities, and the WEEE CoC that regulate the conditions of service at municipal collection centers and grouping places (e.g., conditions and times for collection of WEEE from collection centers, the conditions for and size of the efficiency bonuses paid to the collection centers minimum level of quality of WEEE)
- Providing economic resources to the municipal collection centers and grouping places
- Establishing annual funds through tenders for the infrastructure of the municipal collection centers and the implementation of communication activities to encourage collection of WEEE
- Establishing a system for adequate treatment, characterized by the best available recycling and recovery methods, and sending the collected WEEE for treatment¹⁵²

Producer responsibility organizations (PROs)

Collective systems, or PROs, are non-profit consortia made up of EEE producers and importers. PROs for domestic EEE are legally required to join the WEEE Coordination Centre. They collect and manage domestic WEEE following uniform operating rules established by the WEEE CoC. PROs for professional WEEE can join the CoC WEEE, but participation is voluntary. There are currently 15 PROs for domestic WEEE affiliated with the WEEE CoC and one PRO for professional WEEE. Of the 15 PROs for domestic WEEE, 12 operate in all WEEE categories, two focus on solar panels and one focuses on air conditionings¹⁵³.

The Coordination Centre for WEEE (WEEE CoC or CdCRAEE)

The WEEE Center of Coordination (WEEE CoC) plays a central coordinating role within the Italian EPR system with multiple, competing PROs. Article 13 of the Legislative Decree n.151 of 25 July 2005 dictated the establishment of a coordination center financed by the PROs to optimize the activities of the PROs and guarantee uniform operating conditions¹⁵⁴. The WEEECOC was officially established through Legislative Decree n.185 of September 25th 2007. The WEEE CoC stipulates agreements with the National Association

¹⁵⁰ Centri di Coordinamento Rifiuti di Apparecchiature Elettriche ed Elettronich (CdCRAEE). (n.d.). EEE Producers. [EEE Producers - WEEE CoC | WEEE Coordination Centre](#)

¹⁵¹ The President Of The Republic. (2014). Legislative Decree no. 49 of 14 March 2014. Implementation of Directive 2012/19/EU on waste electrical and electronic equipment (WEEE). *Normattiva*. [DECRETO LEGISLATIVO 14 marzo 2014, n. 49 - Normattiva](#)

¹⁵² Centri di Coordinamento Rifiuti di Apparecchiature Elettriche ed Elettronich (CdCRAEE). (n.d.). EEE Producers . [EEE Producers - WEEE CoC | WEEE Coordination Centre](#)

¹⁵³ Centri di Coordinamento Rifiuti di Apparecchiature Elettriche ed Elettronich (CdCRAEE). (n.d.). Collective Systems. [Collective Systems - WEEE CoC | WEEE Coordination Centre](#)

¹⁵⁴ The President Of The Republic (2005). Legislative Decree no. 151 of 25 July 2005 Implementation of Directives 2002/95/EC, 2002/96/EC and 2003/108/EC on the reduction of the use of hazardous substances in electrical and electronic equipment and on the disposal of waste. *Normattiva*. [LEGISLATIVE DECREE no. 151 of 25 July 2005 - Normattiva](#)

of Italian Municipalities, collection companies, PROs and trade associations of EEE producers, distribution and treatment companies.

The main responsibilities of the WEEE CoC are to:

- Ensure homogenous operating conditions and uniform levels of treatment between the PROs
- Distribute the collection sites amongst the PROs based on their market share and facilitate communication between collection sites and PROs through an online portal
- Report on the quantities of domestic WEEE collected and treated
- Define the methodology for adequate treatment of WEEE and manage a list of approved WEEE treatment plants
- Carry out communication campaigns to raise awareness on proper electronic waste collection
- Draft agreements between players in the supply chain to regulate the conditions of service at municipal collection centers and distribution grouping places
- Organize permanent and temporary working groups with experts in the system on various issues related to WEEE¹⁵⁵

Ministry of Environment and Energy Security

The Ministry of Environment and Energy Security (previously the Ministry of Environment and Protection of Land and Sea) is the primary authority responsible for overseeing the EPR system for WEEE in Italy. The Ministry's roles include drafting and implementing WEEE legislation, setting national collection and recovery targets, coordinating with other governmental bodies, and supervising the Supervisory and Control Committee on WEEE management. The Ministry also oversees the national WEEE register, monitors compliance with regulations, and reports to the European Commission on Italy's WEEE management performance.

The Supervisory and Control Committee for WEEE

The Committee falls under the Ministry of Environment and Energy Security and the costs are borne by P&Is. The need for a Supervisory and Control Committee on the management of WEEE was set by the Legislative Decree n.151. The responsibilities of the Supervisory and Control Committee on the management of WEEE as laid out in the Legislative Decree n.151 are 1) preparing and updating the national registry of P&Is; 2) collecting data related to products placed on the market and the way in which P&Is intend to follow up on their financial guarantees (i.e., through a collective or individual scheme); 3) calculate the markets shares of the P&Is; 4) plan and arrange inspections of producers who do not report their products placed on the market or their financial guarantee; 5) ensure that equipment placed on the market after August 2005 bears the manufacturers identification; 6) to process data relating to the recovery of objects and to prepare reports based on this data.

The Supervisory and Control Committee on the Management of WEEE was officially established by the Decree on the 25th September 2007. In this Decree, the following responsibilities were added to the responsibilities of the Committee 1) monitoring the implementation of the Legislative Decree n.151; 2) act as point of reference for the representation of various problems for the subcategories of WEEE; and 3) encourage the adoption of initiatives aimed at ensuring the uniform application of Legislative Decree n. 151, amongst others by submitting proposals for amendments to legislation.

¹⁵⁵ Centri di Coordinamento Rifiuti di Apparecchiature Elettriche ed Elettronich (CdCRAEE). (n.d.). Collective Systems. [Collective Systems - WEEE CoC | WEEE Coordination Centre](#)

Municipalities

Legislative Decree No. 151 assigns operational responsibility for establishing an effective Waste Electrical and Electronic Equipment (WEEE) management system to municipalities. This requires them to create collection centers where citizens can drop off their electronic waste at no cost, with items sorted into specific subcategories of WEEE¹⁵⁶. These collection centers are operated either by the municipalities themselves or by waste management companies contracted to handle the service. They are authorized to collect WEEE from residents of one or more municipalities, depending on the agreements in place. Additionally, collection centers must accept WEEE from domestic users delivered by distributors, installers, and technical assistance centers, regardless of the waste's origin. The municipalities can either choose to sell the WEEE they collect directly to treatment plants, or have it collected by the PROs¹⁵⁷.

The Municipalities organize together into the National Association of Italian Municipalities (ANCI) through which they enter into Program Agreements with the WEEE CoC, PROs, and waste management operators. To utilize the collection services coordinated by the WEEE CoC, municipalities must adhere to several conditions outlined in the program agreement:

- Compliance with the technical and organizational requirements specified in Annex 1 of the Ministerial Decree dated April 8, 2008, along with applicable environmental legislation.
- Registration of the collection center on the designated portal provided by WEEE CoC following the acceptance of the general collection conditions and the operational agreement¹⁵⁸.

Municipal collection centers receive funding from producers of EEE through PROs to ensure the efficiency of the WEEE management system. These contributions, referred to as efficiency bonuses, are awarded to collection centers that fulfill the criteria established in the agreement, and they consist of a fee for each ton of properly managed WEEE delivered to the PROs¹⁵⁹.

EEE Retailers

EEE retailers sell EEE produced or imported by the P&Is directly to consumers, either via physical stores or online. Legislative Decree 49/2014 indicates that EEE retailers have a one-for-one takeback obligation, which means that the retailer is obliged to collect old appliances when consumer purchases a new equivalent product. Take-back is not mandatory if the WEEE does not contain all essential components. EEE retailers that have a sales area dedicated to EEE of more than 400m² are obliged to collect WEEE smaller than 25 cm on a one-for-zero basis, meaning that they must accept WEEE bought to them by the consumer even if the consumer buys nothing in return. This service is optional for shops with a smaller surface area.

EEE retailers, physically and online, are obligated to register collected WEEE on the WEEE CoC portal. EEE retailers can either choose to sell the WEEE they collect directly to treatment plants, or have it collected by the PROs. Retailers are also eligible for efficiency bonuses for the WEEE they provide to the PROs.

Treatment plants

Treatment plants authorized companies conducting WEEE recycling and recovery. Decree 49/2014 requires them to register with the treatment plant register of the WEEE CoC and to annually report the

¹⁵⁶ Centri di Coordinamento Rifiuti di Apparecchiature Elettriche ed Elettronich (CdCRAEE). (n.d.). Municipalities. [Municipalities - WEEE CoC | WEEE Coordination Centre](#)

¹⁵⁷ Centri di Coordinamento Rifiuti di Apparecchiature Elettriche ed Elettronich (CdCRAEE). (n.d.). Municipalities. [Municipalities - WEEE CoC | WEEE Coordination Centre](#)

¹⁵⁸ Centri di Coordinamento Rifiuti di Apparecchiature Elettriche ed Elettronich (CdCRAEE). (n.d.). Municipalities. [Municipalities - WEEE CoC | WEEE Coordination Centre](#)

¹⁵⁹ Centri di Coordinamento Rifiuti di Apparecchiature Elettriche ed Elettronich (CdCRAEE). (n.d.). Municipalities. [Municipalities - WEEE CoC | WEEE Coordination Centre](#)

quantities of WEEE treated. Registration is free and required for plants handling and storing electronic waste, regardless of whether the WEEE is domestic or professional¹⁶⁰.

Plants that want to receive domestic WEEE through PROs must demonstrate that they meet the requirements set out in the program agreement on the adequate treatment of WEEE and be accredited by the WEEE CoC. The program agreement on the adequate treatment of WEEE (outlined in article 33 of the Legislative Decree 49/2014) sets the requirements for qualifying WEEE treatment companies, to ensure proper treatment of domestic electronic waste. PROs are obligated to only deliver domestic WEEE collected as part of the activities coordinated by WEEE CoC to accredited treatment plants¹⁶¹.

Treatment plants must achieve accreditation with WEEE CoC. After passing the audit the treatment plant will obtain a special certification, which allows it to accredit with the WEEE CoC. Currently, the third-party verifiers in charge of conducting the checks are Certiquality S.r.l., IMQ S.p.A, and SGS Italia S.p.A¹⁶².

