

Bending Toward Circular:

Using Extended Producer Responsibility Schemes to Transition to Appliance Circular Economy

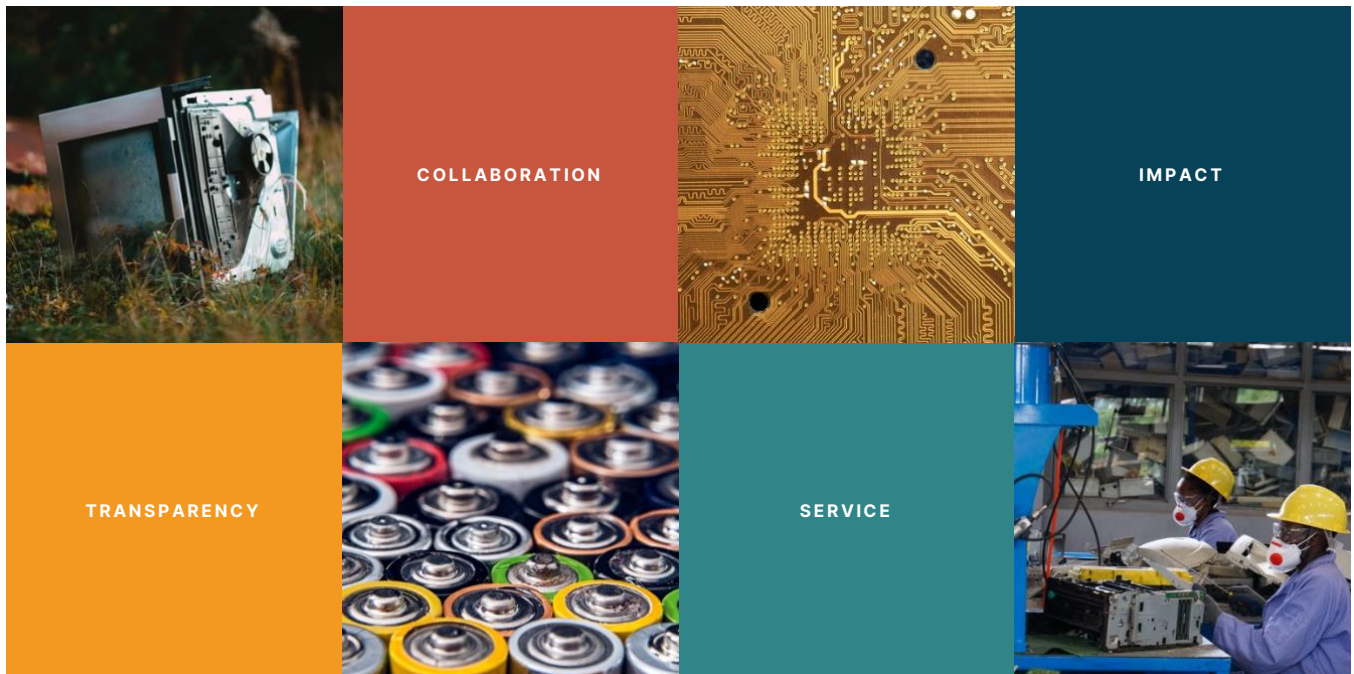
DEFINITIONS, COMPONENTS, AND CASE STUDIES 1 SEPTEMBER 2022

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Executive Summary

This work investigates how circularity can be applied to the end-of-life (EOL) management of electrical and electronic waste (e-waste).

In this report, EOL is defined as *“the point in time when the product reaches its end of life for one user.”* This research reviews EOL options with strategies to increase circularity through Extended Producer Responsibility (EPR) schemes. EPR schemes are policy approaches where “the producer’s responsibility for a product is extended to the post-consumer stage of a product’s life cycle.”*

EPR schemes are an opportunity to support the transition to circularity within linear economic models and are being implemented in various contexts. In particular, this research uses EPR schemes as a policy approach to address challenges that CLASP can be applicable to various developing contexts.[†] These include:

- **Lack of a national CE policy framework and the integration of e-waste management within CE framework:** Policymakers are starting to develop policy frameworks[‡] to embrace circular economy and e-waste management, but more needs to be done.
- **Lack of awareness by local stakeholders:** Participants in the local economy lack enough understanding of the circular economy concept as well as its implementation for it to gain traction in the current linear economic system.
- **Lack of a stakeholder network:** Different stakeholders across the whole life cycle of appliances are involved, but they often operate in silos.
- **Lack of infrastructure and technical capacity:** In Thailand, as in many developing countries, limited capacity exists for treating hazardous waste. This is often coupled with a lack of infrastructure that allows e-waste to be treated appropriately.

Through the review of various reports, policies, and papers, this work identifies in a simple and succinct manner key implementation options and components that should be taken into account when developing an EPR scheme for appliances.

While this research offers an overview of options for EPR implementation, it can also serve as a foundation for other work, such as investigating if and how EPR schemes could be used as a means to integrate the informal sector’s capacity and stakeholder network into a successful circular EOL model.

* OECD EPR schemes’ definition available at <https://www.oecd.org/env/tools-evaluation/extendedproducerresponsibility.htm>

[†] For example, CLASP conducted research in Thailand and interviewed stakeholders about challenges to transition to appliance circularity

[‡] [Case Study 2, Annex 1.](#)



Background and Introduction

1.1. E-WASTE AND EOL: DEFINITIONS AND STAKEHOLDERS

Electrical and Electronic Equipment (EEE) includes a wide range of products with circuitry or electrical components with a power or battery supply.¹ According to the United Nations University's *Guidelines on Classifications, Reporting and Indicators*, EEE products can be categorized into six product groups: temperature exchange equipment, screens and monitors, lamps, large equipment, small equipment, and small IT and telecommunication equipment. EEE becomes e-waste once it has been discarded without the intent of reuse.²

According to Global E-waste Monitor data, in 2019, the world generated 53.6 million metric tons (Mt) of e-waste, and only 17.4% of this was officially documented as properly collected and recycled.³ In the European Union, e-waste is the largest growing kind of waste, and only 40% of e-waste is recycled, although this varies greatly among member states.⁴

E-waste is a double-edged sword. Each type of material that composes e-waste has unique considerations for disposal and recycling. Improper handling poses a human health hazard and results in pollution and degeneration of the environment, as well as loss of valuable resources. The opposite is true if e-waste is properly managed. This results in recovery of valuable resources, protection of natural resources through reduced mining of virgin resources, and reduction of environmental pollution and human health hazards.

At the international level, conventions are addressing, regulating, and defining e-waste, testifying that this is a matter of global concern. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted in 1989 following the discovery of hazardous waste dumped in African and in other developing countries. Since 2002, the Convention is the main global instrument to collaboratively guide environmentally sound management of e-waste, prevent illegal trafficking and dumping it to developing countries, and support capacity building.

