



Toxics Link  
for a toxics-free world

# Long Road to Circularity



## About Toxics Link

Toxics Link is an Indian environmental research and advocacy organisation set up in 1996, engaged in disseminating information to help strengthen the campaign against toxics pollution, provide cleaner alternatives and bring together groups and people affected by these problems. Toxics Link has a unique expertise in areas of hazardous, plastic, medical and municipal wastes, international waste trade, and emerging issues of pesticides, Persistent Organic Pollutants (POPs), hazardous heavy metal contamination, etc. We have successfully implemented various best practices and have contributed to policy changes in the aforementioned areas apart from creating awareness among several stakeholder groups.

Toxics Link's Mission Statement - "Working together for environmental justice and freedom from toxics, we have taken upon ourselves to collect and share both information about the sources and the dangers of poisons in our environment and bodies, and information about clean and sustainable alternatives."

## Acknowledgment:

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# List of Abbreviations

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## **WEEE Directive**

Waste Electrical and Electronic Equipment Directive

## **EU**

European Union

## **DfE**

Design for Environment

## **EPR**

Extended Producer Responsibility

## **MoEFCC**

Ministry of Environment, Forest and Climate Change

## **e-waste**

Electronic Waste

## **et al.**

And others

## **OECD**

Organisation for Economic Co-operation and Development

## **EEE**

Electrical and Electronic Equipment

## **ESM**

Environmentally Sound Management

## **CPCB**

Central Pollution Control Board

## **SOPs**

Standard Operating Procedures

## **EPA**

The Environmental Protection Act, 1986

## **i.e.**

That is

## **MT**

Metric Tonnes

## **Au**

Gold

## **Cu**

Copper

## **Al**

Aluminium

## **Fe**

Iron



# Executive Summary

This report critically examines India's Extended Producer Responsibility (EPR) framework under the E-Waste (Management) Rules, 2022, situating it within international policy developments and domestic legal mandates under the Environment Protection Act, 1986. Through a mixed-method approach—combining analysis of legal and policy documents, RTI responses, stakeholder interviews, and secondary data from CPCB, NGT, and parliamentary sources—the study identifies gaps in implementation and explores challenges faced by producers, recyclers, and consumers.

The findings indicate that India's EPR system continues to face several implementation challenges. The 2022 Rules represent a positive shift from collection-based obligations to recycling and recovery targets. However, their effective execution is constrained by factors such as limited baseline data, dependence on self-reported compliance, and incomplete producer coverage on CPCB's portal. Moreover, the framework's extensive compliance requirements may sometimes divert resources away from innovation and eco-design. At the same time, the absence of strong incentives for promoting product longevity, high-quality recycling, and active consumer participation has limited the system's overall impact. Importantly, the exclusion of the informal sector—despite its significant role in India's e-waste ecosystem—continues to be an area requiring greater attention and integration.

The report concludes that India's EPR framework represents a strong foundation for addressing e-waste but requires significant strengthening to achieve its intended environmental and social objectives. The recommendations include enhancing data transparency through digital reporting and public dashboards, expanding stakeholder coverage, strengthening reverse supply chains like repair, recycling, reuse etc. Addressing these gaps will allow India to transform its e-waste challenge into an opportunity for sustainable growth, resource efficiency, and climate resilience.

A large pile of discarded, broken smartphones, illustrating electronic waste. The phones are scattered across the frame, many with cracked screens and damaged casings. The overall color palette is dark and muted, with shades of grey, black, and brown, emphasizing the theme of waste and environmental impact.

**“Responsibility  
of producers for  
environmentally  
sound  
management of  
waste generated  
by their product  
throughout  
the lifecycle,  
including end-of-  
life disposal.”**

# 01

## Introduction to Extended Producer Responsibility

### 1.1 Background

Extended Producer Responsibility (EPR) is an environmental policy approach that places the responsibility of post-consumer waste management on producers. This includes collection, recycling, and environmentally sound disposal of products at the end of their lifecycle (OECD, 2016). By shifting the waste burden from municipalities to producers, EPR incentivises manufacturers to design more sustainable products and manage their environmental impact from production to disposal. Thus, EPR can be defined as:

EPR was first formally conceptualised in Sweden and proposed in 1988 through the report *Models for Extended Producer Responsibility*. It has since become a globally recognised tool for managing various waste streams, particularly electronic waste (e-waste) and plastic waste (Ramasubramanian, B. et al., 2024). The implementation of EPR varies across countries. While some adopt financial responsibility models, others incorporate physical take-back systems, eco-design standards, and public awareness components. For instance, the European Union mandates producer take-back and eco-design, while India emphasises on collection targets and certificate trading mechanisms.

## 1.2 EPR in International Environmental Law and Practice

As discussed above, EPR is a policy approach and has gained significant recognition in the international environmental governance framework, but not through a single binding treaty. The international governance is based on multiple principles, including polluter pays principle, lifecycle responsibilities and sustainable development. Historically, the conceptual foundation of EPR can be traced back to the 1972 United Nations Conference on the Human Environment (popularly known as the Stockholm Conference). It acted as a precursor encouraging states to promote environmental protection, intergenerational equity, and sustainable resource use. Though EPR was not explicitly mentioned, the Stockholm Declaration emphasised principles that later resulted in the development of EPR, particularly fixing responsibility for post-consumer waste and the need to reduce environmental damage throughout the product lifecycle (United Nations, 1972). It was followed by Rio Declaration on Environment and Development (1992) that further strengthened the EPR policy under Principle 16, which basically encourages the “polluter pays” principle and the use of economic instruments to internalise environmental costs (United Nations, 1992).

The Agenda 21 document, adopted in the 1992 Earth Summit held in Rio de Janeiro, Brazil, did not mention EPR explicitly but highlighted the underlining principles, including the need to adopt product lifecycle management, cleaner production methods, and mechanisms that place responsibility on producers and manufacturers to reduce the environmental impact of their products.

The Basel Convention (1989) called on Parties to take responsibility for “minimising” hazardous waste generation, and to ensure environmentally sound management and disposal of such waste “as close as practicable” to its place of generation. It also regulates transboundary movement of hazardous waste through a prior informed consent procedure, and under certain amendments limits export of hazardous wastes. These provisions are consistent with, though not identical to Extended Producer Responsibility principles, which emphasise on localised responsibility and environmentally sound disposal.

The Organisation for Economic Co-operation and Development (herein referred as OECD) has played a significant role in formalising and strengthening EPR. In the Guidance Manual, 2001, the OECD defined EPR as “an environmental policy approach in which a producer’s responsibility for a product extends to the post-consumer stage of its lifecycle”. In 2016, the OECD published the key objectives of EPR, which continue to guide global policy frameworks till date:

Though EPR was not explicitly mentioned, the Stockholm Declaration emphasised principles that later resulted in the development of EPR, particularly fixing responsibility for post-consumer waste and the need to reduce environmental damage throughout the product lifecycle (United Nations, 1972).