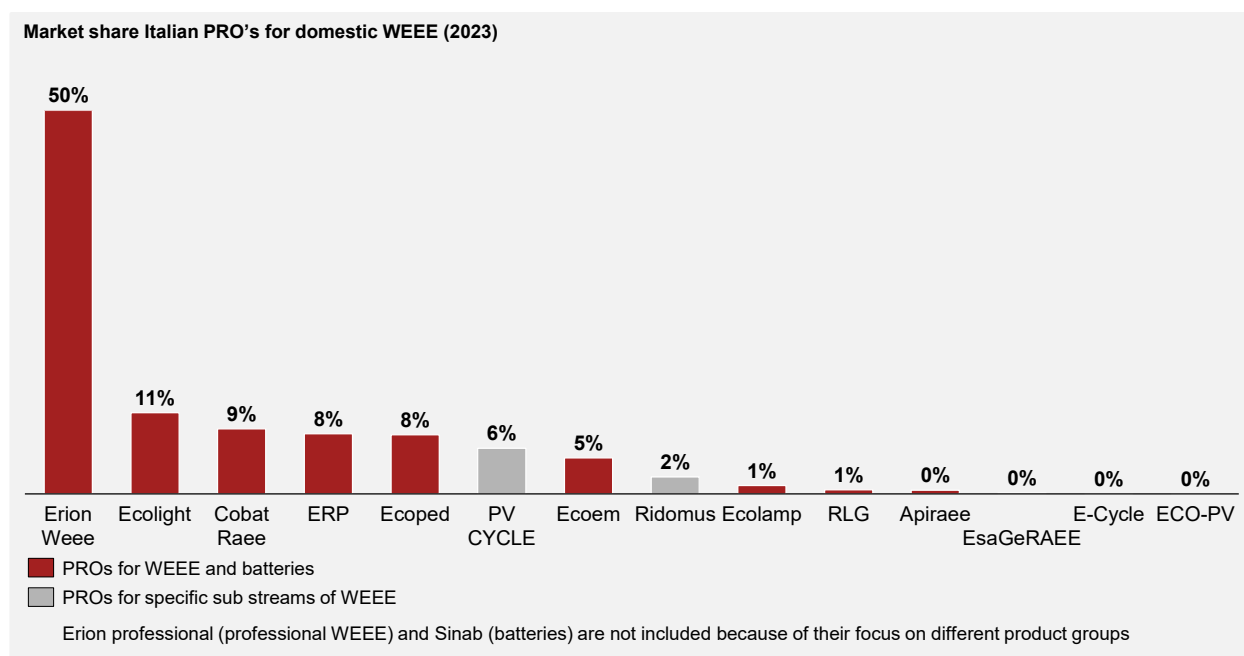


Figure 38: Market share of Italian PROs focused on domestic WEEE and batteries 2023

¹⁶⁰ Centri di Coordinamento Rifiuti di Apparecchiature Elettriche ed Elettronich (CdCRAEE). (n.d.). Treatment plants. [Treatment plants - WEEE CoC | WEEE Coordination Centre](#)

¹⁶¹ Centri di Coordinamento Rifiuti di Apparecchiature Elettriche ed Elettronich (CdCRAEE). (n.d.). Treatment plants. [Treatment plants - WEEE CoC | WEEE Coordination Centre](#)

¹⁶² Centri di Coordinamento Rifiuti di Apparecchiature Elettriche ed Elettronich (CdCRAEE). (n.d.). Treatment plants. [Treatment plants - WEEE CoC | WEEE Coordination Centre](#)

5.4.2.2. Organization of the supply chain

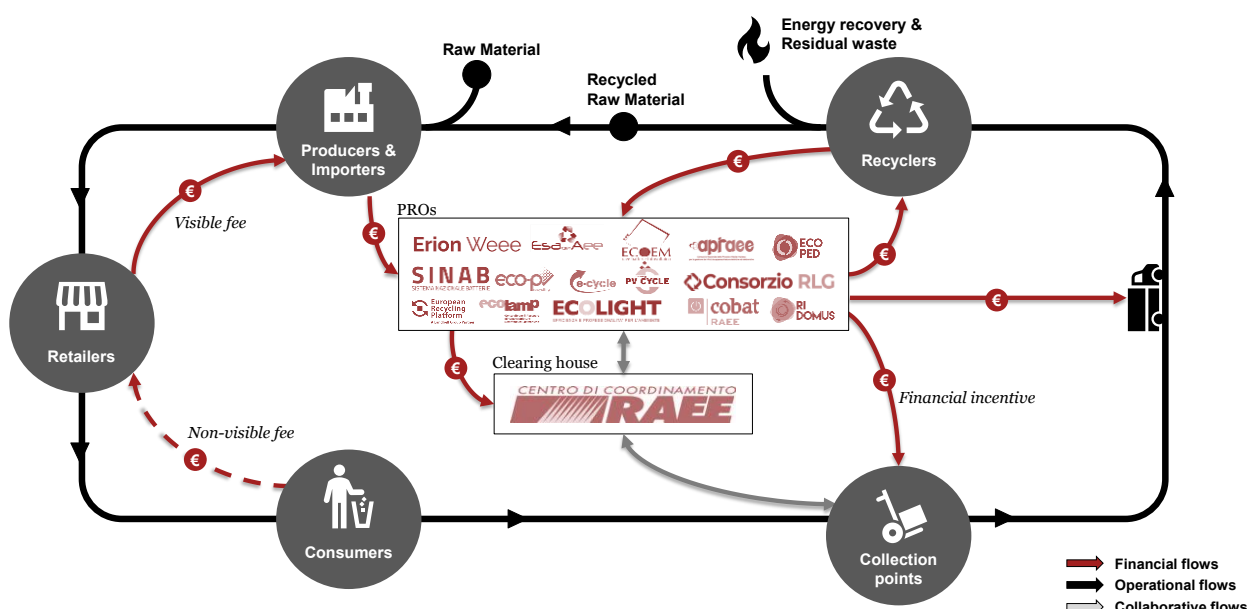


Figure 39: Organization of the Italian EPR system for WEEE

In Italy, domestic and professional WEEE are treated differently. Regulations state that P&Is of professional WEEE are only obligated to take care of the collection and treatment of their WEEE if the owner of the WEEE contacts them. However, since most waste streams for professional WEEE are valuable, this rarely happens. Most often, the WEEE is sold directly to the treatment plants by the owners of the EEE. As a result, there is almost no professional WEEE in the EPR system, and documentation of professional WEEE streams is lacking¹⁶³. Because of this, the overview provided by figure 38 focuses on domestic WEEE. The system for management of domestic WEEE is coordinated by the WEEE CoC, under the supervision of the Ministry of Environment and Energy Security and the Ministry of Enterprises in Italy¹⁶⁴.

Collection

Collection happens through municipal collection centers, grouping places, or collection places at companies and institutions (private collection centers). Municipal collection centers are set up by municipalities, and either managed by the municipalities themselves or entrusted to waste collection companies. Grouping places are spaces organized by EEE retailers or installers where WEEE is stored. Producers can set up private collection centers through their PRO to store waste collected from EEE retailers. Only the producers or their PRO can register a private collection center on the WEEE CoC portal. Following registration, the WEEE CoC assigns the individual collection points to the PROs.

Citizens can drop their WEEE of free of charge at the municipal collection centers, where the WEEE are divided into subcategories. At the EEE retailers, citizens can hand in their WEEE on a one-for-one or one-for-zero basis. The one-for-one takeback means retailers must accept WEEE when a consumer buys a new equivalent product, including online purchases. The one-for-zero takeback means that retailers with a sales area over 400 square meters must accept WEEE smaller than 25 cm from consumers without requiring a purchase. This service is optional for smaller shops.

The financing of WEEE collection infrastructure is multi-faceted. Municipal collection centers are primarily funded by the government through taxes, while retail collection points are financed by the retailers themselves, who incorporate these costs into their product pricing. PROs offer efficiency bonuses

¹⁶³ Expert interview. (2025).

¹⁶⁴ Expert interview. (2025).

("premios de eficiencias") to collection points for the WEEE they receive. These incentives, which partially offset collection costs, vary based on the type, quantity, and quality of WEEE collected.

Processing and Recycling

In Italy, both municipalities and retailers are permitted to sell their WEEE to any authorized treatment operator. Collectors receive compensation that varies according to the type and size of the WEEE collected. When WEEE is sold to PROs, this compensation equals the efficiency bonuses which are fixed; however, when sold to other operators, the compensation fluctuates depending on the value of raw materials. The compensation rates offered by the alternative operators are often higher than those offered by the PROs, which leads to approximately half of the WEEE bypassing the PROs and causes PROs to primarily receive the less valuable material streams.

When WEEE is sold directly to treatment facilities, those facilities arrange for transportation from the collection points. In contrast, when the WEEE is sold to PROs, the responsibility for transportation falls to them. Transport companies contracted by PROs handle the transportation of e-waste to recycling facilities that also have agreements with the PROs. Each company that a PRO wishes to engage with must be pre-approved by the WEEE CoC, which ensures uniform quality standards among the PROs. The standards for treatment set by the WEEE CoC are based on CENELEC treatment standards, but CENELEC certification is not a requirement.

During the treatment process, some of the e-waste is recycled or reused, while the remainder is either processed for energy recovery or incinerated as residual waste.

5.4.3. Effectiveness

In 2023, Italy achieved most of the EU recycling and recovery targets, although collection remained challenging. Competitive price pressures also pose a hurdle to innovation and awareness in Italy's EPR system. Awareness presents a challenge as investments in this area might inadvertently benefit competitors. To ensure continued investment in awareness, the law mandates that at least 3% of last year's revenues be allocated to awareness efforts, with the WEEE CoC coordinating national awareness campaigns.

5.4.3.1. Realization collection and recycling targets

In 2023, Italy's total 3-year average put-on-market was 1,695kt, equivalent to approximately 29 kg per inhabitant. The largest subcategory of WEEE by weight in Italy is small equipment, followed by large appliances and temperature exchange equipment. In 2023, 29% of the average put-on-market from the previous three years, or 493kt, was collected, falling short of the Italian and EU target of 65%. However, the subcategory of WEEE screens achieved a collection rate of 71%, meeting the 65% target¹⁶⁵.

The recycling targets were met for all WEEE subcategories except for solar PV. Italy's average recycling rate in 2022 was 84%, indicating that 84% of the collected WEEE was recycled. Recovery targets for WEEE were also met for all subcategories except solar PV and small IT and telecommunications equipment. The overall recovery rate was 89% in 2022, meaning that 89% of all collected WEEE was recovered¹⁶⁶.

¹⁶⁵ WEEE Forum. (2023). Key Figures Data.