Although the Basel Convention is focused on transboundary hazardous waste movement, and therefore its scope is not directly applicable to this work, it provides definitions of waste and non-waste that are relevant to this report. In particular, according to Technical Guidelines developed in 2019,⁵ *“used equipment is **waste** in a country if it is defined as or considered to be waste under the provisions of that country’s national legislation.”* In addition, equipment should not be considered waste *“when it is not destined for any of the operations [...] [of recovery or disposal] and it is destined for direct reuse, or extended use by the original owner for the purpose for which it was originally intended.”*

In the European Union, Directive 2008/98/EC⁶ defines waste *“any substance or object which the holder discards or intends or is required to discard.”* Also, according to Directive 2012/19/EU,⁷ **waste electric and electronic equipment (WEEE Directive)**, *“[...] means electrical or electronic*

equipment which is waste [...], including all components, sub-assemblies and consumables which are part of the product at the time of discarding.

In this report, we define **EOL** as “the point in time when the product reaches the end of its life cycle for one user.” In particular, this research integrates EOL management strategies to increase circularity.

A wide variety of stakeholders play prominent roles in promoting the transition to CE. Table 1 provides a list of stakeholders involved in CE for EEE products, categorized based on their role in the product supply and value chain. Subsequent sections provide more information on their roles. In this paper, “implementing stakeholders” refers to stakeholders involved in the administration and execution of the EPR scheme, which can vary depending on the scheme’s structure.

TABLE 1: STAKEHOLDERS INVOLVED IN EOL MANAGEMENT

CATEGORIES	STAKEHOLDER EXAMPLES	SECTOR TYPE
Production	Original equipment manufacturers; brand manufacturers and importers*	Formal
Policy & implementation	Regulators and implementers (provincial and local administrative authorities); electricity regulators	Formal
Sale	Wholesalers; retailers; distributors; local shops (e.g., secondhand or “junk” shops)	Formal or Informal (if appliance sold as one unit)
Use	Consumers (residential and commercial); public sector	N/A
Repair	Service staff trained by manufacturers from repair shops or other technicians;	Formal and Informal
EOL Transport†	Collectors (formal and informal collectors); manufacturers or related staff‡	Formal and Informal
Refurbishing	Refurbishers	Formal and Informal
Disassembly	Disassemblers; scrap resellers; national or international stakeholders could be involved§	Formal and Informal
Recycling	Formal recyclers, informal sector, refurbishers	Formal and Informal
Context influencers	Civil society; academia; advocacy groups; funders; press; media	N/A

* Importers may be classified as producers in the sense that by importing and selling the product, they must follow the same requirements as producers.

† Transport of e-waste at their end of life from the final user to the collection point and from the collection point to the recycling or disposal site.

‡ If an EPR scheme is in place, manufacturers might be responsible for collecting end-of-life products.

§ For example, in Thailand, circuit boards cannot be handled directly and are sold abroad.

1.2. FROM LINEAR TO CIRCULAR ECONOMY MODELS

According to the Ellen MacArthur Foundation, circular economy efforts aim to eliminate waste, extend the useful life of products, and regenerate natural systems.⁸ Transitioning from a linear economic model to a circular economic model requires that a product lifecycle move away from the take-use-dispose approach typical of a linear model⁹ and toward one that is restorative and regenerative to the environment and nature.¹⁰ This transition requires changes to how our production and consumption systems are conceived, going beyond resource efficiency and recycling waste.¹¹ According to the European Environmental Agency, linear and circular economy systems have different mechanisms to interpret the way products are perceived from a business, consumer, and policy perspective (Table 2).¹²

TABLE 2: KEY MECHANISMS SHAPING THE ROLE OF PRODUCTS IN A LINEAR AND A CIRCULAR ECONOMY*

PERSPECTIVE	EOL IN LINEAR ECONOMY MODEL	EOL IN CIRCULAR ECONOMY MODEL
Business	Businesses tend to disregard EOL phase; no economic incentive for product life extension, reuse, or remanufacturing, as they counteract most linear business models.	Internal incentive to incorporate EOL phase because products are assets. Minimizing life cycle costs is an implicit incentive for a company, prompting efforts to find the best economic equilibrium between reusing, repairing, remanufacturing, and recycling products.
Consumer	Low/no residual value of EOL products. Broken or obsolete products are considered a burden, to be disposed of as cheaply as possible (e.g., through secondhand market, storing at home, through regulated waste disposal systems, illegal incineration, or dumping).	End-of-use incentives are incorporated, including returning products (as services) to the provider after use, avoiding stocks of obsolete products in households, or illegal dumping.
Government	Action is only prompted by health or environmental concerns without inherent incentive for regulation of EOL products. As waste-related health or environmental concerns arise, regulatory action is taken to minimize negative impacts.	Governments facilitate EOL management. For example, EPR rules create incentives for companies to internalize EOL management. Governments provide basic infrastructure and fiscal measures to support reverse logistics.


The “three Rs”—reduce, reuse, recycle—have become globally well-known strategies to lower the environmental impact of products, with a focus on consumer responsibility. Within circular economy models, additional “Rs” are identified to reflect the broader array of strategies available over the course of a product’s life cycle, incorporating government and business responsibilities.


* Extracted and elaborated from EEA Report No 6/2017 Circular by design Products in the circular economy.

https://circulareconomy.europa.eu/platform/sites/default/files/circular_by_design_-_products_in_the_circular_economy.pdf

Table 3 reports the 9R model introduced by PBL Netherlands Environmental Assessment Agency (NEEA).¹³ According to NEEA, earlier stages in a product's life cycle (smaller "R" numbers at the top of the table) present the most opportunity to advance circular economy efforts. EOL considerations are at the bottom of the table and relate more closely to a linear economy. There is a particular focus on extending the useful lifespan of a product and its parts including "reuse," "repair," and "remanufacture" (R3, R4, R6 in Table 2) strategies. Each of the stakeholder groups in Table 1 has a crucial role to play in facilitating the circular economy transition along this spectrum.