**Table 1: Primary objective of EPR as per OECD (2016)**

Objective	Key Focus
<b>Environmental Impact Reduction</b>	Minimise waste generation, reduce environmental footprint, and promote eco-friendly product design.
<b>Producer Responsibility</b>	Shift end-of-life responsibility from government to producers; incentivise repairable, reusable, and recyclable designs.
<b>Resource Efficiency &amp; Circular Economy</b>	Promote material recovery, recycling, and reduced dependence on virgin raw materials.
<b>Cost Internalisation</b>	Ensure producers, and not society, bear the financial responsibility for end-of-life management.
<b>Consumer Awareness &amp; Participation</b>	Encourage consumers to return products and practice sustainable disposal.
<b>Innovation &amp; System Development</b>	Drive innovation in product design, recycling processes, and sustainable business models.

Source: Organisation for Economic Co-operation and Development. (2016). *Extended producer responsibility: Updated guidance for efficient waste management*.

The document also highlights a variety of EPR models implemented in countries such as Japan, South Korea, Canada, and other OECD member states (OECD, 2001). For example, in the European Union (EU), the WEEE Directive mandates producers to take responsibility for the collection, recycling, and recovery of e-waste. The WEEE Directive, along with the EU Circular Economy Action Plan, emphasises on reducing material use, promoting design for environment (DfE), and ensuring long-term resource efficiency through the adoption of EPR mechanisms (EU, 2020). Building on these global experiences, India has integrated EPR into its regulatory framework through the E-Waste (Management) Rules, 2022.

With many countries adopting and developing strategies for sustainable waste management, EPR has emerged as a key policy approach. However, there is no uniform model for implementation of EPR. Different nations have adopted different legal and operational frameworks according to their priorities, capacity, and current policy goals. In India, the EPR for e-waste was adopted under the E-Waste (Management) Rules, 2022. These rules replaced the 2016 Rules and introduced a market-based approach, prescribing phase-wise collection and recycling targets. To have a deeper understanding of different EPR models, let's examine the EPR mechanisms developed in different countries:



**Table 2: EPR Models in Different Countries**

Country	Key EPR Features	Producer Responsibility	Special Features
<b>EU</b>	<ul style="list-style-type: none"> <li>Mandatory producer compliance schemes for take-back and shared responsibility</li> <li>Eco-modulated fees to incentivise eco-design</li> <li>Qualitative standards for recovery, recycling, and safe treatment (WEEE Directive 2012/19/EU)</li> </ul>	Producers manage take-back via regulated collective schemes; accountable reporting	Emphasis on both quantitative and qualitative compliance; environmental protection
<b>Japan</b>	<ul style="list-style-type: none"> <li>Recycling fees paid by consumers to fund proper recycling</li> <li>Clear labelling &amp; certified recyclers</li> <li>Mandatory retailer acceptance of returned appliances</li> </ul>	Producers finance recycling; certified companies handle treatment	Structured system with clear roles for retailers, producers, and recyclers
<b>South Korea</b>	<ul style="list-style-type: none"> <li>Centralised collection network</li> <li>Material-specific recycling quotas</li> <li>Strong monitoring &amp; reporting</li> </ul>	Producers responsible for collection, recycling, and compliance reporting	Government actively enforces compliance; emphasis on high recovery of valuable materials
<b>China</b>	<ul style="list-style-type: none"> <li>Government-managed recycling fund</li> <li>Licensed recyclers for safe treatment</li> <li>Incentives for proper handling</li> </ul>	Producers contribute to recycling fund; fund supports certified recyclers	Penalties for non-compliance; focus on incentivising formal recycling network

Source: Author’s Creation based on WEEE Directive 2012/19/EU; INFORM, Inc. (2003); Ram (2023); Envilience Asia (n.d.); and Lv, Liu, and Howe (2024)

The different EPR models adopted by these countries focus on a holistic approach and attempts to achieve a balanced integration of all three pillars of sustainable development—environmental, social, and economic. Environmental protection is ensured through the promotion of product design requirements and treatment standards; economic development is supported by efficient, shared compliance mechanisms that lower costs and enhance competitiveness; and social inclusion is strengthened by focusing on worker safety regulations, consumer rights, and transparent governance systems (OECD, 2016).



# 02

## India's EPR Framework for E-Waste

### 2.1 Legal Foundation and Policy Structure

India's EPR framework for e-waste is governed by the E-Waste (Management) Rules notified under the Environment (Protection) Act, 1986. The concept of Extended Producer Responsibility was first introduced with the E-Waste (Management) Rules in 2011. It became effective in 2012, was revised in 2016 and most recently updated in 2022. These rules make producers responsible for the collection and environmentally sound recycling of end-of-life electrical and electronic equipment (EEE).

The Table 3 below outlines the gradual development of the EPR framework for e-waste management in India. It highlights how the concept, introduced in 2012, was subsequently revised and updated, reflecting the evolving regulatory approach towards ensuring producer responsibility for end-of-life electrical and electronic equipment (EEE).

**Table 3: Evolution of EPR Concept under Indian E-Waste Management Rules**

Parameter	2011 Rules	2016 Rules	2022 Rules
<b>Definition of EPR</b>	Basic take-back responsibility for producers	-Lifecycle accountability introduced -Producers must collect e-waste linked to sales/ imports	Market-based approach
<b>Scope of Responsibility</b>	Producers only	Expanded: Producers, manufacturers, recyclers, refurbishers, dismantlers	Streamlined: Producers, manufacturers, recyclers, refurbishers
<b>Producer Obligations</b>	Ensure safe collection & disposal through take-back/collection centres	-Meet phased collection targets -Establish PROs	-Register on CPCB portal -Purchase EPR certificates -Submit annual/quarterly returns
<b>Definition of EPR</b>	Basic take-back responsibility for producers	-Lifecycle accountability introduced -Producers must collect e-waste linked to sales/ imports	Market-based approach
<b>Scope of Responsibility</b>	Producers only	Expanded: producers, manufacturers, recyclers, refurbishers, dismantlers	Streamlined: producers, manufacturers, recyclers, refurbishers
<b>Producer Obligations</b>	Ensure safe collection & disposal through take-back/collection centres	-Meet phased collection targets -Establish PROs	-Register on CPCB portal -Purchase EPR certificates -Submit annual/quarterly returns

Source: Author’s Creation based on MoEFCC notifications (2012, 2016, 2022)

Building upon the key regulatory developments summarised in Table 3, the **E-Waste (Management) Rules, 2022** mark a significant shift in India’s approach to managing electronic waste. These rules not only consolidate earlier provisions but also introduce new mechanisms aimed at strengthening compliance, accountability, and resource recovery. The salient features of the 2022 Rules are outlined below.