¹⁶⁶ Eurostat. (2022). Waste electrical and electronic equipment (WEEE) by waste management operations - open scope, 6 product categories (from 2018 onwards). https://doi.org/10.2908/ENV_WASELEEOS

Italian put-on-market (3-year average), collection, recycling, and recovery in kt (2022, 2023)

	Total							
		TEE	Screens	Lamps	Large appliances	PV	Small equipment	Small IT equipment
Put-on-market 3-year average <i>WEEE Forum 2023</i>	1695	373	76	6	530	64	554	91
Collection <i>WEEE Forum 2023</i>	493	118	54	2	201	0	78	39
Recycling <i>Eurostat 2022</i>	447	107	79	4	120	19	101	17
Recovery <i>Eurostat 2022</i>	476	124	81	4	124	19	103	22

Figure 40: Italian put-on-market (3-year average), collection, recycling and recovery in kt (2022, 2023)

Italian achieved collection, recycling, and recovery rates in relation to targets (2022, 2023)

	Total							
		TEE	Screens	Lamps	Large appliances	PV	Small equipment	Small IT equipment
IT collection target	65%	65% across all categories						
Achieved collection rate <i>WEEE Forum 2023</i>	29%	32%	71%	38%	38%	0%	14%	43%
IT recycling target	-	80%	70%	80%	80%	80%	55%	55%
Achieved recycling rate <i>Eurostat 2022</i>	84%	81%	87%	80%	85%	88%	90%	58%
IT recovery target	-	85%	80%	-	85%	85%	75%	75%
Achieved recovery rate <i>Eurostat 2022</i>	89%	93%	90%	82%	87%	88%	91%	74%

 EU target achieved

Figure 41: Italian results compared to national and EU targets in 2022 and 2023 (%)

5.4.3.2. Innovation, knowledge sharing and awareness

The Italian EPR system has various instruments used to promote innovation, knowledge sharing and awareness. Each PRO organizes its own awareness campaigns. Additionally, the WEEE CoC organizes national awareness campaigns, focusing on two main areas: institutional messaging and educational/environmental outreach.

- **Institutional Communication and Stakeholder Engagement:** The WEEE Coordination Center (CoC) in Italy plays a crucial role in institutional communication, aiming to highlight its position within the WEEE system and foster strong connections with various stakeholders. The WEEE CoC actively participates in events, exhibitions, and conferences. This engagement strategy allows them to interact with national and local institutional representatives and other interested parties, thereby strengthening the WEEE system's network and influence.
- **Public Awareness and Educational Campaigns:** Italy's WEEE management system employs a multi-faceted approach to public awareness. The WEEE CoC leads national communication efforts and supports local initiatives. Their 2024 campaign, "La raccolta gira l'Italia," (Collection travels around Italy) combines a national tour with media events and multi-platform promotions, featuring partnerships at major events like the Sanremo Festival. This campaign offers branded stands, WEEE collection points, and educational activities to engage the public across Italy¹⁶⁷. The CoC also provides annual funding for enhancing collection infrastructure and local awareness campaigns, fostering innovation in a competitive EPR system by allowing PROs and P&Is to compete for funds. Individual PROs initiate their own initiatives, such as Erion's 2024 "If you don't care, you're screwed" campaign, which educates about WEEE disposal and promotes takeback schemes. Additionally, Erion WEEE's "Materia Viva Experience" presents an interactive exhibition blending art with environmental awareness, highlighting the impact of individual choices on the circular economy transition.
- **Innovation in Collection and Data Management:** The Italian WEEE system has implemented innovative approaches to improve collection and tackle free riding issues. A pilot program collaborates with online platforms to tackle free riding by distance sellers. In this model, online platforms are mandated to collect data and fees from distance sellers using their platforms, which are then passed on to the PRO. This innovative approach enables the system to reach thousands of distance sellers effectively¹⁶⁸. Additionally, a partnership with Politecnico di Milano resulted in a design competition for small electronic waste collection containers, with the winning design made available to all collection managers, promoting innovation in collection infrastructure¹⁶⁹.
- **Research and Analysis for System Improvement:** To enhance the efficiency and effectiveness of the WEEE management system, Italy has undertaken research initiatives. A comprehensive commodity analysis of over 210 tons of WEEE was conducted at 28 different plants. This study aimed to analyze the types of WEEE managed and understand critical issues impacting the recovery process. Such research provides valuable insights for improving collection, sorting, and recycling processes, ultimately contributing to a more effective WEEE management system¹⁷⁰.

5.4.4. Efficiency

Total costs of the EPR system in Italy amount to approximately €200 million. Approximately half of these costs are covered by income from selling WEEE to treatment operators, although this fraction varies depending on the prices of raw materials. This leaves a €100 million deficit in the system which must be covered by producer contributions. This €100 million is collected from consumers through eco-contributions. In Italy, it is mandatory to show the eco-contribution as a visible free on the receipt from the P&I towards the retailer. However, the retailer is not obligated to make the eco-contribution visible on the

¹⁶⁷ Centri di Coordinamento Rifiuti di Apparecchiature Elettriche ed Elettronich (CdCRAEE). (2024). La raccolta gira l'Italia – Campagna 2024. [La raccolta gira l'Italia - Campagna 2024 - CdC RAEE | Centro di Coordinamento RAEE](#)

¹⁶⁸ Expert interview. (2025).

¹⁶⁹ Centri di Coordinamento Rifiuti di Apparecchiature Elettriche ed Elettronich (CdCRAEE). (2023). 2023 WEEE Report Official data on the collection of electronic waste in Italy. [rapporto-RAEE-nazionale.pdf](#)

¹⁷⁰ Centri di Coordinamento Rifiuti di Apparecchiature Elettriche ed Elettronich (CdCRAEE). (2023). 2023 WEEE Report Official data on the collection of electronic waste in Italy. [rapporto-RAEE-nazionale.pdf](#)

receipt to the customer. In practice, almost no retailers show the visible fee, but account for the eco-contribution in the price of their products.

The societal costs associated with Italy's EPR system are low, amongst others because a significant part of the costs is covered by income from material sales, and because expenses on innovation and awareness are low. A €100 million deficit amounts to a societal cost of €1,70 per Italian inhabitant, and €59, €203 and €224 per ton WEEE POM, collected, and recycled. The operating costs of the system are approximately €90 million, representing 90% of total costs. These include the payments to contracted parties such as transport companies and treatment facilities. Non-operating costs such as costs for coordination, administration and campaigns represent the other 10%. In Italy, PROs are obligated by law to spend at least 3% of last year's revenue on awareness campaigns^{171, 172}.

The amount of the producer contribution varies among PROs. To ensure fair competition, the fee charged by each PRO to their P&Is must be uniform for all producers within the same material stream. PROs are required to post the amounts of their contributions on their websites, although compliance with this requirement is not always enforced.

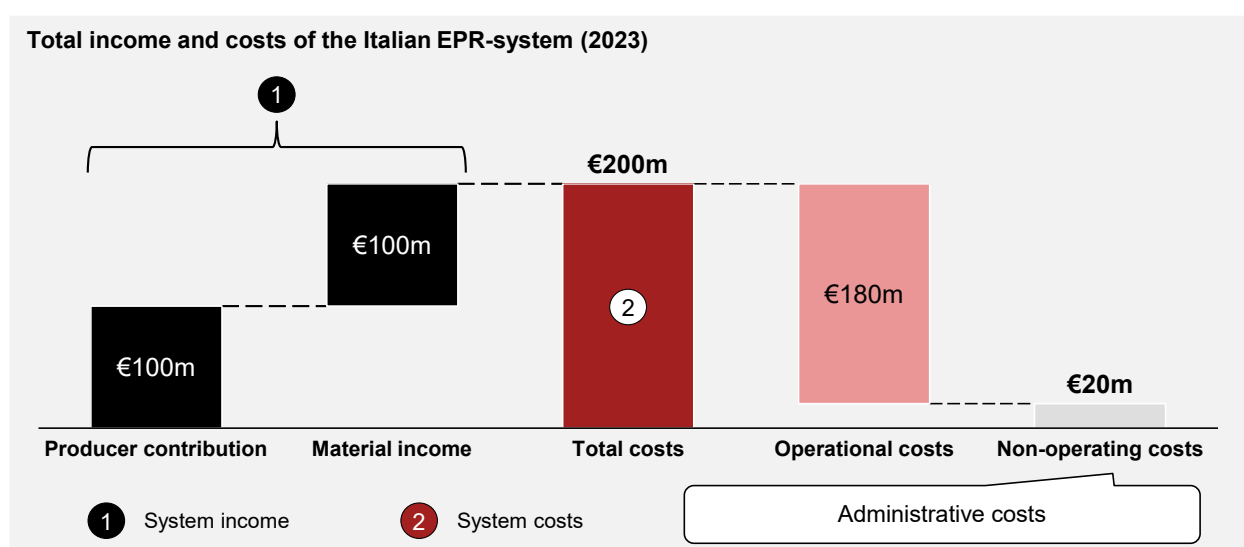


Figure 42: Total income and costs of the Italian EPR system for WEEE in 2023 (€ m)

5.4.5. Strengths and challenges

Strengths of the Italian EPR System

- **Efficiency bonuses for collection points improve the quality and quantity of WEEE collected** and encourage treatment within the EPR system. Appliances missing valuable parts do not count towards these bonuses, reducing scavenging. Treated WEEE within the EPR system ensures better quality control and accurate data reporting.
- **The pilot program requiring online platforms to register volumes** is an innovative approach to combat free riding by distance sellers. By partnering with online platforms for data and funds related to online product sales, the PROs effectively utilize an existing data and financial system.

¹⁷¹ Ahlers, J., Hemkaus, M., Hibler, S. & Hannak, J. (2021). Analysis of Extended Producer Responsibility Schemes. Adelphi. https://erp-recycling.org/wp-content/uploads/2021/07/adelphi_study_Analysis_of_EPR_Schemes_July_2021.pdf

¹⁷² Expert interview. (2025).

- **The WEEE CoC's fair allocation of collection points** ensures equal opportunities for all PROs and minimizes inefficiencies. PROs are assigned distribution points based on previous year's market share in POM, factoring in the quality of WEEE supplied and the proximity and accessibility of collection sites. This reduces logistical inefficiencies, such as multiple PROs collecting from nearby points.
- **Producer fees set within each PRO** establish a level playing field for both large and small P&Is. Set producer fees limit preferential treatment of large P&Is by offering them lower prices, while still allowing PROs to compete by enhancing or customizing their services for larger players.
- **National coordination of education and awareness campaigns** by the WEEE CoC minimizes the drawbacks of individually organized campaigns, like no guaranteed direct effect on results and benefits to specific PROs. By allocating funds and awarding them based on proposals for impactful local campaigns, the WEEE CoC encourages awareness efforts that might not emerge in a price-pressure competitive system.