TABLE 3: EPR MODEL ADAPTED FROM J. KIRCHHERR ET AL. (2017, P. 224) AND POTTING ET AL. (2017, P.5)

 <p>Circular economy</p> <p>Increasing circularity</p> <p>Linear economy</p>	Smarter product use and manufacture	R0 Refuse	Make product redundant by abandoning its function or by offering the same function with a radically different product
		R1 Rethink	Make product use more intensive (e.g., by sharing product)
		R2 Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources and materials
	Product in use		
	Extend lifespan of product and its parts	R3 Reuse	Reuse by another consumer of discarded product which is still in good condition and fulfils its original function
		R4 Repair	Repair and maintenance of defective product so it can be used with its original function
		R5 Refurbish	Restore an old product and bring it up to date
		R6 Remanufacture	Use parts of discarded product in a new product with the same function
		R7 Repurpose	Use parts of discarded product in a new product with a different function
	EOL (parts or product)	R8 Recycle	Process materials to obtain the same (high grade) or lower (low grade) quality
		R9 Recover	Incineration of material with energy recovery



EPR Schemes as a Policy Approach to Circularity Transition

The need for WEEE disposal would be eliminated within a perfect circular economy model. However, a perfect model does not exist yet. This research investigates EPR schemes as a policy approach that can favor the transition to a circular model from a linear economic model. EPR schemes have been widely introduced in various countries, and they are continuously being revised and improved.*

EPR schemes can cover some of the “Rs” of a product’s life cycle (e.g., recycle and refurbish) and are an opportunity for increasing material and energy recovery from waste streams. They often represent an additional cost for the manufacturer, so EPR schemes can also incentivize producers to design less resource-intensive products, which last longer and are easier to repair and recycle. This, however, is not necessarily a direct or mandated consequence of EPR schemes. Nonetheless, initiatives from municipalities and Producer Responsibility Organizations (PROs) can create incentives for promoting reuse and repair of appliances.^{†,‡}

The following sections provide an overview of EPR schemes, including a definition and their possible structure and scope. Case studies are referenced, where possible, to exemplify how different economies have approached implementation. All case studies are provided in [Annex 1: EPR Scheme Case Studies](#).

1.3. WHAT ARE EPR SCHEMES?

EPR schemes are policy approaches that apply the “Polluter Pays Principle,” first introduced by the Organization for Economic Co-operation and Development (OECD) in 1972. This principle states that polluters should bear the responsibility for end-of-life management, compliant with control measures introduced by public authorities to prevent harm to human health and the environment.¹⁴ In EPR schemes, the producer’s responsibility for reducing environmental impact is extended across the whole life cycle of the product, from upstream activities including selection of materials and production/manufacturing processes to downstream activities including use and EOL.[§]

At the beginning of a product’s life cycle, EPR schemes incentivize producers to design products to be less resource-intensive, have a longer useful life, and be easier to repair, repurpose, and eventually recycle. Producers can take responsibility in the form of legal liability (for the

* As an example, the European Union introduced EPR schemes through the European Waste Electrical and Electronic Equipment (WEEE) directive. However, various challenges for harmonized implementation and achieving targets exist. Improving the system is a priority for the European Commission and the member States.

† PROs serve as intermediaries to support EPR schemes compliance. For more information see section on EPR schemes’ features.

‡ For more information Dalhammar, C., Wihlborg, E., Milios, L. et al. Enabling Reuse in Extended Producer Responsibility Schemes for White Goods: Legal and Organisational Conditions for Connecting Resource Flows and Actors. *Circ.Econ.Sust.* 1, 671–695 (2021). <https://doi.org/10.1007/s43615-021-00053-w> <https://link.springer.com/article/10.1007/s43615-021-00053-w>

§ For more information <https://www.eprclub.eu/about-epr-club/what-is-epr/>

environmental damage caused by the product), economic responsibility (by paying for the costs associated with collection, disposal, and recycling), informative responsibility (by sharing information about environmental properties of products), and improved design.*¹⁵ However, despite most emphasis being placed on the producer, all actors along the value chain, including national authorities, consumers, recyclers, and the informal sector (see Table 1), play a role in ensuring the success of EPR schemes.¹⁶

1.4. EPR FEATURES AND SCOPE

EPR schemes can vary substantially in their features and scope, depending on the stakeholder that establishes the EPR scheme, the priorities of the stakeholder, and the geography of where the scheme will be implemented.

EPR schemes may present different features, including:

- **Can be established by government or private sector entities.** Governments may use them to support specific policy goals. For example, in the EU, EPR schemes are used as means to achieve the WEEE Directive targets ([Case Study 2, Annex 1](#)). Private sector stakeholders may find them convenient to reduce their costs by reusing or recycling the material from collected products.
- **Can be either voluntary or mandatory.** Schemes may begin as voluntary and transition to mandatory requirements after a de facto “grace period” where producers are given time to set up their systems to comply with new requirements. However, mandatory schemes may be preferred as more effective means to achieve set targets.
- **Can entail individual or collective responsibility.** Mandated EPR schemes entail an obligation for individual producers to take responsibility for the impacts of their products. However, in practice, producers often exert this responsibility collectively in the form of Producer Responsibility Organizations (PROs) to implement the EPR principle on behalf of all member companies. This can take form as one PRO with multiple members, or multiple PROs within the same EPR system that cover specific products under a similar umbrella. PROs are common in the EU but are also widely used for e-waste management in India ([Case Study 5, Annex 1](#)).
- **Should define collection, sorting, recycling, and recovery targets,** which are used to assess the overall success of the scheme. General objectives may be set depending on desired outcomes, but specific stakeholder objectives such as targets should be measurable and verifiable.

* The Concepts of Extended Producer Responsibility and Product Stewardship available at <https://ilsr.org/the-concepts-of-extended-producer-responsibility-and-product-stewardship/>

EPR schemes can also vary in terms of their scope, including:¹⁷

- **Definitions of products and material types covered and excluded** under the scheme, including any synergies with other waste streams. There may be differentiation between one product with different end uses.
- **Definitions of producer and importer types covered and excluded** under the scheme, including at what point a producer or importer falls under the definition of a company obliged to comply with EPR requirements (e.g., when a product is produced, sold, and/or disposed of in the domestic market).

However, EPR schemes may be designed in stages to grow in scope as capacity increases. EPR schemes can be initially limited by existing infrastructure and revised at a later stage. See [EPR scheme revision section](#) below.

PRIORITIZING PRODUCTS FOR EPR SCHEMES

A country's unique economic, social, and political landscape significantly impacts the feasibility of implementing circular-economy-oriented schemes for different products and therefore the scheme's scope. Determining which product(s) should be targeted may involve:

- **Conducting an EOL management needs assessment**, including stakeholder consultations, to better understand what additional infrastructure and support would be required as well as the feasibility to introduce an EPR scheme ([Case Study 8, Annex 1](#)).
- **Conducting an impact assessment**, including market research and/or a cost-benefit analysis, to assess the scheme's risks, benefits, and feasibility. This is key to prioritizing products based on environmental and economic impact when establishing the scheme's scope.
- **Starting with one pilot product** and expanding to cover additional products over time. Pre-determined time intervals can be set to scale the program coverage.

Factors that may influence the assessment of EPR schemes may include:

- **The goals of the implementing entities** – Is the priority human health and safety, marketing, environmental protection, emissions reductions, economic competitiveness and resilience, or another goal? Under government schemes, priorities are influenced by the mandate of the operating agency (e.g., a program under a Ministry of Economy vs. Ministry of Environment).
- **Product components/materials and their related environmental impact and economic value** – Are they directly or indirectly hazardous? How recoverable are they? How durable, recyclable, & reusable are they? How valuable are they? For example, metal recovery provides the highest economic reward, but capacity to handle it varies across countries. Policymakers may assess the country's ability to recover different components and determine their relative economic

value. This assessment is also linked to the type of fee associated with the product (See EPR scheme financing section below).