## 2.2 Salient Features of E-waste (Management) Rules, 2022

- **Compulsory Registration (S.4(3)):** The Rules mandate compulsory registration of all recyclers, refurbishers, and other stakeholders engaged in e-waste management. No entity is permitted to operate without being registered on the centralised portal.
- **Annual and Quarterly Returns:** Producers, recyclers, and other stakeholders are required to file periodic returns—both annual and quarterly—through their respective EPR portal. These returns must follow the prescribed format, enabling authorities to track compliance levels, monitor material flows, and assess the performance of the stakeholders in meeting their obligations.
- **Compliance and Monitoring:** The Rules emphasise self-reporting mechanisms. Registered recyclers and refurbishers must provide details of their recycling capacity, occupational safety measures, and other operational information on the portal.
- **Metal Recovery Targets:** To promote resource efficiency and circularity, the CPCB sets annual recovery targets for key metals such as aluminium, iron, copper and gold from e-waste. These targets encourage scientific recycling practices, minimise resource wastage, and contribute to reducing dependency on virgin raw materials.
- **Quantitative Collection Targets:** The rules prescribe phase-wise, weight-based targets for producers, starting at 60% of the quantity of Electrical and Electronic Equipment (EEE) placed in the market and gradually increasing to 80% in subsequent years. This approach ensures measurability and accountability, making producers legally responsible for a defined share of end-of-life EEE.
- **EPR Certificate Trading System:** The rules formalise a market-based certificate trading mechanism. Registered recyclers can issue digital certificates proportional to the quantity of e-waste processed, which producers purchase to meet their obligations. This system enhances transparency and standardisation but de-links producers from direct system-building.
- **Environmental Compensation:** There are a few provisions related to environmental compensation payments as well if there is any act of non-compliance by producers. This fund can be utilised by concerned bodies for the purpose of recycling, disposal, research, or to support the local authorities.
- **Verification and Audit (S.24):** The Rules allow CPCB or designated agencies for verification and audits to assess compliance with the provisions. This mechanism strengthens accountability and ensures that self-reported data provided by recyclers, refurbishers, and producers are accurate.

The E-Waste (Management) Rules, 2022 mark a significant shift in India's approach to managing electronic waste. These rules not only consolidate earlier provisions but also introduce new mechanisms aimed at strengthening compliance, accountability, and resource recovery.

India's EPR framework under 2022 Rules is still evolving with greater emphasis being given on compliance mechanisms, while broader objectives such as environmental quality improvements and social inclusion are yet to be integrated.

Against this backdrop, it becomes important to situate India's EPR framework within the larger legislative context from which it derives its authority. The Environmental Protection Act (EPA), 1986 serves as the parent legislation under which the E-Waste (Management) Rules have been issued. Understanding the purpose and preamble of the EPA is therefore essential to assess how far the current EPR regime aligns with the Act's overarching mandate of environmental protection and sustainable development.

### 2.3 Environmental Protection Act, 1986: Purpose, Preamble, and Its Relation to EPR in E-Waste Management

The Environmental Protection Act (EPA), 1986, is regarded as India's umbrella legislation on environmental matters, enacted after the 1972 United Nations Conference on the Human Environment (Stockholm Conference). At Stockholm, India endorsed several guiding principles, including the need for comprehensive national legislation to address pollution and environmental degradation (United Nations, 1972).

The preamble of the EPA explicitly states its purpose: *"An Act to provide for the protection and improvement of environment and for matters connected therewith"* (Government of India, 1986). This underscores that the Act's primary goal is the protection and improvement of environmental quality, rather than serving as a mere economic or revenue-generating instrument. The EPA confers wide powers upon the Central Government, including the power to frame rules, set environmental standards, and issue notifications to regulate environmental harms. It is under this statutory mandate that the E-Waste (Management) Rules, 2022, were promulgated (MoEFCC, 2022). Within these rules, EPR has been institutionalised as the cornerstone of India's e-waste management framework, placing end-of-life accountability for electrical and electronic equipment (EEE) on producers. However, the current EPR regime places stronger emphasis on achieving quantitative collection and recovery targets, while integration of qualitative and social dimensions is still in progress.

Having outlined the legal framework and policy basis under the Environmental Protection Act, 1986, and the E-Waste (Management) Rules, 2022, we will now understand how these provisions are implemented in practice. The operational mechanism is structured around the preparation and execution of an EPR Plan by producers. This plan serves as the primary instrument through which producers demonstrate compliance with their statutory responsibilities for collection, recycling, and reporting of e-waste.



# 03

## EPR plan

An EPR Plan is like a roadmap prepared by a producer that explains how they will manage the waste generated from their products at the end of their life. In this plan, the producer describes:

- ◆ How they will meet their EPR targets (the amount of e-waste they must collect and recycle)
- ◆ How they will collect and send e-waste for recycling
- ◆ How they will track and report their progress

An EPR Plan typically involves:

- ◆ Getting EPR certificate
- ◆ Filing an annual compliance report (Annual EPR return)
- ◆ Meeting their EPR target and earning EPR credit

### Understanding by Example

Suppose *Company X* manufactures *Product Y* (an electrical or electronic device). Once a consumer finishes using a *Product Y*, it reaches its end-of-life stage and becomes e-waste. Under the EPR system, *Company X* is responsible for ensuring that this waste is managed safely, rather than allowing it to end up in landfills or cause environmental pollution.



**“To qualify for an EPR certificate, a producer must satisfy eligibility requirements established by the CPCB. “**

**Fig. 1: The EPR certification process under E-waste Management Rules, 2022.**



Source: Author’s creation based on E-Waste (Management) Rules, 2022

The EPR certification process is as follows:

➤ **Registration on CPCB Portal**

- ◆ Company X must register on the CPCB online portal.
- ◆ For this, they need to submit certain documents, including an E-Waste Management Plan that explains how they will handle their e-waste.
- ◆ They must also pay a registration fee.

➤ **Approval**

- ◆ Once CPCB reviews and approves their application, Company X is officially registered.

➤ **Getting the EPR Certificate**

- ◆ After registration, Company X needs to get an EPR certificate (from authorised recyclers) to show they are meeting their waste management obligations.
- ◆ They can get this certificate by partnering with registered recyclers, or using their own approved recycling facilities.

### 3.1 EPR Certificate – What It Means

The **EPR certificate** is an official document issued “in favour of registered recyclers” via CPCB’s online portal.

- ◆ It proves that a certain amount of e-waste has been properly recycled.
- ◆ Producers buy these certificates to show they have met their recycling targets.

Getting this certificate is a key step for any producer.

To qualify for an EPR certificate, a producer must satisfy eligibility requirements established by the CPCB. This includes calculating the minimum waste quantity for which the producer is accountable, using a prescribed formula:

$$Q_{EPR} = Q_P \times C_f$$

Where  $Q_{EPR}$  = quantity eligible for EPR certificate

This is the final amount of waste that the producer is responsible for managing

$Q_p$  = Quantity of the end-product

How much (weight wise) of the product (total weight of electronic devices) the producer manufactures.