Challenges for the Italian EPR System

- **The absence of mandatory WEEE handover post-collection** and the autonomy of even municipal collection sites to sell directly to treatment operators result in significant WEEE being processed outside the EPR system. This results in inaccurate monitoring, data reporting, and quality control.
- **Strong competition between treatment operators and lack of enforcement of treatment standards** lead to subpar WEEE processing or processing as metal scrap, distorting recycling outcomes. Although the WEEE CoC sets Italy's treatment standards there is a competitive push to lower standards because of the strong competition between accredited and non-accredited recyclers, and the standards are not readily enforced. This skews recycling results by including substandard or scrap metal-treated WEEE.
- **Lack of enforcement of non-accredited operators' reporting obligations** leads to substantial undocumented streams. Large shares of WEEE are sold directly to non-accredited operators. All operators are required to declare the quantities of WEEE they manage. However, this obligation is not enforced, causing undocumented streams to become significant¹⁷³.
- **The low PRO participation threshold (minimum share of 1%)** allows small PROs to participate in the system, which have limited or no funding to invest in collection and treatment improvements. This creates a fragmented market, exerting price pressure. Small PROs contribute little to improvements but withdraw funds that could benefit larger, better-equipped PROs.

¹⁷³ Baldé, C. P, Wagner, M., Iattoni, G., Kuehr, R. (2020). In-depth review of the WEEE Collection Rates and Targets in the EU-28, Norway, Switzerland, and Iceland. Unitar. <https://www.scycle.info/wp-content/uploads/2020/11/In-depth-review-WEEE-Collection-Targets-and-Rates-UNITAR-2020-Final.pdf>

6. International comparison

The international comparison aims to provide insight into how various EPR market models in surrounding countries compare in terms of effectiveness and efficiency. Accurate international comparisons of EPR systems for e-waste are complicated by the limited comparability of performance indicators between countries. Differences in scope, POM calculations, collection and recycling metrics, and treatment standards hinder fair assessments.

The first challenge arises from the scope of activities, challenging the comparability between countries. The scope of activities differs per PROs, with some, such as Stichting OPEN, focusing on WEEE and batteries, while others focus on specific subsegments, such as PV Cycle in Italy. Some PROs also include B2B WEEE, and some even cover multiple EPR systems such as Electrão in Portugal, which covers both WEEE and packaging. Data accuracy presents an additional challenge. Countries with high levels of free riding often report lower POMs, skewing comparisons.

Recycling metrics further limit the comparability between countries. For instance, the Netherlands only counts tons processed by accredited recyclers, while other countries may estimate WEEE handled by non-accredited operators or factor in scrap metal treatment.

Treatment standards vary widely across countries. The Netherlands uses only CENELEC-certified treatment plants, while Belgium and Ireland accept EN-certified facilities. Portugal has its own standards, but the majority of WEEE is treated in CENELEC-approved facilities. Spain and Italy also have their own treatment standards. Such disparities in standards make comparing e-waste treatment quality and effectiveness across nations challenging.

Despite these challenges, comparing case studies on key performance indicators offer valuable insights. Figure 43 provides an international comparison of different EPR market models in Europe.

International comparison effectiveness and efficiency

	 Netherlands	 Belgium ¹	 Ireland	 Portugal	 Italy	 Spain
Scope	B2C and B2B	B2C and B2B	B2C	B2C and B2B	B2C and B2B	B2C and B2B
Number of PROs	1	1	2	2	16	12
Inhabitants (# m)	18	12	5	11	59	49
Put-on-market 3-year average (kt)	789	338	114	228	1695	1128
Put-on-market 3y-average per inhabitant (kg/inh)	44	29	21	21	29	23
Collection points / km²	0,25	0,41	0,02	0,21	0,04	0,07
Collection points / 1000 inhabitants	0,48	1,05	0,26	1,78	0,20	0,68
Total producer contribution (€ m)	€59m	€35m ²	€16m	€16m	€100m	€90m
Collection per inhabitant (kg/inh) <i>WEEE Forum 2023</i>	12	14	10	4	8	7
Collection rate (%) <i>WEEE Forum 2023 (national reporting)</i>	28% (29%)	49%	46% (53%)	21% (20%)	29%	32%
Collection rate excl. PV (%) <i>WEEE Forum 2023 (national reporting)</i>	42% (43%)	56%	51% (53%)	21% (20%)	30%	43%
Recycling per inhabitant (kg/inh) <i>Eurostat 2022 (national reporting)</i>	8	10	10	3	8	6
Recycling rate (%) <i>Eurostat 2022 (national reporting)</i>	73% (80%)	73% (83%)	82% (80%)	57% (79%)	84%	69%
Recovery per inhabitant (kg/inh) <i>Eurostat 2022 (national reporting)</i>	10	11	12	5	8	6
Recovery rate (%) <i>Eurostat 2022 (national reporting)</i>	90% (98%)	81% (95%)	94% (95%)	100% (86%)	89%	75%
Innovation	High	High	High	Medium	Medium	Medium
Awareness	High	High	Medium	High	Medium	Medium
Producer contribution per inhabitant (€/inh)	€3,31	€2,98	€2,92	€1,54	€1,70	€1,85
Producer contribution per ton 3-year average pom (€/t)	€75	€104	€137	€72	€59	€80
Producer contribution per ton collected (€/t)	€271	€213	€297	€349	€203	€247
Producer contribution per ton recycled (€/t)	€411	€290	€288	€516	€224	€311
Producer contribution per ton recovered (€/t)	€331	€263	€252	€293	€210	€288
Free-riding (%) <i>Expert input</i>	< 5%	N/A	N/A	15-20%	< 10%	N/A

 Better than average of selected countries

(1) For Belgium POM and collection, the latest available data is 2022; (2) €25m producer contribution + €10m reserves

Figure 43: International comparison of selected countries

6.1. Effectiveness

The effectiveness of selected EPR market models is assessed based on their collection, recycling, and recovery performance and the extent to which an EPR system contributes to innovation, knowledge development, and public awareness.

Effectiveness – Collection

Traditionally, collection rates are calculated as a percentage of the average put-on-market (POM) of the three preceding years. A flaw in this methodology is that it does not accurately reflect product lifetime and is therefore significantly influenced by WEEE composition. Alternatively, collection rates can be based on the percentage of WEEE generated annually. Although the latter method is considered more accurate, it has not been implemented yet across all countries. For this international comparison we calculate collection rates based on the three-year-average POM.

WEEE Forum 2023 data indicates an overall collection rate of 28% for the Netherlands. Compared to other European countries the Netherlands ranks in the lowest quadrant for collection. Only Portugal, among the selected case studies, has a lower collection rate at 21%. In collection per inhabitant, the Netherlands aligns with the EU average. The collection performance of the Netherlands is strongly influenced by the characteristics of the POM. First, the Netherlands boasts the highest POM per inhabitant in the EU at 44 kg, 50% above the EU average, making the absolute collection target more challenging. Second, the POM per inhabitant surged by approximately 65% between 2018 and 2023, vastly outpacing the available volumes for collection. Third, the increase in POM largely stems from solar-PV expansion, which accounts for 30% of the POM. Given the lifespan of solar panels, volumes will most likely not be available for collection soon, adversely affecting the overall collection rate.

The Netherlands' (relative) performance improves significantly when solar PV panels are excluded from the calculation. In 2023, the Netherlands achieved a 42% collection rate without solar panels, near the average collection rate of 44% for WEEE Forum countries. While this doesn't change the Netherlands' relative position compared to other case study countries, it highlights that the difference in collection rates including and excluding solar PV is most pronounced in the Netherlands. In 2023, solar PV panels constituted 39% of the Dutch POM. The long lifecycle of solar PV panels (25-30 years) skews results when calculated against the three-year-average POM, as collection within three years is unlikely.

A general observation is that most countries do not meet the 65% collection target, indicating that the current collection target might not be fit for purpose. The Czech Republic and Greece have among the highest collection rates in the WEEE Forum 2023 data but still fall short by around 10%. The European commission is currently evaluating the WEEE Directive.

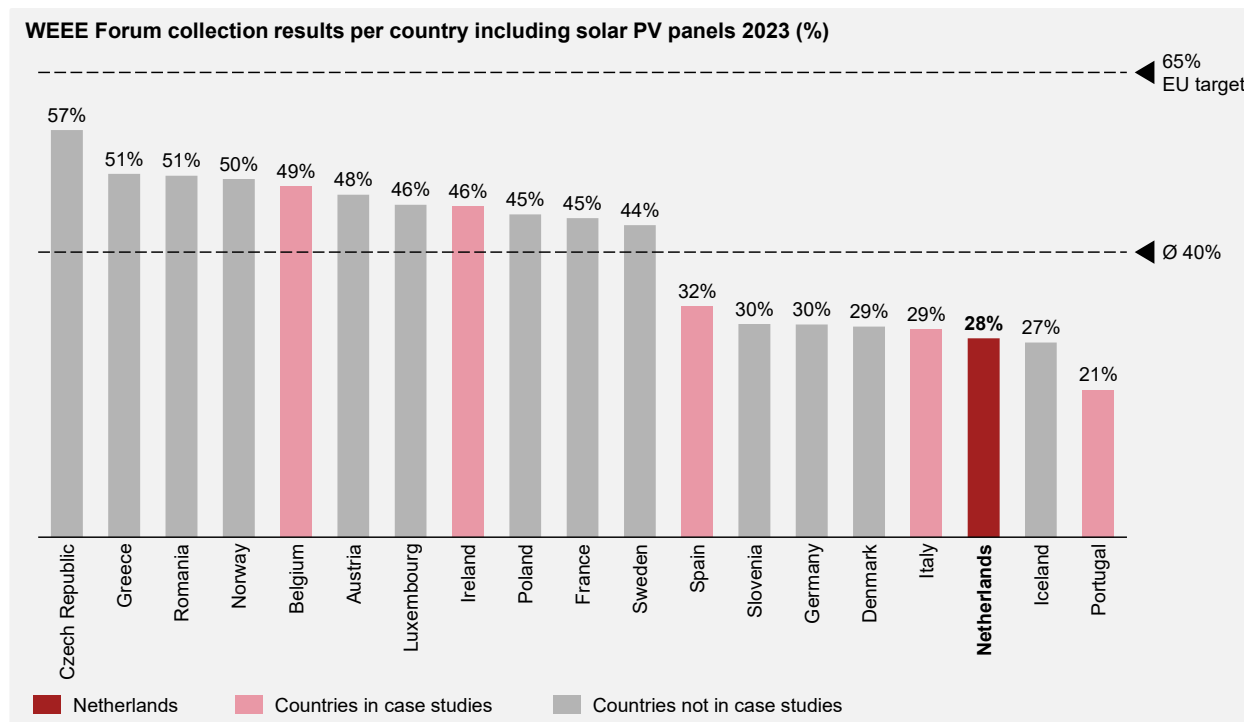


Figure 44: WEEE Forum collection results including PV panels per country 2023 (%)