- **Product ownership and trends** – How many products are owned/in use? Is ownership expected to increase? More products on the market would increase the relative product impact.
- **Design improvement potential** – How much opportunity/flexibility is there to improve product design? Incentives for manufacturers to improve product circularity in the design phase will only work if those improvements are feasible. Otherwise, the EPR scheme may only incentivize investments in EOL disposal management, which does not serve to “close the loop.”
- **Product lifetime and extension potential** – What is the product’s average useful and functional lifespan? Extending the useful life phase can reduce emissions from new production. This is key for developing countries where most of the electronics manufacturing take place.¹⁸
- **Product market** – Are the components, materials, and/or units produced locally, imported, or exported? Are the rates of production/import/export expected to increase? This impacts the logistics around what producers can take responsibility for as well as their incentives to do so. If the local market is expected to expand, it can be an opportunity to proactively set up infrastructure to accommodate the anticipated influx of e-waste.
- **Emissions reduction potential** – What emissions are associated with the product life cycle (Table 4)? Which stages of the life cycle contribute most to emissions?

A 2016 CLASP report¹⁹ on emissions reductions from circular economy-related efforts includes life cycle assessments (LCA) of representative units for electric motors, air conditioners, dishwashers, and televisions in the EU (Table 4). Using this LCA as an example, if an agency’s priority was reducing emissions and they were looking to implement a scheme focused on EOL, air conditioners would be appealing. See [Case Study 10, Annex 1](#) on Thailand ACs.

TABLE 4: LIFE CYCLE ASSESSMENT FOR 2020 SALES

<i>units: kt CO₂-eq.</i>	MATERIALS	PRODUCTION	USE	EOL	TOTAL / UNIT
ELECTRIC MOTORS	315	59	22,603	21	22,998
AIR CONDITIONER	154	100	3,622	306	4,181
DISHWASHER	140	13	1,700	6	1,859
TELEVISIONS	241	106	187	3	537

1.5. EPR SCHEME OPERATING MODELS AND FINANCING

EPR schemes need to be financially sustainable to operate effectively. Establishing a fee structure and an operating model helps define the roles and responsibilities of implementing stakeholders.

FEE STRUCTURE

For EPRs to be implemented, stakeholders must pay fees based on the products placed on the market. Different methodologies can be used to calculate these fees. According to OECD, fees can be: ²⁰

- **Basic modulated fees:** These fees are paid based on the number of products or on the weight of the product. For example, 1 mobile phone equals 1 unit so the fee for all mobile phones is the same regardless of design aspects. These fees can vary among countries as they are linked to operational costs for collection and treatment.
- **Advanced modulated fees:** Advanced modulated fees are fees based on a specific set of product characteristics. In this case, 1 mobile phone fee is based on its durability, reparability, reusability and recyclability and the presence of hazardous substances. This is consistent with the approach the EU is taking under the EU Waste Framework Directive (WFD) (2018/851).*

When establishing a new EPR scheme, it is advisable to begin with a basic fee modulation to reduce complexity in initial implementation.

FINANCIAL RESPONSIBILITY AND OPERATING MODELS

In addition to the type of fees, EPR schemes may vary depending on who bears the costs for financing the EPR scheme (the fees) as well as who takes charge of the various operating needs. These might result in various EPR models, such as:

- **Producers bear the full financial responsibility of the EPR scheme,** but operation responsibilities are shared across stakeholders.
- **Responsibility is shared with government agencies.** Producers may pay fees to the municipalities, who remain in charge of waste management (usually collection), while recycling is outsourced to specialist contractors. In Denmark, both the producer and municipalities have responsibilities in the EOL management of WEEE, but municipalities are responsible for collecting and sorting waste.
- **Consumers bear the whole or part of the financial responsibility, but operation responsibilities are shared across stakeholders.**

* For more information see <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32018L0851>.

- In Switzerland, an advance recycling fee paid by consumers supports all operations (subsidizing recovery, transportation, processing) ([Case Study 9 Annex 1](#)). In China, responsibility is also on consumers ([Case Study 1, Annex 1](#)).
- Japan has a consumer-paid EPR system where consumers pay an additional fee to cover the EOL transportation, refurbishment, and recycling of WEEE, but producers implement the refurbishment and recycling. Retailers pay for the WEEE recovery and transportation, and importers are responsible for recovering the products sold. ([Case Study 6, Annex 1](#)).

More information on how fees can be used in EPR schemes is provided under the “EPR Instruments” Section.

OTHER FACTORS IN EPR SCHEME DEVELOPMENT

In addition to operating models, stakeholders developing EPR schemes should also consider means to implement EPR schemes and ensure to include budget dedicated to these key activities:

- **Education and awareness raising** (e.g., raising awareness about the EPR scheme and/or encouraging specific consumer behaviors such as sorting waste)
- **Human and infrastructure capacity building** (e.g., knowledge; skills of operators involved; infrastructure for safe disposal of refrigerants, [Case Study 10, Annex 1](#)).
- **The definition and implementation of an EPR compliance activities** (e.g., ensuring the PROs meet their targets, producers pay required fees, stakeholders comply with relevant laws and regulations).

1.6. MEANS TO ACHIEVE EPR SCHEME OBJECTIVES

EPR INSTRUMENTS

Various instruments can be introduced to support the EPR scheme’s operating models described in the section above. These instruments can combine different elements for maximum impact with a broad range of stakeholders.²¹ According to the OECD, these can be divided into four types:²²

- **Product take-back requirements (used by the majority of EPR schemes)** where producers are responsible for taking back their products from consumers when they reach their EOL and for their EOL management. These include voluntary or mandatory collection targets for specific products and materials. Reuse, recycling, and recovery targets are normally used alongside higher-level targets.
- **Economic and market-based instruments** which support producers and incentivize them to implement the EPR scheme through:
 - **Deposit refund systems (DRS)**, where the consumer makes an initial payment at the moment of purchase that is fully or partially refundable once the product is returned.
 - **Advance disposal or recycling fees (ADF – ARF)**, in which non-refundable fees are built into the price of products at the point of purchase and based on the estimated cost of collection

and treatment. These are intended to be used to finance EOL management of the products in question. ([Case Study 9, Annex 1](#)).

- **Regulations and performance standards** including technical standards, landfill bans, and mandatory recycling rates.
- **Information-based instruments**, which aim to indirectly support EPR programs by raising public awareness as explained under the “Education and Awareness Raising” Section.

CAPACITY BUILDING

Successful EPR scheme implementation often requires capacity building of all stakeholders to enhance and sustain multi-sectoral expertise around fundamental EPR topics. This would entail bridging skill gaps identified across different stakeholders and developing resources and making them accessible.