$C_f$  = Conversion factor (shows how much e-waste is generated per unit of the product)

\*  $C_f$  for each end-product shall be determined by CPCB

**Example 1:** Let’s say a company manufactures 100 tons of a certain type of electronic device, and the conversion factor ( $C_f$ ) for that device is 0.5 (meaning 0.5 tonnes of e-waste is generated for every tonne of product). The quantity eligible for EPR certificate generation ( $Q_{EPR}$ ) would be:

**$Q_{EPR} = 100 \text{ tonnes} * 0.5 = 50 \text{ tonnes}$**

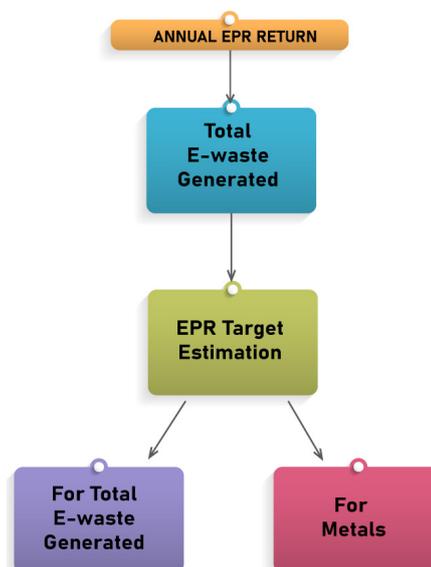
This means; to fulfil the obligation, the producer would have to ensure the responsible management of 50 tonnes of e-waste, potentially by purchasing EPR certificates from registered recyclers. The EPR certificate shall be valid for up to two years from the end of the financial year in which it was generated. The certificate will thereafter expire and shall be automatically terminated/invalidated. Each EPR certificate will have a unique number containing the year of generation, code of end-product, recycler code and a unique code.

### 3.2 Filing the annual compliance report (Annual EPR return) –Determining EPR Targets for E-Waste Generators

Once the EPR certificate is provided, the company needs to comply with the EPR obligations every year based on the EPR targets. For this, the amount of E-waste generated is calculated.

#### > E-waste generated

E-Waste generated for a specific EEE item is to be estimated based on the quantity (weight) of that EEE item placed in the market (sales) in the previous years and the average life of that EEE item as per the formula given below:



Source: E-Waste (Management) Rules, 2022

#### Example 2

If we want to calculate the E-waste generated by “AB” which sells smartphones (placed under ITEW-15) for the year 2023-2024.

**E-waste generation (X – Y) = Sales in the year (P – Q)**

Here, X = 2023; Y = 2024 and Z = 5 years

P = 2023-5 = 2018

Q = 2024-5 = 2019

Therefore,

E-waste generated by “AB” in 2023-2024 = Sales done by “AB” in the year 2018-2019

#### Formula

E-Waste generation (by weight) of an EEE item in the year (X – Y) = Sales in the year (P – Q)

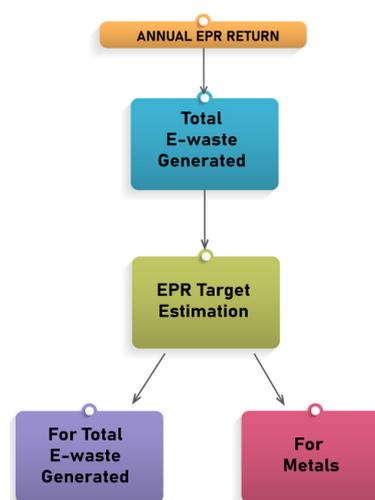
Where, P = X – Z and Q = Y – Z

Z = Average life of that EEE item in years (average life proposed for 106 CPCB categorised EEE items under E-waste (Management) Rules, 2022 is provided in the CPCB portal.

## ➤ EPR Target Estimation

### ◆ FOR TOTAL E-WASTE GENERATED

Once the E-waste generated is calculated, thereafter, the EPR targets are set for each item. The target for EPR, i.e., recycling of E-Waste, shall be based on the E-Waste generation as calculated in Section 3.2 above. The year-wise target is specified in Schedule III of E-Waste (Management) Rules, 2022.



Source: E-Waste (Management) Rules, 2022

**Table 4: Schedule III E-Waste (Management) Rules, 2022**

S. No.	Year	E-Waste Recycling Target (by weight)
1.	2023-2024	60% of the quantity of an EEE placed in the market in year Y-X, where 'X' is the average life of that product
2.	2024-2025	60% of the quantity of an EEE placed in the market in year Y-X, where 'X' is the average life of that product
3.	2025-2026	70% of the quantity of an EEE placed in the market in year Y-X, where 'X' is the average life of that product
4.	2026-2027	70% of the quantity of an EEE placed in the market in year Y-X, where 'X' is the average life of that product
5.	2027-2028	80% of the quantity of an EEE placed in the market in year Y-X, where 'X' is the average life of that product
6.	2028-2029 onwards	80% of the quantity of an EEE placed in the market in year Y-X, where 'X' is the average life of that product

#### Note:

E-waste recycling target shall be reviewed and may be increased after the end of year 2028- 2029.

- The importers of used EEE shall have 100% EPR obligation for the imported material after end of life, if not re-exported.
- E-Waste recycling targets shall not be applicable for waste generated from solar photovoltaic modules or panels or cells.

**Example 3:** If the sales of the abovementioned company “AB” for the year 2018-2019 was 1,000 Metric Tonnes (MT), then the E-waste generation will also be equal to 1,000 MT for the year 2023-2024 (refer example 2). Thus, as per schedule III of E-waste Management Rules, 2022, the EPR target of “AB” for smart phones in 2023-2024 would be 60% of the quantity of an EEE placed in the market in year Y-X, where ‘Y’ is the compliance year (2023-2024) and ‘X’ is the average life of that product

$$60\% \text{ of } 1000 = 60/100 * 1000 = 600 \text{ MT}$$

Now the producer has the target of 600 MT recycling. That 600 MT will be sent to the recycler. From that, they may recover ferrous metals, non-ferrous metals, precious metals, plastics, glass, etc. depending on their availability on the device type and availability of approved recycling technology.

The EPR targets for new producers, who have recently started sales operations and whose number of years of sales operations is less than average the life of their products, shall be as per CPCB guidelines issued from time to time:

**Table 5: E-waste Recycling Targets under E-waste Management Rules, 2022**

S. No.	Year	E-Waste Recycling Target (by weight)
1.	2023-2024	15% of the sales figure of financial year 2021-22
2.	2024-2025	20% of the sales figure of financial year 2022-23
3.	2025-2026	20% of the sales figure of the financial year two years back

**Note:**

- Once the number of years of sales operation equals the average life of their product mentioned in the guidelines issued by CPCB, their EPR obligations shall be as per Schedule-III.
- E-Waste recycling targets shall not be applicable for waste generated from solar photo-voltaic modules or panels or cells.

◆ **EPR OBLIGATIONS (TARGETS) FOR METALS**

The EPR obligation of producers in terms of non-ferrous (Cu and Al) and ferrous metals (Fe) will be 100% of the obligation. This indicates that all of the metals present in the collected e-waste (non-ferrous, ferrous) must be recovered and none should go to landfill, meaning, if 600 MT of e-waste is collected, then it must be ensured that 100% of the recoverable metals (Fe, Cu, Al) in that 600 MT are recovered through authorised recyclers. None should be dumped in the landfill, nor it should be wasted under any

circumstance. The producers EPR obligation implicitly includes ensuring that 100% of the metal content of their e-waste is recovered. But this happens through the recyclers' process, not by the producers splitting their EPR Certificate into metal fractions.

The CPCB issued a notification on September 21, 2023, introducing the framework for generation of EPR certificates for key metals recycled from various EEE items, included in Schedule-I of the E-Waste (Management) Rules, 2022.

The key metals are classified in 3 groups namely Precious, Non-ferrous and Ferrous metals.