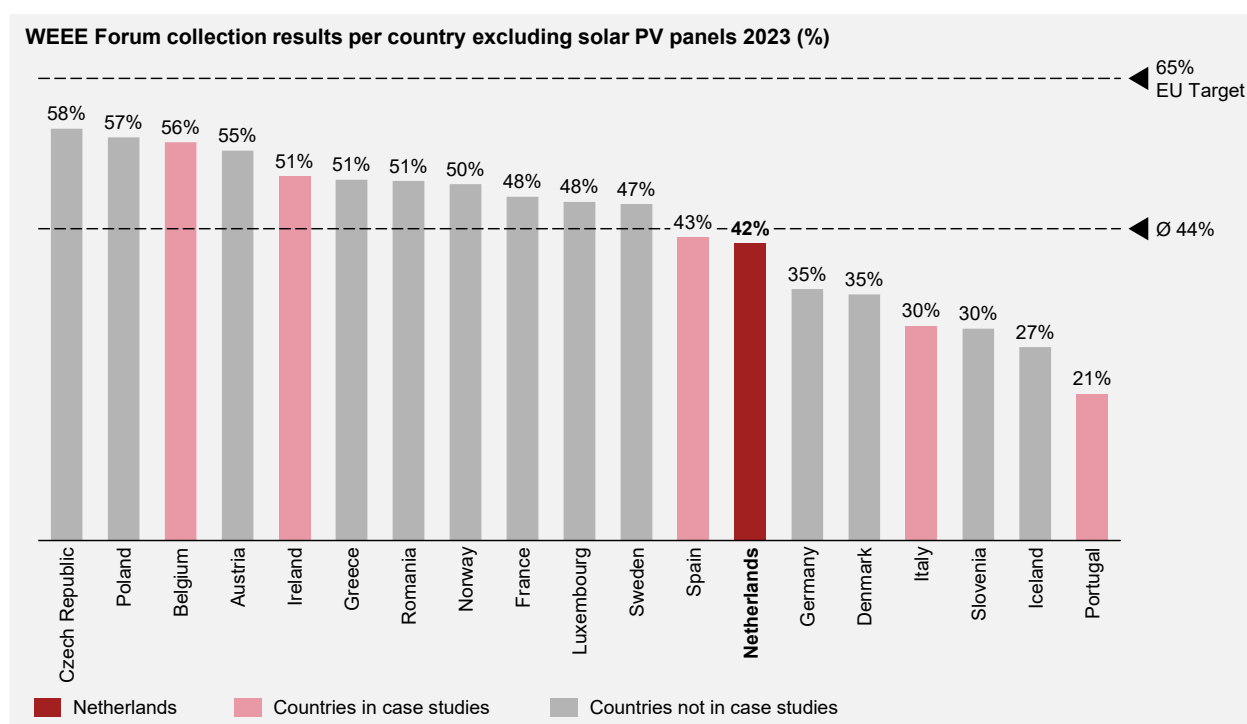


Figure 45: WEEE Forum collection results excluding PV panels per country 2023 (%)

Effectiveness – Recycling

Recycling rates are calculated as a percentage of total WEEE collected. Two primary data sources have been used to compare the recycling performance across countries: Eurostat 2022 and own reporting. Based on Eurostat 2022, the Netherlands has an overall recycling rate of 73%, in line with other WEEE Forum countries and the assessed case studies. Ireland (82%) and Italy (84%) demonstrate the highest score on recycling, followed by Belgium and the Netherlands at 73%. Portugal (57%) and Spain (69%) score

relatively lower. Based on Eurostat, Italy is the only country that meets the recycling targets for all WEEE categories. Belgium and Ireland have difficulty meeting the recycling targets for temperature exchange equipment and solar PV panels. Portugal only meets the recycling target for screens in 2022.

In addition to Eurostat, each country has its own monitoring report on recycling results, which may differ substantially from the Eurostat data. Based on the PRO's own reporting, Belgium scores highest with 83%, followed by the Netherlands and Ireland at 80% and Portugal at 79%. For recovery, the best performing countries are the Netherlands (98%), followed by Belgium and Ireland at 95%, and then Portugal (86%). It is important to note that some countries may report their recycling percentages from outdated measurement points. Following corrections, the Eurostat comparison generally turns out more conservative than own reporting.

Eurostat recycling results per country 2022 (%)								
	Total	 TEE	 Screens	 Lamps	 Large appliances	 PV	 Small equipment	 Small IT equipment
EU recycling target	-	80%	70%	80%	80%	80%	55%	55%
 NL achieved recycling rate (NWR 2023)	73% (80%)	81% (82%)	60% (73%)	100% (91%)	72% (83%)	99% (80%)	66% (75%)	75% (81%)
 BE achieved recycling rate (Recupel 2023)	73% (83%)	78%	74%	90%	79%	68%	67%	66%
 IE achieved recycling rate (Annual reports '23)	82% (80%)	82% (82%)	79% (72%)	83% (83%)	86% (84%)	0% (84%)	72% (68%)	85% (85%)
 PT achieved recycling rate (Annual reports '23)	57% (79%)	78% (81%)	80% (73%)	40% (64%)	48% (82%)	65% (0%)	46% (72%)	50% (85%)
 IT achieved recycling rate	84%	81%	87%	80%	85%	88%	90%	58%
 ES achieved recycling rate	69%	83%	65%	64%	66%	3%	68%	70%

 EU target achieved

Figure 46: Eurostat recycling results per country per WEEE category in 2022 (%)

Effectiveness – Innovation, knowledge sharing and awareness

The countries studied employ varying approaches to innovation, knowledge development, and awareness. Table 6 qualitatively summarizes the extent to which EPR organizations within selected countries are involved in innovation, knowledge development, and awareness within the chain.

Country	Innovation	Knowledge and awareness
Netherlands	High	High
Belgium	High	High
Ireland	High	Medium
Portugal	Medium	High
Italy	Medium	Medium
Spain	Medium	Medium

Table 6: Innovation and knowledge and awareness within EPR systems

Innovation and knowledge development in EPR systems vary significantly between countries. The Netherlands and Belgium score high on innovation and knowledge and awareness. A potential explanation could be that the Netherlands and Belgium both have a single scheme market structure. Investments in public innovation, prevention and awareness are costly and do not yield immediate results. PROs that are competing might be reluctant to pursue such investments as it will most likely increase the producer fee and therefore the risk that P&Is will switch between PROs.

In market models with multiple PROs, innovation and knowledge can provide a competitive edge, encouraging PROs to invest. However, these investments are costly, potentially leading to higher producer contributions and reducing the PRO's economic attractiveness compared to competitors. Moreover, the effects of such investments are not immediately apparent, and investments in public awareness may benefit competitors as much as, or more than, the investing PRO. Our case studies suggest that as EPR systems become more competitive, the high costs, uncertain returns, and long-term nature of investments in innovation and awareness tend to reduce overall investment in these areas.

The Netherlands, Belgium and Ireland score highest on innovation initiatives. In the Netherlands, innovation primarily focuses on improving recycling quality, promoted through contracts with a long-term perspective. This contractual security encourages waste management partners to invest in better machinery and infrastructure, such as Coolrec's plastics machine or equipment for treating solar PV panels. In Belgium, innovation centers on the use of technology to facilitate reporting and optimize treatment processes. The BeWeee Tool, developed in collaboration with waste management partners, has simplified reporting and significantly increased the documentation of previously undocumented waste streams. Belgium has also launched a scanning application that provides product information to determine reusability and appropriate recycling methods. Belgium's pilot to make online platforms responsible for the compliance of the P&Is that sell through them, is an innovative method to tackle free riding by online marketplaces. Ireland's innovation initiatives aim to stimulate a circular economy by extending the lifespan of EEE and offering limited eco-modulation. WEEE Ireland invests in training programs for EEE maintenance, repair, and reuse, and has created a website showcasing best circularity practices across Ireland. Additionally, WEEE Ireland has initiated research into the possibility of adjusting producer contributions based on the recyclability of products that are put on the market, aiming to increase environmentally friendly designs that facilitate repair and recycling.

The Netherlands, Belgium, and Portugal score highest on knowledge and awareness initiatives. The Netherlands primarily invests in awareness through its knowledge platform, circulairkennis.nl, which conducts and publishes research promoting a circular economy. Additional campaigns include social media, radio, and trade media outreach, as well as educational initiatives under the WeCycle brand. Belgium's awareness campaigns focus on special collection and reuse days, targeting children and young adults. This approach is based on the belief that habits formed early persist and that young people can influence older generations' behaviors. Portugal concentrates its awareness campaigns on engaging

various communities in proper handling of e-waste. They mobilize scouts through the Electrão Scouts campaign, engage firemen by setting up collection points at fire stations, and enter collaborations with football clubs and artists, amongst others.

6.2. Efficiency

The producer contribution is an approximation for the societal costs of an EPR system. It represents the total costs needed to cover the collection and treatment activities and the coordination needed to achieve collection and recycling target. In this study we use five metrics to compare performance on efficiency between countries: producer contribution per ton put-on-market (POM), per ton collected, per ton recycled, per ton recovered, and per inhabitant.

Table 47 shows that there are significant differences in producer contributions per ton put on the market (POM), per ton collected, and per ton recycled among the countries studied. The producer contribution per ton POM ranges from at least €59 in Italy to €137 in Ireland.

Belgium and Ireland require higher producer contributions per ton POM, partly due to their EPR system scopes. B2C e-waste management typically incurs higher costs than B2B e-waste management, as B2B waste streams often already have established recycling pathways. Ireland's system covers only B2C waste, resulting in higher producer contributions per ton due to lower overall tonnage (without B2B waste) and a more expensive waste mix (exclusively B2C). Belgium's Recupel manages the entire B2C process but takes a facilitative role for B2B, connecting businesses to recyclers rather than organizing all infrastructure. Unlike other countries where the lower costs of processing B2B waste are used to decrease the overall producer contribution, in Belgium, B2B producers pay only a small administrative fee, causing the producer contributions for B2C waste in Belgium to be higher than in other countries. These factors contribute to the elevated costs in both countries, illustrating how system design impacts producer financial obligations.