- **Assess EPR needs by engaging stakeholders.** Stakeholder mapping and engagement is foundational for buy-in and success of any recommended interventions.
- **Develop/formulate a capacity development strategy** based on findings from the needs assessment and stakeholder engagement. The strategy should identify key objectives as well and measurable progress indicators.
- Based on these findings, capacity building interventions can be developed in such a way to:
 - **Target individual groups of stakeholders** (e.g., producers). This strategy could include institutional capacity building activities that help national authorities identify and develop policies and procedures, organizational capacity and leadership, operational frameworks (e.g., finance and funding, communication, and infrastructural requirement, etc.).
 - **Encourage cross-sectional collaboration and cooperation among stakeholders.** For example, standardization of service technician training could be accomplished through skill certification managed collaboratively by state agencies, education institutions, and private sector training programs^{*,23} ([Case Study 3, Annex 1](#)).
 - **Involve the informal sector as a key stakeholder for the creation of inclusive EPR programs.** The informal sector plays a significant role in WEEE management and participates in activities like collection and dismantling, particularly in low- and middle-income countries. Informal sector engagement can include trainings, workshops with medical teams, and awareness-raising campaigns to help explain the consequences of unsafe practices to workers in the informal sector²⁴ ([Case Study 7, Annex 1](#)).
- **Capacity building efforts should focus on identified needs**, such as building the social capital through knowledge creation and transfer programs, enhancements in the physical infrastructure, private sector partnerships, etc.

^{*} With the RAC servicing sector accounting for over 40% hydrochlorofluorocarbon (HCFC) use in India, the goal of curricula standardization is to ensure all training programs incorporate topics that address changes anticipated for the HFC phasedown in India.

- A training program for technicians could include handbooks providing practical information that can be applied on a day-to-day basis during installation and servicing of air conditioners, such as the 2013 handbook for residential air conditioner (RAC) technicians prepared by GIZ under their ProKlima program²⁵ ([Case Study 4, Annex 1](#)).
- **Evaluation of capacity building activities.** Encourage objective reviews based on the set goals and indicators to ensure quality and comprehensiveness of the capacity development effort and make further evidence-based decisions.

EDUCATION AND AWARENESS RAISING

Alongside policy and economic instruments, EPR schemes necessitate investment in education and awareness raising activities for implementing stakeholders and consumers. Table 5 outlines methods and channels for raising awareness.

Education and awareness raising activities may focus on:

- **Securing buy-in from implementing stakeholders** to make the EPR scheme a priority. If the EPR scheme is perceived as a box-checking exercise in corporate social responsibility, it may be difficult for staff to prioritize implementation activities.
- **Securing buy-in from consumers** to participate in the EPR scheme. Positive consumer engagement incentivizes government entities to recognize the importance of and prioritize EPR activities. In the case of a voluntary scheme, this can help build the argument for a mandatory scheme.
- **Developing an understanding of the EPR scheme** and its importance across implementing stakeholders and consumers. This may include providing information on the importance of separating e-waste from other waste during collection.
- **Awareness about the landscape** of relevant roles, responsibilities, programs, and relationships across implementing stakeholders. Even in the case of mandatory schemes, this helps increase consistency in implementation.

TABLE 5: METHODS AND CHANNELS FOR RAISING AWARENESS

METHODS	CHANNELS	EXAMPLES	AUDIENCE	EST. COST
Traditional advertising	Radio; newspapers; TV; billboards; online ads; cinema spots	Vermont Department of Environmental Conservation's Hazardous Waste 30-Second Radio Ad	Older audiences; consumers; retailers	Medium
Direct outreach	Public consultations; door-to-door canvassing;	Singapore Ministry of Sustainability and the Environment (formerly	Consumers; specific	High

METHODS	CHANNELS	EXAMPLES	AUDIENCE	EST. COST
	informational leaflet distribution; exhibitions; events	MEWR) Public Consultation on Sustainability Daikin L∞p Refrigerant Program Brochure eCYCLE DC Running List of E-Waste Collection Events	geographic areas	
Online tools	Online calculators; websites; mobile apps; product comparison features	ALBA E-waste Smart Recycling Map of E-Waste Collection Points Daikin L∞p Refrigerant Program Site iPhone app Justdispose SUEZ & Anthesis Group Resources and Waste Policy Impact Calculator	Consumers	High
Online engagement	Newsletters; social media; interactive activities and videos	European Recycling Platform's YouTube Video What is Extended Producer Responsibility? The Circular Economy Network's Twitter account and sample EPR post Call2Recycle's #NationalBatteryDay Social Media Campaign	Younger audiences; consumers; retailers	Low
Product labeling	On physical products or product packaging; online labeling	See Annex 2 CLASP Brief on Communicating Circular Economy through Labeling	Consumers; retailers	High
Knowledge sharing	International/regional knowledge exchanges; conferences; facilitating NGOs	Circle Lab Knowledge Hub European Circular Economy Stakeholder Platform	Government; regulators; implementing authorities	Low

Considerations for facilitating education and awareness raising activities include:

- **A single entity should coordinate, if not execute, all activities** to ensure a cohesive plan and accountability for intended outcomes.
- **Harmonized policies across local governments and other countries in the region** can make it easier for stakeholders to comply with consistent requirements and help ensure consumers do not receive conflicting messages.
- **Providing opportunities to share constructive feedback** can help identify challenges that need to be addressed in future iterations of education campaigns.
- **Defining and communicating roles and responsibility clearly** to implementing stakeholders can avoid exacerbating confusion for consumers. While these should be clearly outlined in

regulatory and private sector policy documents, targeted communications efforts can help ensure they are widely understood.

- **Guidelines for interpreting regulations** can help identify tangible implementation strategies for implementing stakeholders.

Successful EPR schemes depend on consumer engagement. However, consumers can be overwhelmed by demands to change their behavior. In addition to general fatigue from calls to action, stakeholders setting up an EPR scheme may need to consider these barriers to changing consumer behavior:

- **Attitudes and perceptions** (e.g., understanding the importance of action)
- **Customs and habits** (e.g., information used to inform purchasing and EOL decisions)
- **Accessibility of information** (e.g., language and literacy, awareness of warranty)
- **Ability to take action** (e.g., geographic eligibility for product takeback or proximity to a drop-off location)
- **Resources** (e.g., time, money)

Additional considerations for consumer-targeted education and awareness raising activities include:

- **Messaging can intervene in consumer decision-making:**
 - Proactively (e.g., for consideration in the future)
 - At the time of product purchase (e.g., choosing to purchase from a retailer with an EPR scheme)
 - At the end of product life (e.g., choosing to participate in a takeback program instead of disposal)
- **Effective consumer messaging:**
 - Is clear, concise, and easy to understand
 - Ensures accessibility of information (e.g., multi-lingual resources, incorporating pictorial representations)
 - Makes change feel achievable by including actionable and ideally small, easy steps consumers can take that add up to a meaningful contribution
- **Consumer behavior research can:**
 - Establish a baseline reference for where different target audiences stand in their perceptions and behaviors
 - Provide insight into what motivates consumers to act
 - Help refine subsequent messaging

EPR COMPLIANCE ACTIVITIES

Compliance activities should be built into the EPR scheme, which are rooted in the relevant laws and regulations. In the context of mandatory national requirements, government agencies are ultimately responsible for enforcement, and in cases of private or voluntary program, the organization managing the scheme would set up monitoring activities to ensure compliance with program requirements. Building capacity for and awareness of compliance allows producers to identify and resolve noncompliance issues as early as possible, and in the case of a mandatory requirement, avoid penalties.