**Table 6: Key metals covered under E-waste Management Rules, 2022**

S. No.	Group	Metals
1.	Precious metals	Gold (Au)
2.	Non-Ferrous	Copper (Cu) and Aluminium (Al)
3.	Ferrous	Iron (Fe) (Including steel and galvanised iron)

For the first two years, the EPR certificate generation is only limited to metals (Cu, Au, Fe & Al). Rare earth and other precious metals will also be considered under this EPR regime after some time.

The average material composition of key metals in terms of weight has been given in Annexure I of the Framework for generation of EPR Certificate under E-Waste (Management) Rules, 2022.

There is a standard formula to calculate the EPR liability for Cu, Fe, Al and Au for certain EEE for year Y.

**Formula:**

EPR liability for Cu/Al/Fe = total weight (in tons) × 1000 (kg) × % Wt. of Recoverable Cu/Al/Fe given by CPCB

EPR liability for Au = total weight (in tons) × 1000 (kg) × % Wt. of Recoverable Au given by CPCB × EPR obligation for gold in the year Y.

◆ **EXEMPTIONS FOR GOLD**

The CPCB reviewed the capacity of 11 e-waste recycling facilities across India that claimed to recover gold from electronic waste (Rules, 2022) during the drafting of the rules. It was found that the total amount of gold these facilities can recover each year is less than the quantity that producers are supposed to manage under their EPR.

To address this shortage, the government has decided to reduce the gold-related EPR targets proportionally.

For the first year of implementation (2023–24), producers will only need to meet **20%** of their total gold recovery obligation. This target will gradually increase each year as follows:

- In the second year, the obligation will rise by 10% (i.e., to 30%) in 2024-25.

- In the third and fourth years, it will increase by 15% each year (reaching 45% and 60% in 2025-26 and 2026-27 respectively).
- In the fifth and sixth years, it will increase by 20% each year, thus reaching 80% in 2028–29 and then 100% by 2029-30.

This step-by-step approach allows time to expand recycling capacity in the country so that all gold recovery obligations can be fulfilled within five years. However, for other metals, the obligations remain unchanged. Producers must still meet 100% of their responsibilities to recover Cu, Al and Fe. The weights of the key recoverable metals from various EEE items (as % of the weight of the EEE item) are listed in Annexure-I of the said notification of CPCB.



# 04

## Rationale and objectives of the study

### 4.1 Rationale of the study

Extended Producer Responsibility (EPR) holds producers accountable for the lifecycle of their products, including collection, recycling, and safe disposal (OECD, 2016). In India, the E-Waste (Management) Rules, 2016, introduced phased collection targets, which were further strengthened through the 2022 amendment by establishing the EPR Certificate Trading System and emphasising the role of Producer Responsibility Organisations (Rules, 2022). Existing literature, however, highlights on persistent challenges in implementation—low consumer awareness, poor financial traceability of e-waste flows, and limited monitoring capacity (CRB, 2018; Nyakudya et al., 2022). Such gaps hinder effective compliance and undermine the environmental benefits of EPR. Against this backdrop, the present study aims to examine the operational challenges of EPR in India, assess compliance patterns, and explore ways to strengthen regulatory and institutional mechanisms for sustainable e-waste management.

## 4.2 Objectives

The main objectives of the study are:

- ◆ To develop an understanding of the EPR policy and its subsequent amendments for e-waste management under E-waste Management Rules in India.
- ◆ To identify and analyse the existing gaps in the implementation of EPR policy in India for e-waste management.
- ◆ To explore the key challenges faced by key stakeholders in achieving EPR compliance, including enforcement limitations, financial constraints and logistical complexities for e-waste management.

# 05

## Methodology

### › Research Design

The study adopts a mixed-method research design, combining document analysis and stakeholder mapping to assess the implementation and effectiveness of EPR in e-waste management in India. It also employs a case study approach, focusing on the roles and challenges of key stakeholders while analysing government reports, legal directives, and compliance data.

### › Data Collection:

#### ◆ Primary Sources:

- i. Right to Information responses from CPCB to collect data on implementation.
- ii. Stakeholder interviews: Interviews with producers, PROs and recyclers to understand practical challenges and perspectives.

#### ◆ Secondary Sources:

- i. **Compliance of National Green Tribunal (NGT) Orders and Status Reports:** Action Taken Reports (ATRs) submitted by the CPCB to the NGT were examined to extract data on e-waste collection, recycling volumes, the number of registered recyclers, producers, and dismantlers.

**ii. Unstarred Parliamentary Questions and**

**Answers:** Written replies to the unstarred questions laid on the table of the House (Lok Sabha and Rajya Sabha) related to e-waste management were reviewed for official statements and data presented by the Ministry of Environment, Forest and Climate Change (MoEFCC), offered additional insights into national-level policy execution and gaps.

**iii. Central Pollution Control Board (CPCB)**

**Reports:** CPCB's annual compliance reports, performance evaluations of EPR

implementation, and data from the E-waste EPR portal were analysed to understand the trends in producer registration, target fulfilment, and the functioning of recycling and dismantling infrastructure.

**iv. Policy Documents and EPR Guidelines:**

Key regulatory documents including the E-Waste (Management) Rules, 2016 and subsequent amendments, as well as CPCB- guidelines on EPR registration, implementation, and compliance mechanisms, were reviewed to provide a comprehensive policy context.



# 006

## Limitations of the Study

### > **Access to Data on EPR Implementation:**

Comprehensive data on the CPCB EPR portal was not fully accessible. RTI responses were often partial or lacked complete disclosure of relevant information, limiting the depth of analysis.

### > **Stakeholder Engagement Constraints:**

Responses from key stakeholders were limited in number. However, to overcome this limitation, a stakeholder consultation meeting was organised, which provided additional insights and helped validate the study's findings.

# 07

## Findings and Discussion

### **7.1 Key Gaps of E-waste Management Rules 2022 related to EPR Implementations**

The Extended Producer Responsibility framework under the E-waste Management Rules, 2022, has several critical gaps that undermine its effectiveness. Insights gathered from both primary data (RTI replies and stakeholder consultations) and secondary data (policy reviews, reports and official EPR portal) highlight systemic shortcomings in compliance, monitoring, and enforcement. While the rules introduced significant reforms aimed at improving accountability and promoting circular economy practices, their execution remains constrained by lack of transparency, reliance on self-reported data, limited monitoring of recovery targets, and weak enforcement of environmental compensation provisions. These deficiencies not only compromise the credibility of the system but also restrict its capacity to ensure environmentally sound e-waste management and resource recovery.

## 7.1.1 Registration and Compliance

### ➤ Absence of Comprehensive Baseline Data

One of the major challenges in implementing the EPR framework for e-waste management is the absence of comprehensive baseline data. At present, there are no official figures that compare the total number of obligated entities with those that have registered on the EPR portal. The lack of year-wise registration data further restricts the ability to analyse trends, measure compliance growth, or identify persistent gaps over time.

According to the EPR portal dashboard, a considerable number of applications remain pending for approval. Such delays reflect administrative bottlenecks that weaken compliance and create uncertainty for entities awaiting registration.

Beyond administrative delays, coverage gaps persist in terms of market participation. Many micro and small-scale manufacturers, grey-market importers, and unregistered traders remain outside the ambit of the EPR framework. These unaccounted actors divert e-waste into informal or unregulated channels, where environmental and occupational safeguards are often absent, undermining accountability and traceability.