Moreover, except for Portugal, countries with low producer contributions per ton POM have a higher total POM. A higher POM causes volume related costs to rise, such as costs for the collection, storage, transport, and recycling of WEEE. However, fixed costs such as those for coordination, innovation, and awareness, don't necessarily increase proportionally. Additionally, a higher POM doesn't always require more collection points if existing ones adequately cover the area and population. Consequently, while volume related costs increase, fixed costs remain relatively stable, reducing the producer contribution per POM in high-POM countries.

With collection rates ranging from 20-50%, the producer contribution per ton collected is typically (more than) double the contribution per ton POM. Italy and Belgium have relatively low producer contributions per ton collected, albeit for different reasons. Belgium achieves a low producer contribution per ton collected despite its high per ton POM contribution, by attaining relatively high collection results. Italy has a low contribution per ton collected despite having low collection rates, due to its relatively low per ton POM producer contributions.

The Netherlands and Portugal have comparatively high producer contributions per ton recycled, but for different reasons. While most countries' producer contributions center around €300 per ton, the Netherlands and Portugal range between €400 to €500. In the Netherlands, the total producer contribution is relatively high for its population, and the recycling results are not sufficient to align the per-ton-recycled contribution with other systems. In Portugal, while the per-inhabitant contribution is the lowest among the case study countries, the low recycling rate results in a high per-ton-recycled contribution.

The producer contribution per inhabitant, as shown in figure 48, is lowest in Portugal and highest in the Netherlands. This may mean that the costs in the Netherlands are higher compared to the other case

studies, because of a robust infrastructure that supports high performance on quality, awareness creation and innovation.

In conclusion, it seems that no country consistently scores the best in both efficiency and effectiveness. The Netherlands scores high in quality, awareness and innovation, but not low in costs. Belgium effectively has a low producer contribution per ton of recycled waste but has higher costs per ton POM. While Portugal has low costs per inhabitant, the costs per ton collected and recycled are high, calling into question the overall efficiency of their system. This analysis emphasizes that each country has its own strengths and challenges in striving for an effective and efficient waste management system.

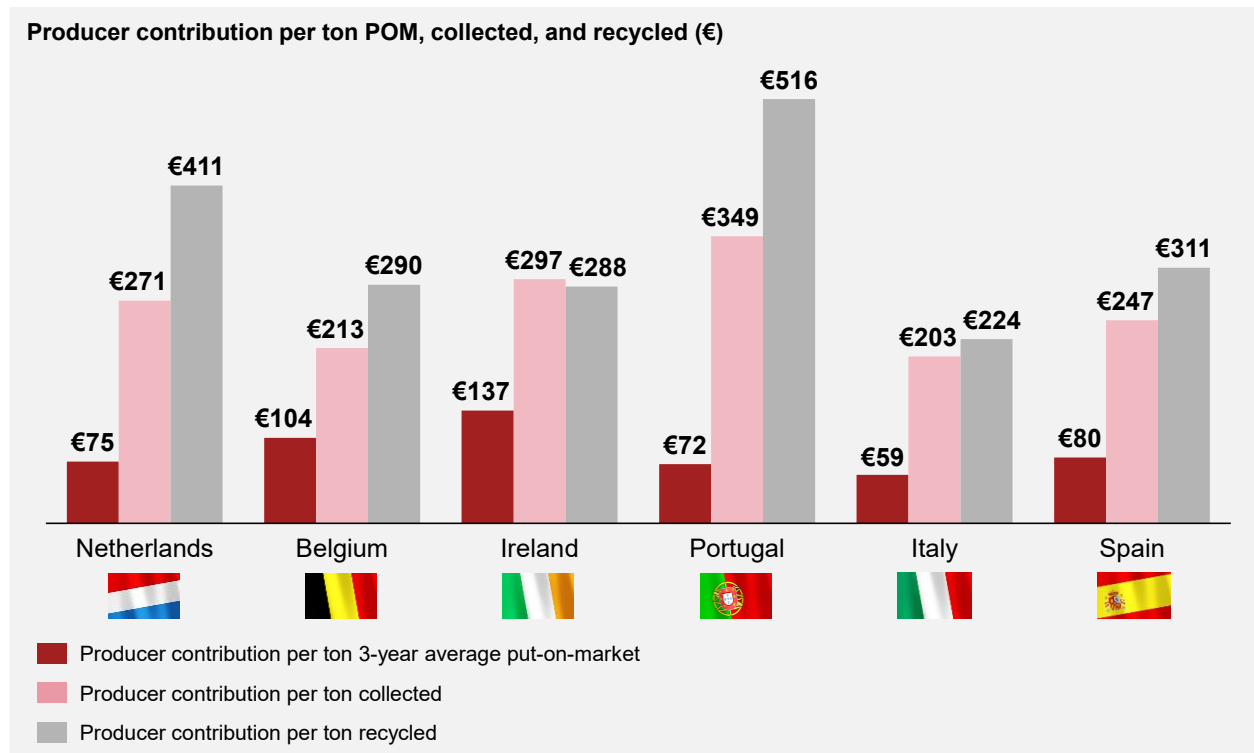


Figure 47: Producer contribution per kt put-on-market, collected and recycled (€/kt)

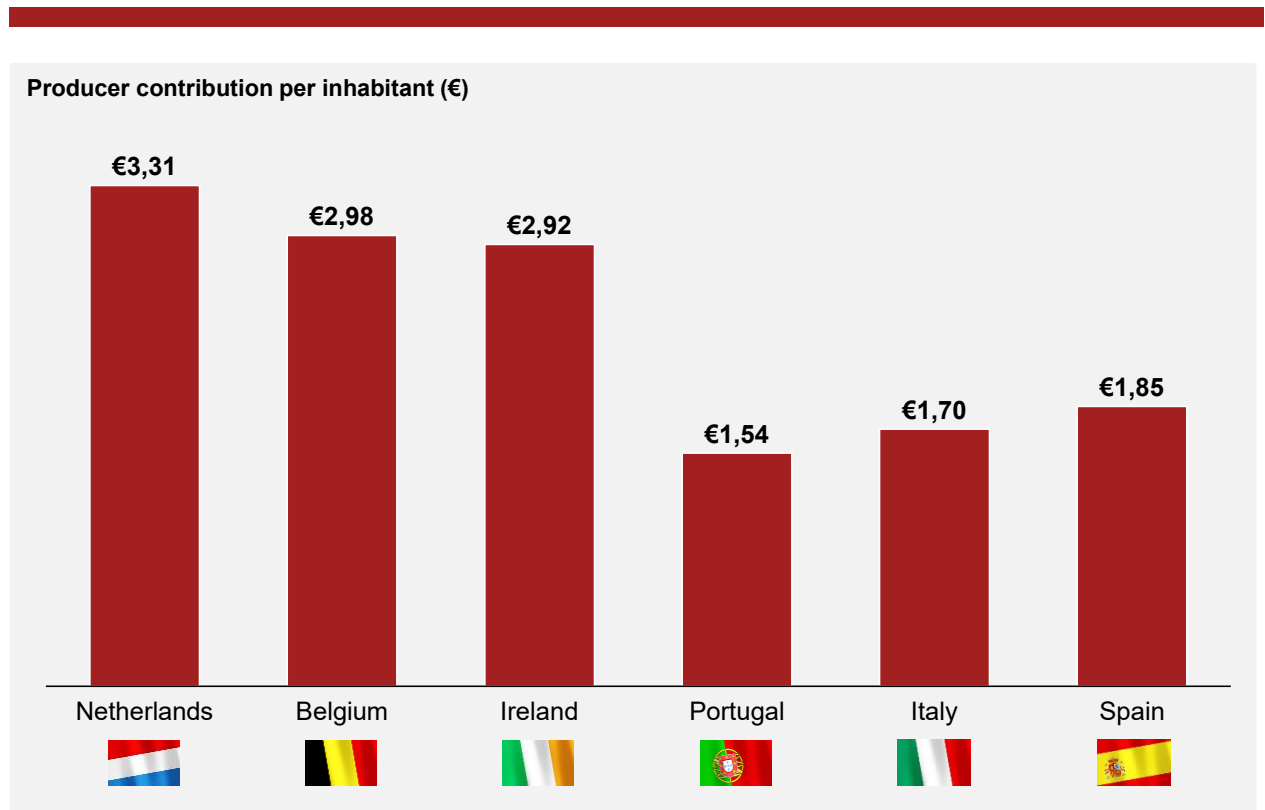


Figure 48: International comparison producer contribution per inhabitant (€/inhabitant)

6.3. Strengths and areas for improvement per country

Comparing case studies of neighboring countries offers valuable insights into the diverse approaches to EPR system design and their relative performance in terms of effectiveness and efficiency. Beyond mere performance metrics, each case study illuminates the unique strengths and challenges inherent in the various systems. This comprehensive analysis provides a broader perspective for comparison and highlights potential lessons that could be applied to enhance the Dutch EPR system. The strengths and challenges of each EPR system, as discussed in detail in the preceding chapters, are concisely summarized in Table 8.