Reliable legal framework for EPR scheme implementation ensures market fairness and competition for all and minimizes the instances of free riding (when a company avoids obligations such as paying required EPR fees), which is becoming common in online sales.²⁶

The following are key considerations for EPR scheme implementation and compliance:

- **Legal framework** that clearly spells out stakeholder responsibilities, obligations, offences, penalties, and targets, if appropriate.
 - The regulations should set out the specific responsibilities and duties of all parties involved: the monitoring and enforcement activities in relation to producers, sellers, waste processors, and compliance schemes.
- **Setting up the compliance mechanism** to identify offenders and take enforcement action. Monitoring (or market surveillance) and enforcement can include the identification of free-riders, monitoring compliance with set targets, and ensuring compliance with legislation among others.²⁷ Some examples to support compliance include:
 - Setting up a mechanism for consumers to report the offenders.
 - Investment in producer and importer registries.
- **Awareness raising** to ensure that the producers are aware of their obligations and the actions needed to comply.
 - In the case of online sales, the lack of awareness can be addressed through several different venues, including through the development of voluntary e-commerce codes of practice or increased outreach by online marketplaces.²⁸
- **Coordination of enforcement on national, regional, and international levels.**
 - In the case of online sales, many sellers are based in one country but sell products in others through online marketplaces e.g., Amazon. Thus, it creates a major challenge to track their activities and identify the free riders who do not meet the required EPR obligations. Prosecution of offenders is also a challenge as the authorities in one country may have limited ability to investigate or prosecute offenders in another territory. Therefore, coordination and cooperation among different governments is key to effectively enforce an EPR scheme.²⁹

1.7. EPR SCHEME REVISION

Lastly, any new scheme will not get everything right on the first try but should be designed with enough flexibility to evolve as everyone involved in implementation learns.

FIGURE 1 PLAN-DO-CHECK-ACT (PDCA) CYCLE

- **Setting up a system for stakeholders to provide feedback** on what aspects of the EPR scheme are working well and what introduces unnecessary burdens can help facilitate the scheme revision process, including prioritizing revisions.
- **Continuous improvement strategies** should be implemented based on the Plan-Do-Check-Act (PDCA) Cycle (Figure 2) as popularized in the ISO 9001 Quality Management System requirements.* The scheme should be regularly evaluated against key targets and indicators and revised accordingly.
- **Full revisions can be triggered** based on the passage of time (e.g., once every two years) or by meeting pre-defined targets and setting more ambitious goals (e.g., material usage in product design decreases by 15%). This can depend on whether the scheme is government- or private sector-led, and the accessibility of market surveillance activities.



* For more information <https://advisera.com/9001academy/knowledgebase/plan-do-check-act-in-the-iso-9001-standard/>.



Conclusions

This research investigated opportunities to increase circularity in e-waste management. It highlights EPR schemes as a promising policy approach and low-hanging fruit to introduce opportunities for circularity within linear economic models, particularly in developing contexts.

Section 1 explores definitions related to e-waste and the transition from linear to circular economy models, including an overview of stakeholders involved in making the transition possible across the product life cycle.

Section 2 defines key elements of EPR schemes supported by case studies in different countries. In particular, it identified the following components:

- A general definition of EPR schemes – to discuss what EPR schemes are and why they are important.
- Options of their features and scope – to discuss the variety of EPR schemes that can be developed depending on who establishes the scheme and their objectives.
- Possible EPR schemes' operating models and financing – to discuss the implementation options for EPR schemes which need a sustainable model to operate.
- Possible means to achieve EPR scheme targets – including EPR instruments, capacity building efforts, awareness raising, and compliance activities.
- EPR scheme revision – to ensure that EPR targets and operation are delivering the desired outcomes and adapt to challenges that might arise during implementation.

It is clear that no one single approach exists for implementing EPR schemes, as their development strictly depends on the country context. The case studies, elaborated in Annex 1, serve as additional evidence that various opportunities exist to set up EPR schemes depending on the needs and priorities of the stakeholders where the EPR scheme is being introduced.



Annex 1: EPR Scheme Case Studies

1. CHINA: PRODUCER-FUNDED EPR WITH SUBSIDIES^{30,31}

In 2012, the General Administration of Customs (GAC) and the State Administration of Taxation (SAT) of China jointly published an EPR fund policy to promote e-waste management. The fund management list includes five categories (Table 7). Producers contribute to the fund quarterly through the tax authority for each unit produced (excluding products for export). Importers contribute to the fund when declaring import products through the customs authority.

At EOL, most recycling is performed by the informal sector, in part because informal recyclers tend to pay higher prices (est. 100–150 RMB or \$15–22 more compared to formal recyclers) and will physically go directly to consumers. It is estimated only 20% of e-waste was recycled by formal recyclers in 2019.³² Formal recycling is incentivized through per-unit subsidies available for certified recyclers who can provide documentation for proper e-waste processing. However, there is speculation that the fund cannot pay for itself. One study estimated that the fund had a deficit of RMB 0.6 billion (USD ~\$90 million) in 2013. The study recommended redesigning the fund to incorporate two additional EPR instruments—consumer deposits and recycling content standards—to both financially supplement the fund and operate from more of a closed-loop life cycle perspective.

TABLE 6: 2012 RATES AND SUBSIDY VALUES

PRODUCT	FEE (CNY/UNIT)	SUBSIDY (CNY/UNIT)
Television	13	85
Refrigerator	12	80
Washing Machine	7	35
Air Conditioner	7	35
Personal Computer	7	85

The fund was developed in consultation with former e-waste recyclers, electronic and electrical equipment producers and importers, the Ministry of Finance (MoF), the Ministry of Environmental Protection (MEP), the National Development and Reform Commission (NDRC), the Ministry of Industry and Information Technology (MIIT), the General Administration of Customs (GAC), and the State Administration of Taxation (SAT).