### ➤ Incomplete Producer Coverage on CPCB's Portal

A key concern is the incomplete registration of producers on the CPCB portal. While large, formal-sector companies are mostly covered, many small manufacturers, grey-market importers, and online sellers remain outside the system. One main reason is that EPR registration is not yet linked with important processes such as product certification, customs clearance or GST filing, which makes it easier for some players to bypass the requirement. This gap creates an uneven playing field where bigger companies shoulder most of the compliance responsibility, while many smaller or informal actors remain unaccounted for, ultimately reducing both fairness and the overall effectiveness of the framework.

### ➤ Lack of Public Transparency

One of the key challenges in strengthening the EPR system for e-waste management lies in the absence of public transparency. Compliance-related information submitted by producers, recyclers, and other obligated entities is not made available for public scrutiny. This lack of openness makes it difficult for external stakeholders, such as civil society organisations, researchers and consumers, to evaluate how effectively the system is functioning. Public access to such information could play a critical role in building accountability and trust in the EPR framework.

### ➤ Absence of Return Submission Data

According to an RTI reply, there is no data available on annual return submissions for FY 2023–2024 and FY 2024–2025. This is primarily because the EPR portal became operational only recently in January 2025. Consequently, any compliance data for the years before its operationalisation is not recorded or available in the public domain. The absence of retrospective data significantly limits the ability to track compliance trends, evaluate performance improvements, or measure the effectiveness of the rules over time.

### ➤ No Record of Grievance Redressal

Another gap relates to the lack of information on grievance mechanisms. At present, there is no data on the number of grievances filed, resolved, or the average resolution time for grievance redressal in FY 2023-2024 and FY 2024-2025. Without such information, it is difficult to assess how responsive the system is to stakeholder concerns or whether the portal is equipped to handle disputes and operational challenges effectively.

### ➤ Dependence on Self-Reported Data

The current EPR compliance system relies heavily on self-reported data submitted by producers and recyclers. While this reduces administrative burden, it creates significant limitations for independent verification and accountability. The CPCB portal

requires stakeholders to report their activities, but the information provided is not publicly disclosed, or cross-verified with independent datasets. This raises the risk of under-reporting, misreporting, or selective compliance.

A related concern is also the gap between collection targets prescribed for producers and the actual volumes of e-waste physically collected and processed. Producers may declare compliance based on self-reported sales and collection figures, but physical traceability often remains weak. In many cases, sales data can be under-declared to lower EPR obligations, while regulators lack automated systems for real-time verification.

As EPR targets increase in the coming years, robust systems for measuring, verifying, and reporting recovery performance will become even more critical. Weaknesses in monitoring and reporting not only make it difficult to identify shortfalls and plan improvements but also reduce stakeholder confidence in the system. Greater transparency in EPR certificate trading, recycling audits, and real-time disclosure of compliance data is therefore essential to prevent fraud, enhance traceability, and build trust across the industry.

## 7.1.2 Shift from Collection to Recycling and Recovery-based compliance

### ➤ Earlier Framework: Focus on Collection

Under the earlier E-Waste (Management) Rules, 2016, producers had explicit responsibilities for setting up and maintaining systems to collect end-of-life electronics from consumers. The key obligations included:

- ◆ Setting up collection centres to take back discarded products.
- ◆ Establishing take-back systems through dealer networks or reverse logistics partners.
- ◆ Conducting awareness campaigns to encourage consumer for the safe return of old electronics.
- ◆ Maintaining records of quantities collected and their route to authorised recyclers.

This design made producers accountable for building physical collection infrastructure, encouraging them to invest deliberately in systems to gather e-waste from households and businesses. Such infrastructure was essential for enabling downstream recycling to function effectively.

### ➤ Collection Targets under 2016 Rules:

- ◆ Phase-wise targets were set, starting at 10% of the quantity of waste generated in 2017-18.
- ◆ Targets increased by 10% annually, reaching 70% from 2023 onwards.
- ◆ Collection methods included collection centres, collection points, and formal take-back systems.

This approach ensured that producers could not simply offload responsibility. They had to actively invest in building the collection ecosystem necessary for a functioning recycling system.

### ➤ 2022 Revision: Shift in Focus

The E-Waste (Management) Rules, 2022 significantly altered this approach.

- ◆ The mandatory requirement for producers to maintain their own collection centres was removed.
- ◆ Compliance obligations shifted almost entirely to meeting recycling and recovery targets.
- ◆ Producers now demonstrate compliance by proving that e-waste has been properly recycled, with recovery of valuable materials such as metals.

### ➤ How the Targets Work:

- ◆ The 2022 Rules establish annual e-waste recycling targets for producers.
- ◆ These targets are tied to the quantity of waste generated or sold in previous years.
- ◆ Specific target percentages are laid out for each year, with a more structured and predictable progression than the older rules.

This approach aims to enhance environmental effectiveness by ensuring that waste is not merely stockpiled but also processed, allowing for the recovery of valuable materials. But certain gaps remain:

- ◆ The current rules do not explicitly require producers to invest in or maintain dedicated physical collection systems.
- ◆ This may inadvertently limit the strengthening of upstream collection networks, which are essential to ensure that waste consistently enters formal recycling channels.

### 7.1.3 Metal Recovery Targets

The E-Waste (Management) Rules, 2022 prescribe annual recovery targets for key metals such as aluminium, copper, iron and gold. While this is an important step towards resource efficiency, significant gaps remain in the design and monitoring of these provisions. First, no dedicated monitoring framework has been described to assess recovery efficiency. In the absence of performance audits or standardised methodologies, it is difficult to determine whether the prescribed targets are being met in practice or whether recovered metals maintain the required purity and quality standards. Second, the current targets focus only on a select group of metals, leaving out other significant components of e-waste such as plastics, glass, and critical raw materials or rare earth metals. This narrow approach limits the potential of the EPR framework to support a holistic circular economy strategy. Broadening the scope of recovery targets would help maximise resource recovery, reduce environmental leakages and strengthen supply-chain resilience.

At the same time, significant incentives exist in India to encourage higher recovery rates, particularly for critical minerals. The government has introduced a ₹15 billion (\$1,500 crore) incentive scheme (2025–2031) to support domestic recycling of e-waste and battery waste, providing capital and operational subsidies for recyclers that invest in infrastructure to extract minerals such as lithium, cobalt, nickel, and rare earth elements. Regulatory mechanisms under the EPR framework, including the tradable EPR

certificate system and environmental compensation for non-compliance, further motivate producers and recyclers to maximise recovery.

### 7.1.4 Environmental Compensation

The Environmental Compensation (EC) mechanism under the E-Waste (Management) Rules, 2022 is designed to deter non-compliance by requiring defaulting producers to make financial contributions towards recycling, safe disposal, or environmental remediation. However, its implementation so far appears limited.

According to an RTI reply, no penalties or environmental compensation have been imposed or collected for FY 2023–24 and 2024–25. While non-compliance cases are reportedly under scrutiny, enforcement actions have not yet translated into financial recovery or corrective measures. This delay weakens the deterrent effect of the EC framework and raises concerns about its effectiveness as a compliance tool.