Country	Strengths	Challenges
Netherlands	- Long-term perspective and long-term contracts for innovation in the supply chain (e.g., Coolrec, PV panels) - Incentive scheme to combat parallel streams - Strong emphasis on recycling quality through CENELEC certification - Efficient logistical framework by matching supply chain partners input and output through contractual agreements - Transparent monitoring and data reporting throughout the supply chain, with strict measurement requirements	- Inadequate perspective on legal and illegal export volumes deteriorates collection rate and causes exported WEEE to be recycled at lower standards - Inadequate network for proper collection and treatment of B2B WEEE - Insufficient network to successfully capture the re-use potential of all sub streams of WEEE
Belgium	- Dense collection network of recycling parks and retail points - BeWeee register to decrease undocumented WEEE and increase compliance - Financially robust system, with producer audits, adequate costs allocation through sampling and high level of P&I engagement - High investment in (15-20%) into education and awareness programs - Obligation for online platforms to register volumes to tackle free riding - Uniform municipal collection sites fostering scale advantages	- High level of untraceable volumes and challenge to track exported volumes due to small country size, open borders, and access to international ports (e.g. Antwerp) - Legislative authority over waste management lies with the three regions, which requires alignment to ensure effective county wide waste policy - Understatement of current societal costs of WEEE recycling because of high reserves
Ireland	- Geographic distribution of collection sites to foster collection efficiencies - Financial clearing house to create level playing field for competition - Stimulating environmental & economic efficiencies with eco-modulation (e.g., adjusting the price of products based on recycling costs) - Visible fee that ensures level playing field for consumer products and creates awareness among consumers	- Coexistence of non-profit and for-profit entities in the same market - Competitive push towards non-accredited recyclers to lower costs - Geographical distribution is mathematically determined, not correcting for other factors such as ease of access
Portugal	- Accurate and transparent reporting through end-to-end traceable waste - Door-to-door collection service for collection of large appliances - Large and wide network of collection points (e.g., fire stations, schools) - Pilot scrap metal sector to decrease undocumented WEEE streams and improve recycling quality - Discounts for P&I that open collection points or join public campaigns	- No mandatory handover causes mostly fractions with negative value to enter the EPR system - Large scavenging economy, deteriorating streams (~25% of WEEE in illegal streams) and collection performance - High administrative burden, slowing down new initiatives due to substantial amount of regulation

		Limited number of recycling plants leading to limited levers to lower treatment costs
Italy	- Efficiency bonuses for collection points increase the quality and quantity of WEEE collected - Pilot to obligate online platforms to register volumes to tackle free riding - Fair allocation of collection points through central coordination (CdC) (e.g., based on POM and considering quality of WEEE and accessibility) - Set producer fees within each PRO, ensuring a level playing field for both small and large P&Is - National coordination of campaigns for education and awareness reduces disadvantages associated with organizing them individually	- No mandatory handover after collection results in significant WEEE being treated outside of the system - Strong competition between treatment operators and lack of enforcement of treatment standards allow for WEEE processing at inferior quality - Lack of declaration from non-accredited operators leads to large undocumented streams - Low PRO participation threshold (min share 1%), allows for small PROs that have no or limited funds to invest in improving collection and treatment results
Spain	- Electronic labeling increases the traceability and reporting of WEEE - Clearinghouse helps fairly allocate the municipal collection points amongst PROs based on their market share - Set producer fees within each PRO, ensuring a level playing field for both small and large P&Is	- Too fragmented market puts pressure on prices and poses challenges for an effectively working system and good environmental results - Lower recycling qualities due to competitive push on prices - Large quantities of WEEE handled outside of the system due to financial and administrative incentives, lack of awareness amongst citizens, and scavenging and theft at municipal collection points - Lack of instruments to monitor and penalize the informal sector and illegal exports

Table 7: Strengths and challenges per case study

7. Perspective on EPR market models

Across Europe various Extended Producer Responsibility (EPR) market models exist – single scheme, duopoly, multiple PROs – aiming to enhance collection, recycling, and environmentally responsible disposal of electronic waste. This chapter aims to clarify the desirability, key considerations, and prerequisites of various EPR market models for e-waste, based on case study insights. First, the concept of competition in e-waste is defined, and its applicability within the organization of EPR systems is discussed. We then explore specific considerations and the advantages and disadvantages of a market model with multiple competing PROs versus a centrally coordinated market model, such as the Dutch EPR market model.

7.1. Competition in e-waste

Competition is an important concept within economic theory and is often seen as a driving force behind innovation and efficiency. The idea is that competition encourages companies to work more efficiently, reduce costs, and promote innovation, thereby making higher-quality products and services available to users at lower prices. Key prerequisites for this include the presence of homogeneous products, many producers and users in the market who cannot influence prices, the absence of barriers to entry, no transaction costs, and all players having access to perfect information. The question that remains is to what extent the EPR system itself can be considered a market. The EPR e-waste market arises from a political choice, not from an intrinsic demand for certain products or services to maximize utility. Participation in the market is therefore obligatory. Additionally, there are a limited number of players in the market, information asymmetry exists, and there are substantial barriers to entry (policy goals) and barriers to exit (regulatory obligations), which may prevent the theoretical benefits of competition from being fully realized as they are in other markets.

Irrespective of the EPR market model, competition in the waste market itself is present across the value chain. Across Europe various Extended Producer Responsibility (EPR) market models exist – single scheme (Netherlands, Belgium), duopoly (Portugal, Ireland), multiple PROs (Italy, Spain) – aiming to enhance collection, recycling, and environmentally responsible disposal of electronic waste. Despite differences in the number of PROs in the market, competition plays a critical role in e-waste management. In the Dutch e-waste chain, commercial waste companies compete for the collection, sorting, and processing of e-waste. Waste companies compete for direct contracts with businesses or governments through tendering. Research by the ACM indicates that price is the decisive factor in securing contracts for services such as collection¹⁷⁴. This incentivizes waste companies to operate more efficiently and reduce costs. Figure 49 shows the level of competition among waste companies along the value chain.

Central coordination is essential across all EPR market models as most countries have implemented central coordination entities such as central registers, clearing houses, and entities that allocate collection points. Irrespective of the EPR market model, most countries have implemented a central register, which maintains an up-to-date inventory of all producers and importers, calculates market shares, monitors compliance, and fulfills the EU's data reporting obligations. In countries with multiple PROs, the emergence of clearing houses demonstrates the need for coordination among PROs. These clearing houses typically perform a financial post-calculation function to correct for differences between a PRO's market share and actual volumes collected. In some cases, allocation of collection points among PROs is coordinated by a central entity, as is the case for Italy and Ireland. Additionally, some clearinghouses also perform typical PRO activities such as coordinating awareness campaigns. Besides coordinating entities, coordination between PROs is also evident through legislation. In Italy, legislation

¹⁷⁴ Autoriteit Consument en Markt. (2017). Goedkeuring van de concentratie tussen Shanks en Van Gansewinkel, 16.1044.22. ACM. https://www.acm.nl/sites/default/files/old_publication/publicaties/17020_concentratiebesluit-shanks-vangansewinkel.pdf

establishes minimum requirements for budget allocation to awareness campaigns, to create a level playing field for the 16 PROs in the market.

Within competitive EPR market models, specific system constraints limit the degrees of freedom for PROs to compete. In Ireland (duopoly), price is partially determined through the government approved visible fee and there is no competition on collection since collection sites are geographically allocated. In Portugal, freedom of PROs to set their own price is limited because all PROs must spend the same percentage of the producer contribution on awareness and R&D, and prices must be government approved. In Italy, competition for collection sites is limited since these are geographically determined, and PROs must spend a fixed percentage of their producer contribution on awareness creation.

		 Netherlands	 Belgium	 Ireland	 Portugal	 Italy	 Spain
Characteristics	# PROs	1	1	2	2	16	12
	Coordination	○	○	◐	◐	●	●
	Collection	◐	◐	◐	●	○	○
	Transport	●	●	●	●	●	●
	Sorting	◐	-	-	◐	-	●
	Treatment	●	●	◐	◐	●	●
Additional regulation	Profit / non-profit	Non-profit	Non-profit	Non-profit	Non-profit	Non-profit	Non-profit
	Clearinghouse	None	None	Financial & allocation	Financial	Allocation	Allocation
	Standards for treatment	CENELEC-certified	EN treatment certified	EN treatment certified	Set by APA based on EU regulations	Set by CdC based on EU regulation	In accordance with EU regulation
	Set prices	Calculation method set by government	Approved by 3 regional governments	No	Approved by economic affair policy	No	No
	Visible fee for consumer	No	Yes	Yes	No	No	No
	Regulation on campaigns	No	No	No	Yes	Yes	No

Figure 49: Level of competition and regulation in case study countries

To improve overall efficiency, competition among waste operators is more important than competition among PROs, as around 80% of total EPR costs for the evaluated case studies entails direct costs for contracting collection and treatment of electronic waste. The activities of a PRO can be divided into system management (coordination, compliance, monitoring, innovation and awareness) and operations, as shown in Table 8. Most costs are directly related to contracting collection, sorting and recycling (ca. 75%), whereas a smaller fraction of the costs (ca. 25%) is related to the organizational and administrative functions. Therefore, competition among waste operators is far more important than competition among PROs in improving the overall EPR efficiency.

Activity	Percentage of total costs
System management	25-30%
Operations	70-75%

Table 8: Costs of an EPR system

7.2. Advantages and disadvantages of EPR market models

To evaluate EPR market models two groups of EPR market models are compared. The first group is single schemes such as Netherlands and Belgium, the second group is multiple PROs such as Portugal (2), Ireland (2), Italy (16) and Spain (12).

From the international comparison, no market model consistently outperforms other models in both efficiency and effectiveness. The international comparison of EPR systems reveals a complex interplay between effectiveness and efficiency, with countries seemingly prioritizing either one. The Netherlands and Belgium, both single-scheme EPR systems, and Ireland, a duopoly, collect and recycle more WEEE per inhabitant, have higher recycling rates, and score higher on innovation and/or awareness compared to Portugal (duopoly), Spain (oligopoly), and Italy (oligopoly). On the other hand, the producer contribution per inhabitant is at least 50% lower in Portugal, Spain and Italy, and producer contributions per ton POM, collection, and recycling are also below average.

Literature is also not conclusive on a superior EPR market model. Discussions on EPR market models haven been ongoing since the existence of EPR systems. However, the number of studies that evaluate the performance of different EPR market models are limited in number and are not conclusive. Empirical evidence is even less available. A driving factor might be the limited comparability between countries, driven by limited transparency and data availability, different measuring methods, various EPR scopes and legislation that set out formal obligations per country. See table 9 for outcomes of the literature review.

Study	Most important insights:
OECD (2016), <i>Extended Producer Responsibility Updated Guidance for Efficient Waste Management</i>	"In a competitive environment , PROs and CS take over responsibilities but do not necessarily have the same duties and receive the same penalties in case they fail to reach the assigned targets; this asymmetry possibly generates distortions encourages free riding and makes enforcement more difficult "
Favot et al. (2016), The evolution of the Italian EPR system for the management of household Waste Electrical and Electronic Equipment (WEEE)	"The fees charged per tonne of WEEE collected decreased by almost 43% (2009-2014), while the fees per tonne put on the market (POM) were 134 Euro in 2009 and 104 Euro in 2014. The results prove the theory which states that, competing consortia use the learning effects to reduce the contribution fees for producers rather than to increase the quantity collected. "
Favot et al. (2022), Regulation and competition in the extended producer responsibility models: Results in the WEEE sector in Europe	"Overall, empirical studies do not show a definitive and convincing superiority of competitive models on the efficiency of public service delivery; results differ significantly among countries and may be biased by the lack of consideration of cost determinants, such as quality of service and disposal techniques. " "The most interesting conclusion arising from our study undoubtedly concerns the positive impact of competition. " The impact of competition on efficiency is positive and significant, although not very strong in the end."
Deloitte (2014), <i>Development of Guidance on Extended Producer Responsibility (EPR)</i>	" No single EPR model emerges as the best performing and the most cost-effective " "The best performing schemes are not , in most cases, the most expensive. "
PBL & CPB (2021): <i>Extended Producer Responsibility: Design, Functioning and Effects</i>	"The question under what conditions monopoly PROs are more efficient than competitive ones has not been answered empirically , due to too many differences between cost factors in waste streams and countries"

“Collective EPR systems are more cost-effective than individual systems”

Mallick (2014), Designing and operationalising extended producer responsibility under the EU Green Deal

“There is insufficient empirical evidence to determine the conditions in which a monopolistic PRO is more efficient than competing PROs”

Adelphi (2021): *Analysis of Extended Producer Responsibility Schemes*

“Competition for the access to waste may lead to inefficiencies and higher costs”

Table 9: Historical studies into competition

Central coordination plays a crucial role in enhancing environmental performance, ensuring structural viability, and promoting long-term investments in innovation within the e-waste sector.