Roles & Responsibilities:

- **General administrator:** MoF coordinates collection, utilization, & administration of the fund
- **Fund collectors:** GAC and SAT collect payment through branch agencies

- **Recyclers' administrator:** MEP develops and implements e-waste recycler certification criteria; monitoring and compliance
- **Operational supervision:** NDRC, MIIT, & National Audit Office
- **Monitoring and compliance:**
 - MoF monitors the production and sale of electronics using an online administrative system, as well as the recycling and disposal of e-waste in coordination with MEP, NDRC, & MIIT
 - Producers & importers input their production & import data into the system
 - Tax & customs authorities monitor fee collection; National Audit Office also supervises collection and utilization of the fund
 - Province-level environmental protection authorities verify accuracy of information from recyclers as well as publish compliance statistics in coordination with MEP to ensure transparency

2. EU: WEEE DIRECTIVE AND RELATED MEANS FOR IMPLEMENTATION

The WEEE Directive is the main policy to manage e-waste in the EU. From 2018, the WEEE Directive defines targets for appliances, including air conditioners, 85% of which shall be recovered, and 80% shall be prepared for re-use and recycled.³³ The principles of the WEEE Directive are complemented through the Waste Directive which introduces the principle of EPR as one of the means to advance the design and production of goods through a life cycle approach that supports the sustainable use of resources and EOL options including repair, re-use, disassembly, and recycling. The WEEE Directive also recommends economic instruments as a means to achieve the Directive's objectives. These are reported within the Waste Directive, which provides a list of waste prevention measures across the life cycle of products.* Examples include planning measures and other economic instruments to promote the efficient use of resources; research and development to develop products that produce less waste; promotion of eco-design; training of authorities; awareness campaigns for business and the general public; voluntary agreements and networks to facilitate waste prevention plans or objectives; consumer incentives for clean purchases; ecolabels; public procurement criteria related to waste prevention; and the promotion of the reuse and/or repair of products or of their components (e.g., measures for the establishment of accredited repair and reuse-centers).

3. INDIA: AIR CONDITIONER SERVICE CURRICULUM STANDARDIZATION

The [India Cooling Action Plan](#) (ICAP) identified steps for the standardization of training and skill certification for developing the AC servicing sector in the country. The [RAC servicing sector](#) accounts for over 40% of hydrochlorofluorocarbon (HCFC) use in India, so the goal of curricula standardization is to ensure all training programs incorporate topics that address

* For more information see Annex IX "EXAMPLES OF WASTE PREVENTION MEASURES REFERRED TO IN ARTICLE 29" within <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0098>

changes anticipated in the HFC phasedown in India. This includes awareness and compliance of Good Serving Practices (GSP), knowledge and practical skills in handling alternative refrigerant gases, and implementation of measures to ensure occupational safety.³⁴ This standardization effort is an example of a collaborative effort bringing together actors in the state agencies, education institutions, and private sector training programs.

4. INDIA: AIR CONDITIONING (RAC) SERVICE TECHNICIANS TRAINING

In 2013, GIZ under their ProKlima program prepared a handbook for RAC technicians. The handbook provides preliminary and practical information to the technicians that can be applied on a day-to-day basis during installation and servicing of air conditioners. These good practice recommendations are based on the 3 “Rs”—recovery recycling, and reclamation—of refrigerants with the goal of customer satisfaction, repeat orders and environmental protection.³⁵

5. INDIA: PROS AND E-WASTE

In India, PROs actively manage e-waste following the E-Waste (Management) Rules, 2016. These rules impose primary responsibility on the producer for collection of e-waste products and establishment of a system to collect their EOL products. PROs are authorized or financed collectively or individually by producers to take the responsibility for collection and channelization of EOL e-waste and its environmentally sound management.*

6. JAPAN: STAKEHOLDER SHARED RESPONSIBILITY

Japan’s WEEE EPR scheme is mandated by the law. Consumers are responsible for paying for the costs in the transportation, regeneration, and recycling of WEEE; producers are responsible for the WEEE regeneration and recycling; retailers pay for the WEEE recovery and transportation, and importers should recover the products they sold. To implement this model and enable a connection among stakeholders, Japan introduced a coupon system “Home Appliance Recycling Coupon Center -(RKC).” The coupon is first applied by the consumer to the WEEE product when trading it in to the retailer. The coupon follows every step of the EOL cycle, and one designated person records the process in a system. The WEEE fee is collected at the RKC through the retailers. The RKC issues funding subsidies to WEEE recovery and processing sites a based on the information on the coupons.³⁶

7. NIGERIA: INFORMAL SECTOR ENGAGEMENT FOR E-WASTE MANAGEMENT

In most economies, more so in low- and middle-income countries, the informal sector plays a significant role in WEEE management and participates in activities such as collection and dismantling. Their presence therefore cannot be ignored in the creation of EPR programs that focus on increased takeback and collection, extended product life cycles, and increased and improved recovery, recycling, and remanufacture.

* For more information see article: “India: Producer Responsibility Organization” of 01 March 2019 by S.S. Rana & Co. Advocates S.S. Rana & Co. Advocates at <https://www.mondaq.com/india/waste-management/786196/producer-responsibility-organization>.

In 2014, the National Environmental Standards and Regulations Enforcement Agency (NESREA) in Nigeria published operational guidance for implementation of an EPR Program.³⁷ NESREA started implementing EPR for food and beverage and electronics in 2018.³⁸ Hinckley Recycling is attempting to incentivize informal collectors by holding informal sector training workshops with medical teams and an awareness-raising campaign to reach out, speak with and work with these actors, explaining the consequences of bad practices. What started as training workshops and medical check-ups is evolving into a trade partnership as more and more collectors start looking to work with Hinckley.³⁹

8. SINGAPORE: COMMUNITY CONSULTATION⁴⁰

In 2019, Singapore’s Ministry of Sustainability and the Environment* (MSE) published the Zero Waste Masterplan to strengthen climate, resource, and economic resilience through three priority waste streams: food waste, e-waste, and packaging waste. The Masterplan was created in consultation with over 6,000 stakeholders through online consultations, surveys, and focus group discussions:

- **Industry:** The National Environment Agency (NEA) consulted over 250 companies on possible measures to address priority waste streams.
- **Households:** Over 5,000 households were engaged through two door-to-door surveys: 1) an existing biennial survey on experience with recycling services and infrastructure and 2) a survey commissioned for the Year Towards Zero Waste on recycling behavior.
- **NGOs:** MSE hosted a dialogue with NGOs, youths, and other partners to seek feedback on the zero waste plans and explore opportunities for collaboration.
- **General public:** Over 1,300 people participated in a public consultation on how to pursue sustainable consumption and production as well as build a strong 3R culture; MSE, in collaboration with two NGOs, also conducted two focus group discussions with 90 participants on ways to reduce waste and encourage proper recycling behavior.