Without timely imposition and collection of penalties, producers may perceive the system as lenient, reducing the urgency to meet their obligations. Strengthening the monitoring process, ensuring quicker resolution of non-compliance cases, and publicly disclosing EC impositions could significantly enhance accountability and reinforce the credibility of the enforcement system.

### 7.1.5 Exclusion of the Informal Sector:

Although the E-Waste (Management) Rules, 2016, and the revised 2022 Rules talk of Extended Producer Responsibility, the role of informal sector workers remains largely uncovered. At present, the majority of India's e-waste is still handled by the informal sector using rudimentary methods such as acid leaching and open burning. While these processes enable the extraction of high-value metals like copper and gold, they also result in the loss of critical materials such as tantalum, platinum and palladium, in addition to causing severe environmental contamination of rivers, soils and water bodies.

Earlier frameworks did include provisions to promote the transition of informal workers into formal channels, with as many as 23 categories recognised for integration. However, these categories were subsequently dropped, reducing opportunities for structured inclusion. At the same time, policy changes such as increase in GST from 5% to 18% created additional financial barriers for recyclers, further discouraging formalisation. As a result, while the formal sector struggles with a shortage of material supply, informal workers continue to operate without recognition, financial support, or safe working conditions. This undermines the objectives of EPR and reduces the effectiveness of recovery targets. The absence of a systematic integration plan also means that the socio-economic contributions of informal workers remain invisible in official data, while their practices are treated as liabilities rather than upgraded into safer, more sustainable models. The continued exclusion of informal workers not only weakens India's recycling potential but also perpetuates unsafe practices, data unreliability and environmental risks.

## **7.2 Challenges in EPR Compliance under E-waste Management Rules, 2022: Insights from Key Stakeholders**

### **7.2.1 High Compliance Burden Shifts Focus from Innovation and Circularity**

One of the major challenges in the current EPR framework is the high administrative and regulatory compliance burden imposed on producers. While these measures aim to formalise waste management, the extensive paperwork and delays in approvals often divert the company's resources—both financial and human—towards compliance management rather than innovation. This focus on meeting regulatory checklists leaves limited room for experimenting with circular economy strategies.

In essence, the rules, though well-intentioned, inadvertently discourage investment in sustainable product design and innovation, as the immediate priority is on regulatory adherence rather than on systemic circularity.

Another important observation is that many Original Equipment Manufacturers (OEMs) and producers treat EPR more as a liability than a responsibility. In practice, several companies follow a tendering process where the lowest bidder (L1) or another chosen recycler is selected to handle e-waste. While the Central Pollution Control Board (CPCB) has set a basic EPR price per unit, there are cases where recyclers on the CPCB-approved list offer low rates. This creates a race to the bottom, where the focus is on minimising costs rather than ensuring proper recycling, as they need to fulfil regulatory compliance.

### **7.2.2 Lack of Incentives for Product Longevity**

The EPR framework primarily emphasises waste collection and end-of-life recycling rather than encouraging producers to design durable or repairable products. There is little to no incentive for manufacturers to extend the lifespan of their products through robust design, availability of spare parts, or ease of repair. This gap results in products being designed for planned obsolescence, where shorter product lifecycles not only drive higher sales but also increase the e-waste burden. Without clear policy or financial benefits tied to product longevity—such as reduced EPR fees for easily repairable items or tax incentives for sustainable design—manufacturers are less motivated to adopt circular practices that could significantly reduce waste generation.

### **7.2.3 Lack of Incentives for Quality Recycling Practices**

While the EPR framework mandates producers to ensure recycling of collected e-waste, there are limited mechanisms to reward high-quality recycling practices. Many formal recyclers may

focus on volume rather than quality due to cost pressures, resulting in inefficient recovery of valuable materials or unsafe processing methods. Without differentiated incentives for recyclers achieving higher recovery rates, better environmental standards or safe handling of hazardous substances, the system risks incentivising quantity over quality. Consequently, those recyclers who choose to install superior systems see no advantage in the EPR system, because they get the same from the EPR certificate as those using polluting or inefficient methods.

Understanding by example:

### 7.2.4 Weak Reverse Supply Chain and Collection Leakages

A significant gap in the current EPR system is the weakness of the reverse supply chain, which is responsible for channelling end-of-life products from consumers back to authorised recyclers. The absence of robust collection networks, especially in semi-urban and rural areas, leads to significant leakages, with a large portion of e-waste ending up in the informal sector or being disposed of improperly. Factors such as inadequate

infrastructure, limited financial support for collection, and poor coordination between producers, aggregators, and recyclers exacerbate the problem. These leakages compromise the traceability and accountability of e-waste flows, hindering the effectiveness of recycling and the broader circular economy objectives.

### 7.2.5 Lack of Consumer Awareness

Consumers play a critical role in ensuring e-waste reaches formal recycling channels, yet awareness about proper disposal, take-back schemes, and the environmental hazards of informal recycling is generally low. Many consumers are unaware of the collection points or processes under the EPR framework and may go to informal recyclers for convenience or monetary gain. This lack of awareness not only limits the volume of e-waste entering formal recycling streams but also perpetuates unsafe handling practices in the informal sector. Educating consumers about their role in e-waste management, incentivising participation in take-back programmes, and creating user-friendly disposal mechanisms, are essential to improving the overall efficiency of the EPR system.

#### Example 7: Authorised Recyclers, Contrasting Practices



**Recycler**

**A**

Uses a crude acid-leaching method to extract metals from printed circuit boards

- Low-priced set up.
- Produces toxic wastewater that may be improperly treated or even dumped.
- Poses serious environmental and health hazards.



**Recycler**

**B**

Invests in closed-loop hydrometallurgical systems

- Expensive and technically advanced.
- Ensures clean effluent treatment with minimal environmental impact.
- Safer for workers and communities.

Yet both recyclers:

- Receive the same acknowledgement from authorities.
- Get EPR certificates of the same value per tonne of e-waste processed.
- Are equally eligible suppliers for producers meeting EPR targets.

**There is no extra credit, financial reward, or market preference for Recycler B's cleaner and safer technology.**

# 088

## Conclusion

India's Extended Producer Responsibility framework for e-waste represents a significant step towards formalising electronic waste management and embedding circular economy principles into the electronics sector. The framework provides a structured system that assigns clear responsibilities to producers, establishes mechanisms for collection, recycling and environmentally sound disposal, and aligns with global best practices. This foundation has enabled India to create a regulated approach to a growing e-waste challenge, ensuring that producers contribute to mitigating the environmental and social impacts of electronic products at the end of their life cycle.

Despite these achievements, implementation challenges persist. The current reliance on self-reporting by producers limits accuracy and reliability of data. Likewise, restricted public visibility reduces accountability. The reverse supply chain, although developing, faces gaps in coverage, particularly in informal and rural sectors, which can lead to leakage and improper disposal of e-waste. In addition, there is limited incentivisation for eco-design and product longevity, which limits innovative efforts towards more sustainable production and consumption patterns. Consumer awareness also remains low, further hindering the effectiveness of collection and recycling initiatives.