The Netherlands and Belgium are two examples of a single scheme EPR market model. Critics mention the lack market pressure in a single as a downside compared to a competitive EPR market model, as the lack of market pressure would eliminate the focus on efficiency, leading to less innovation and higher producer fees. On the contrary, also single scheme market models are exposed to competitive pressure. In the Netherlands for example, the AVV mechanism works to some extent self-disciplinary. The AVV is valid for a period of 5 years. This means that Stichting OPEN has an incentive to perform well, to ensure a solid starting position for the next AVV. Underperformance could allow for new players to be considered.

Central coordination through a single PRO guarantees consistent performance, continuity, and representation of various stakeholder interests. In the Netherlands, producers and industry actively shape the system through board positions, fostering a more collaborative and industry-aligned approach. This contrasts with countries where PROs are owned by waste management companies or investors. The Dutch model fosters strong support from P&Is for Stichting OPEN, as they have a direct say about its operations and decision-making processes. Stakeholder satisfaction is also a strength of the Belgian model, where active collaboration among P&Is, municipalities, retailers, and recyclers foster trust and enhances the system's stability.

Furthermore, single schemes market models provide more effective mechanisms to address free riding. Single scheme market models boast a relatively low incidence of free riders compared to other countries, largely due to its coordinated approach. Since there is only one PRO, P&Is have an incentive to assist the central authority in minimizing free riding. Because the total EPR system costs are distributed across a larger group of P&Is the financial burden per P&I lowers.

Countries with more centralized coordination, such as the Netherlands, Belgium, seem to prioritize quality, awareness creation, and a long-term circularity perspective over costs. These nations achieve higher collection and recycling results, both in terms of kilograms per inhabitant and as a percentage of POM and collection. Additionally, they exhibit stronger performance in awareness and innovation initiatives. Conversely, market models with more PROs such as Portugal, Italy and Spain seem to prioritize costs. These countries boast lower producer costs per inhabitant, collection, and recycling compared to the average of the case study countries. However, lower costs should not be confused with a higher efficiency.

A key advantage of a single scheme market model is that the costs of the collective system can always be passed on to P&Is, maintaining the system's structural viability. This approach is vital for investments that benefit society but may not be immediately profitable. Competitive systems may struggle to make such investments due to the risk of P&Is switching between PROs potentially hindering long-term sustainability initiatives. This is particularly crucial for long-term investments made for societal benefit, which may not be immediately profitable. In contrast, competitive systems without central coordination may struggle to implement higher fees for such investments, as P&Is can easily switch between PROs to avoid increased

costs. When it comes to innovation, the Netherlands for example guarantees a consistent volume and quality of WEEE to recyclers providing the security necessary for substantial long-term investments. An example is Coolrec's recent €0.5 million investment in a state-of-the-art shredding machine capable of producing high-quality secondary raw materials for plastics. Furthermore, the Netherlands is proactively developing infrastructure for recycling solar PV panels, anticipating their entry into the WEEE stream in 25-30 years. In Belgium, Recupel's investment in the BeWeee tool has markedly reduced undocumented WEEE streams, while their scanning app optimizes the process of determining WEEE eligibility for reuse and appropriate treatment. In contrast, countries in which multiple PROs compete, such as Italy and Spain, demonstrate lower performance on innovation and awareness. Italy's legal requirement for PROs to allocate a specific percentage of revenues towards awareness campaigns suggests that such investments might not occur organically. The short-term financial considerations in competitive systems appear to discourage PROs from investing in innovation and knowledge development, despite their potential long-term benefits.

From a broader European perspective, a single scheme market model is better positioned to contribute to EU goals on the recovery of critical raw materials. Such efforts require long-term investments and an aligned approach among member states, which is more feasible under a centralized model.

A single system approach allows for economies of scale in streamlining operations, consistent standards, and more effective resource allocation across the entire WEEE management chain. In the Netherlands, this is exemplified by a seamlessly integrated system where contracts between successive partners in the chain specify precise quality and output requirements, ensuring smooth transitions from one stage to the next. This level of coordination and alignment is achievable due to the unified oversight provided by a single coordinating entity.

Lastly, a single scheme market model entails a single point of contact for the government and places legal obligations on one entity. In the Netherlands, Stichting OPEN can take enforcement actions, relieving the government of this responsibility. At the same time, Stichting OPEN maintains its independence, allowing it to also contribute to perspectives on new policies.

Opening a single scheme market model such as the Dutch system to multiple PROs would increase the complexity of the system. Over the past 25 years, the EPR system for WEEE in the Netherlands has undergone substantial evolution. Initially characterized by multiple PROs, the market gradually consolidated, with existing producer organizations merging into Stichting OPEN. This consolidation created a single PRO to assist P&Is in fulfilling their EPR obligations. This trend towards centralization is not unique to the Netherlands. Across Europe, similar patterns are emerging. For instance, in Belgium, Recupel's seven management organizations, each previously focusing on specific product groups, merged into a single legal entity in 2023.

The consolidation of the Dutch EPR system into a single scheme through Stichting OPEN was driven by several factors. The fragmentation of PRO organizations had led to a disjointed system with inconsistent monitoring practices. In a system where multiple PRO organizations compete primarily on price, quality assurance often suffers, and long-term investments become challenging to justify and implement. In 2018, it was estimated that 50% of WEEE was non-compliantly recycled, incinerated, or illegally exported. The Netherlands had become a major exporter of WEEE, often classified as reuse. Weak enforcement and low fines failed to deter illegal exports, given the profits involved.

Reverting to a multi-PRO system could disrupt the progress made in recent years. Transitioning to a new market model could take years and it could lead to a fragmentation of efforts, inconsistent standards, and a potential race to the bottom in terms of environmental compliance as PROs compete on price rather than quality. It could hamper the ability to make long-term investments in infrastructure and innovation necessary for advancing circular economic goals.

A system with multiple PROs has several disadvantages that can hinder the effectiveness and level playing field of the EPR system. First, competition between PROs can lead to an uneven playing field, with larger companies potentially receiving preferential treatment in terms of service and pricing over smaller P&Is. This disparity can for example manifest in lower producer contribution for larger P&Is, resulting in unequal competition between large and small EEE producers.

Second, fragmentation of monitoring data across multiple PROs hampers transparency and consistency and makes it more challenging to address free-rider issues. Different PROs might use different measurement points or standards, leading to inconsistent data across the system. Fragmented data also makes it more difficult to track which P&Is are evading their responsibilities.

Third, PROs may be hesitant to invest in long-term awareness and prevention initiatives. These investments increase immediate costs but do not yield immediate results, and the benefits of such initiatives will accrue to all PROs, including competitors. The competitive environment creates a short-term focus on cost reduction rather than a long-term focus on sustainability. Additionally, a lack of coordination between PROs can lead to duplicated efforts or gaps in coverage. This underinvestment can slow down progress towards circular economic goals and reduce the overall environmental impact of the EPR system.

Fourth, the competitive push on prices incentivizes the use of non-accredited recyclers to lower costs. The competitive nature of these systems allows Producers and Importers (P&Is) to switch between PROs, with cost often being the primary factor in their decision-making. Many P&Is are companies from the USA, Japan, or South Korea, with limited connection to Europe and, consequently, less incentive to support Europe's resource independence goals as outlined in the WEEE Directive. Moreover, a significant portion of P&Is are importers operating in highly competitive markets with tight margins and limited control over product pricing. This economic pressure further reinforces their focus on cost over environmental performance when selecting PROs. This can lead to reduced quality of recycling processes, increased environmental risks due to substandard handling of hazardous materials, potential for illegal waste exports, and undermining of efforts to establish and maintain high recycling standards.

Finally, the need for central coordination entities, such as clearing houses, to supervise competition creates an additional layer of complexity and cost. PROs must operate more efficiently to offset these expenses, potentially diverting resources from core environmental objectives. The complexity of the system can lead to increased administrative burdens for all stakeholders, and additional costs may be passed on to consumers.

8. Appendix

Stakeholders interviewed by country

Country	Interviewed stakeholders
Netherlands	Stichting OPEN
Belgium	Recupel
Ireland	WEEE Ireland
Portugal	Electrão
Italy	Erion
Spain	Ecotic

Table 10: Interview list

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About this report

Our scope



This study primarily focuses on the performance of EPR-organizations regarding effectiveness (the extent to which the efforts of the entity contribute to the intended objectives) and efficiency (the extent to which objectives are achieved at the lowest possible cost). Evaluation of waste policy for e-waste is not part of the scope of this study.

In the report, the EPR system in the Netherlands is compared with EPR systems in other countries. In this comparison, particular attention was paid to, but not exclusively, Belgium, Ireland, Portugal, Italy, and Spain.

The research had a lead time of approximately 10 weeks. Therefore, the study focused on the key insights and providing a perspective on competition among EPR organizations and best practices from abroad. Consequently, this report cannot be seen as a comprehensive overview.

Availability and quality of information



Our research concluded on May 6, 2025. In our research, we used, among others, the following sources:

- Publicly available information regarding European and national policies on e-waste recycling
- Monitoring reports from EPR-organizations for the Netherlands, Belgium, Ireland, Portugal, Italy, and Spain
- Comparative studies on the effectiveness and efficiency of EPR organizations

These documents are, for example, issued by European institutions, Dutch policymakers and regulators, and knowledge organizations at national and international levels.

For this report, interviews were conducted with various organizations to obtain a wide range of perspectives. The interviewed organizations are: Stichting OPEN, Recupel, WEEE Ireland, Electrão, Erion and Ecotic.

We have not conducted quality control or other activities on the obtained information and insights from the interviews that constitute a due diligence.

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