FIGURE 2 SUMMARY INFOGRAPHIC
SINGAPORE MASTERPLAN



9. SWITZERLAND: CONSUMER-BASED EPR OPERATING MODEL

Switzerland’s EPR system uses an EPR fund operating model in which the consumer bears the responsibility for paying the fund and where the PROs perform recovery and utilization directly without the intermediation of a WEEE recovery system set up by the government. In particular, PROs charge an advance recycling fee (ARF) to the producers, which is annotated in the product

* Formerly Ministry of the Environment and Water Resources (MEWR)

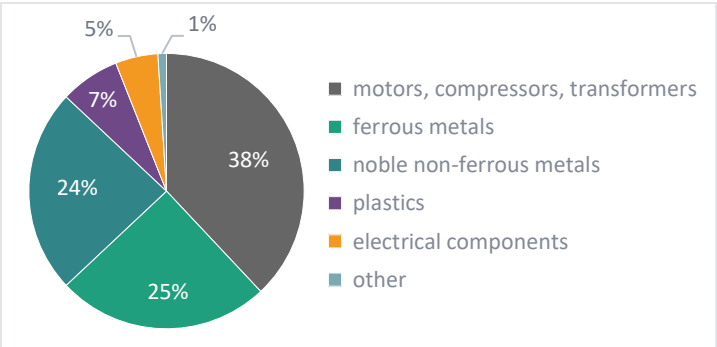
invoice. This fee accompanies the product invoice through the selling point, and it is ultimately paid by the consumer. The ARF is used to subsidize recovery, transportation, and processing enterprises.⁴¹

10. THAILAND: PRIORITIZING EOL AIR CONDITIONERS

Cooling appliances are critical to ensuring a higher standard of living. Lack of access to cooling represents a threat to health, safety, and prosperity for an estimated 1.1 billion people globally.⁴² In particular, in terms of air conditioners (ACs), global air conditioning systems sales are estimated at 107.9 million units in 2020 and projected to reach 148.7 million units by 2026.⁴³ However, the uptake of these appliances also raises concerns about proper EOL handling.

Preliminary results from interviews with formal and informal sector stakeholders revealed a lack of capacity for all the stakeholders in treating various AC components, such as circuit boards, refrigerants, and plastic surrounding the appliance.* ACs, like all electronic and electrical equipment (EEE), contain hazardous materials and rare resources, which, if properly extracted, can be reused or recycled. The constituent materials in ACs differ depending on product application; however, plastics and ferrous metals such as copper, aluminum, and stainless steel are most commonly used. Figure 4 provides an estimated breakdown of AC materials. In addition to these materials, ACs along with other cooling products contain gas or liquid refrigerants.

FIGURE 3 AC MATERIALS



Refrigerants pose a risk to the environment and human health, including respiratory problems and skin and cardiovascular diseases⁴⁴ that put EOL workers and people living near processing facilities at risk. Therefore, they must be disposed of/recycled properly. As a result, the proper management of the EOL of ACs represents a significant opportunity to facilitate the transition to a circular economy.

10.1. THE THAILAND REFRIGERANT CHALLENGE

Refrigerants are used in air conditioning products because of their thermodynamic properties. They absorb environmental heat and provide cooling by passing air through compressors and evaporators. However, part of the most used refrigerants are fluorinated gases (F-gases) including hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbon (HFCs). These are anthropogenic greenhouse gases (GHGs). Table 6 includes examples of refrigerants along with their global warming potential (GWP).

* More details will be made available through the local assessment report CLASP conducted with support of partners

TABLE 7: EXAMPLES OF REFRIGERANTS AND THEIR GWP

REFRIGERANT	CATEGORY	GWP	FLAMMABILITY
R-22	HCFC	1760 - high	low
R-410A	HFC	1924 - high	low
R-32	HFC	677 - low	low
R-290	HC	3 - very low	high

CLASP's research found that the cooling energy efficiency transition in Thailand is happening hand-in-hand with the refrigerant transition. In 2012, room air conditioners predominantly used R-22 (95% of AC sold), but recent data collected by CLASP⁴⁵ reported that R-32 was the most widely used refrigerant in Thailand in 2021 (over 90% of labeled ACs), followed by R-410A. R-290, despite its very low environmental impact (R-290 is propane, which is a natural refrigerant, hydrocarbon -HC), its use is being investigated for adoption in Thailand, and the regulations for high-rise buildings forbid the use of these refrigerants for safety reasons.⁴⁶

CLASP's research in Thailand highlighted that very limited or no capacity exists for the treatment of refrigerants in disposed ACs and during repair phases. In particular, technicians or informal sector stakeholders (e.g., collectors) are not prepared to handle refrigerants properly and dump them in the general waste or leave them to evaporate, causing environmental (emissions-related) and health concerns (human exposure to harmful substances).

A 2015 study⁴⁷ researched the life cycle carbon footprint of refrigerants, including R22, R410A, R32, R161, and R290 (R-161 and R290 were included as the refrigerants with the lowest GWP and ozone-depletion potential). The study considered the process flows of the refrigerant cycle: emission and energy consumption across the production, filling, service, and disposal life stages. It found that indirect emissions from the service process (use phase) accounted for 99% of the total indirect emissions for all refrigerants. For high- and middle-GWP refrigerants (i.e., not R-161 and R-290), emissions were linked to the disposal process (over 90% of indirect emissions). The same study found that benefits from recycling and reusing refrigerants is linked to reducing direct emissions during the disposal of refrigerants and the production of new refrigerants. However, when low-GWP refrigerants were considered, improved recycle rates had no effect on their direct emissions, since their life cycle impact was already very small. Instead, the indirect emissions from disposal increased because of the higher energy consumption linked to reuse and recovery operations. Therefore, according to the study, improving the refrigerant recycle rate in the disposal process is the best way to improve the GHG emissions reduction potential in the short term.

Annex 2: Circular Economy Labeling Examples

TABLE 8: SELECTED CIRCULAR ECONOMY LABELS AND INFORMATION SCHEMES (CELIS) COVERING DIFFERENT PHASES OF THE VALUE CHAIN

PRIMARY MATERIALS EXTRACTION	DESIGN, PRODUCTION, RETAIL	USE, CONSUMPTION	EOL (RE-USE, RECYCLING, DISPOSAL)	ENTIRE LIFE CYCLE
Forest Stewardship Council (FSC) 100%	SEB "Product 10 Years Repairable" label	EU Energy Label	Compostability mark (e.g., BPI)	Blauer Engel
Fairtrade	EWG verified	Energy Star	TerraCycle	Nordic Swan
Global Organic Textile Standard	LEED certification	LEED®-EB: O&M	Global Recycled Standard	EU Ecolabel
UTZ certified	BREEAM certification	BREEAM In-USE	How2Recycle	C2C certified
Organic food labels	TÜV TOXPROOF		SCS Zero waste certification	EPEAT
Marine Stewardship Council (MSC) certification			Triman	BASF Eco-efficiency label
Fairmined Gold certification			ASTM Resign Identification System	TRUE zero waste certification
Alliance for Water Stewardship				Global Green Tag cert.
IRMA certification (Initiative for Responsible Mining Assurance)				Carbon Trust reduction label

Table adapted from Laubinger, F. and P. Börkey (2021), "Labelling and Information Schemes for the Circular Economy", OECD Environment Working Papers, No. 183, OECD Publishing, Paris, <https://doi.org/10.1787/abb32a06-en>.

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