These challenges, however, represent actionable opportunities for strengthening the EPR system. By expanding regulatory oversight, improving data transparency, and implementing mechanisms to reward sustainable product design and quality recycling practices, India can enhance compliance and accountability. Broader stakeholder engagement, including integration of informal sector, civil society participation and industry collaboration, can further ensure that the EPR framework is inclusive, socially responsible, and environmentally effective. Additionally, technological interventions such as digital tracking systems, standardised reporting, and eco-design certifications could facilitate more efficient and transparent operations.

Progressively addressing these areas will allow India to move towards a holistic EPR framework that not only enforces environmental compliance but also fosters innovation, social safeguards, and circular economy objectives. A strengthened framework can serve as a model for other emerging economies, demonstrating how regulatory systems, when combined with market incentives and public participation, can transform e-waste management from a challenge into an opportunity for sustainability, resource efficiency, and climate resilience. India's EPR framework has the potential to create a virtuous cycle where environmental protection, economic innovation, and social responsibility reinforce each other, establishing a long-term sustainable path for the electronics sector.



# 09

## Recommendations

Effective implementation of Extended Producer Responsibility (EPR) in India's e-waste sector requires addressing gaps in data management, stakeholder engagement and regulatory oversight. While the current framework provides a foundation, challenges such as informal sector dominance, weak reverse supply chains, and limited enforcement hinder its effectiveness. For effective implementation of EPR policy in e-waste, here are a few recommendations that may be taken into consideration:

- **Improve Data Transparency and Verification:** Effective EPR implementation relies heavily on accurate, timely, and verifiable data. Currently, self-reporting by producers limits the credibility of reported information and hampers regulatory oversight. Introducing mandatory digital reporting platforms, third-party audits, and real-time tracking mechanisms can significantly enhance transparency. Publicly accessible dashboards can provide insights into collection rates, recycling performance and compliance levels, fostering accountability and building trust among consumers, regulators and civil society. Data transparency also enables evidence-based policy adjustments and targeted interventions, ensuring resources are allocated where they are most needed.

- **Expand Stakeholder Coverage:** E-waste management in India involves multiple actors, including producers, importers, retailers, recyclers and government bodies. To achieve a truly effective EPR system, the coverage must be comprehensive, encompassing small and medium enterprises, regional distributors and informal collection networks. Regulatory frameworks should incentivise participation from all producers, including those in remote areas, while facilitating collaboration between various stakeholders. Expanding coverage would ensure that no part of the supply chain is left unmonitored, reducing leakage and increasing overall efficiency in collection and recycling efforts.
- **Strengthen Reverse Supply Chains:** The reverse logistics of e-waste—from consumer collection points to recyclers—remains a critical bottleneck in India. Strengthening these supply chains involves creating more collection centres, optimising transportation routes, and ensuring environmentally sound handling and storage practices. Integration of digital tracking tools can improve traceability and prevent unauthorised disposal. Strengthened reverse supply chains not only minimise environmental risks but also enhance economic opportunities by enabling organised aggregation and processing of e-waste, thereby supporting the growth of formal recycling industries.
- **Enhance Consumer Awareness:** Consumers play a pivotal role in ensuring the success of EPR initiatives. Awareness campaigns should focus on the environmental and health impacts of improper e-waste disposal, the availability of collection points, and the benefits of returning products to authorised channels. Educational programmes in schools, communities and workplaces, coupled with digital campaigns and incentives for participation, can significantly increase responsible disposal behaviour. Empowering consumers with knowledge strengthens the demand side of the EPR system and ensures higher recovery rates.
- **Introduce Incentives for Product Design and Quality Recycling:** To foster a circular economy, producers must be incentivised to adopt eco-design practices that prioritise durability, reparability and recyclability. Policy measures could include differential EPR fee structures, tax rebates, or recognition programmes for environmentally optimised products. Similarly, recycling units delivering high-quality, verified outputs should receive preferential access to resources or market support. By aligning the financial and regulatory incentives with sustainable practices, India can encourage innovation, reduce environmental impact, and enhance the economic viability of recycling operations.
- **Integrate the Informal Sector:** A significant proportion of India's e-waste is managed by informal actors who often operate without protective measures or formal oversight. Integrating these actors into the formal EPR system through training, certification and partnerships can improve environmental safety, working conditions and data collection. Formalisation not only ensures compliance with environmental standards but also enhances livelihoods and promotes social inclusion. Collaborative models between formal recyclers and informal workers can leverage local expertise while advancing sustainable e-waste management.
- **Mandate Data Security and IT Asset Disposition (ITAD):** Current EPR rules and the DPDP Act do not adequately address data sanitisation, creating risks of data breaches and legal liabilities. To mitigate these risks, India must integrate IT Asset Disposition (ITAD) practices into e-waste management, requiring that devices be securely wiped or destroyed following internationally recognised standards such as NIST SP800-88, GDPR, and the DPDP Act. Professional recyclers and refurbishers should be trained in modern data erasure methods—like software-based sanitisation and certified physical destruction—to prevent data leaks,

ensure compliance and build trust of consumers in the formal recycling ecosystem.

- **Adopt International Recycling and Refurbishment Standards:** Refurbishment and recycling in India remain largely informal. This informal dominance undermines material recovery, environmental protection, occupational safety and market credibility. To address this, recyclers and refurbishers should adopt globally recognised certifications such as R2v3, e-Stewards, and TCO, which provide rigorous auditing of processes, ensure traceability of materials, and include occupational safety and environmental safeguards. These standards also cover data security, aligning recycling and refurbishment with international expectations. Adoption of such certifications can professionalise the sector, prevent undercutting by low-cost, non-compliant operators, and enable India's formal recyclers to participate in global supply chains while meeting environmental, social, and economic sustainability requirements. Additionally, prioritising refurbishment over recycling can extend product lifespans. Studies show devices like iPhones and Samsung smartphones can have an additional 10-13 years of useful life, reducing material demand and reinforcing circular economy goals.

- **Strengthen Enforcement and Compliance Mechanisms:** Current enforcement under India's EPR framework remains largely reactive, relying heavily on self-declarations from producers and limited audit capacity, which creates opportunities for misreporting and undermines

environmental protection. To address this, India should adopt a more structured and proactive enforcement framework that ensures genuine material recovery and accountability. Auditing recyclers' recovery claims using defined conversion factors for each type of electronic equipment can verify that reported outputs align with actual recycling capacity. Consistent penalisation for non-compliance, guided by fixed charges and clear regulatory guidelines, will deter fraudulent practices and promote adherence to the rules. Additionally, mandating legally accountable self-declarations ensures that producers and recyclers cannot submit false information without consequences. Integrating third-party oversight for legal, environmental, occupational safety, and data security compliance further strengthens the system, providing an additional layer of verification and transparency. Such a framework not only protects the environment but also builds trust in the formal recycling sector and encourages responsible investment in sustainable e-waste management.

Adopting these recommendations will enhance material recovery, ensure environmental protection, and professionalise the recycling ecosystem. Strengthening data transparency, expanding stakeholder coverage, integrating the informal sector, and enforcing international standards will improve compliance and build trust. Combined with consumer awareness and incentives for sustainable product design, these measures can make India's e-waste management more efficient, sustainable, and aligned with circular economy principles.

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