

From Targets to Outcome: An Assessment of EPR Implementation in India's E-Waste Sector

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Abstract

Extended Producer Responsibility (EPR) has emerged as a key governance tool for managing electronic waste (e-waste) sustainably in India. This paper examines India's EPR performance by comparing EPR targets and actual achievements for financial year 2023-24 and 2024-25, using secondary data from the Central Pollution Control Board (CPCB) and relevant ministry reports. The study finds that while India achieved a high compliance rate in 2023-24 (92.15%) performance declined significantly in 2024-25 (48.32%), reflecting an implementation gap. Material-wise analysis shows especially low recovery for precious metals like gold, highlighting technological and institutional challenges. The result suggests that while India's EPR framework demonstrates strong policy intent, systematic changes in collection, reporting, technology and informal sector integration hinder effective implementation. Policy recommendations to strengthen collection networks, improve market incentives, and enhance institutional co-ordination are discussed.

Keywords: Extended Producer Responsibility-EPR, e-waste Governance, Circular Economy, Recycling Performance.

Introduction:

As a result of shorten product lifecycles, growing digitalization, urbanization and rapid technological advancement, electronic waste becomes one of the fastest growing waste issues today. The amount of electrical and electronic equipment that is thrown away has increased dramatically due to rising consumption. This includes computers, cell phones, televisions, and household appliances. Environmental and public health hazards, such as soil and water contamination and exposure to dangerous element like lead, mercury and cadmium are present when e-waste is improperly disposed off and recycled informally. Waste is valuable resource in the context of the circular economy because it contains commodities that can be recovered including copper, aluminium, iron and precious metals.

One of the world's top producers of e-waste, India has seen a steady increase in the amount of e-waste produced in recent years. According to recent global estimates, around 62 million metric tonnes of e-waste were generated worldwide in 2022, making it fastest growing solid waste stream. Projection indicate that this volume may reach nearly 82 million metric tonnes by 2030 if current trends continue. India ranks among the three e-waste generating countries, producing over 3.5 million metric tonnes annually. The fast rise in electronic consumption and the lack of a formal recycling infrastructure have made it extremely

difficult to ensure environmentally responsible management. The Indian government recognized these issues and implemented a regulatory mechanism to improve the efficiency of material recovery and formalize the collection and recycling system.

Among these regulatory approaches, Extended Producer Responsibility (EPR) has emerged as a central policy instrument for strengthening e-waste management. This framework assigns producers specific collection and recycling goals according to the number of products they put on the market. The Central Pollution Control Board (CPCB) releases yearly data on EPR targets and their levels of accomplishment in addition to keeping an eye on compliance.

Targets have grown significantly in recent fiscal years, indicating a greater level of policy ambition for the goals of the circular economy. However, differences between set goals and actual success rates raise significant concerns about institutional preparedness, implementation capability, and material-specific recovery performance. This context informs the current study's analysis of CPCB data on EPR targets and achievement rates for various material categories and fiscal years. The aim of the study is to evaluate performance trends, identify ambition between operational results and regulatory ambition, and investigate system.

Extended Producer Responsibility-

In the early 1990's, the idea of Extended Producer Responsibility (EPR) was introduced as a new way to solve growing waste problems. Thomas Lindhqvist first explained this concept in Sweden in 1990. EPR means that producers are responsible not only for making products but also for managing them after consumers finish using them. Earlier the government and local authorities handled waste, and the cost was paid by taxpayers. Companies were not responsible for the environmental damage caused by their products after sale. EPR changed this system by shifting the financial and physical responsibility of managing end-of-life products from the government to the producers.

EPR was first implemented in Europe, particularly through Germany's Packaging Ordinance (1991), and later institutionalized at the European Union Level through directives such as the Waste Electrical and Electronic Equipment (WEEE) Directive. The concept became popular worldwide and is now a key tool for managing waste like packaging, batteries, old cars, plastic and electronic waste, etc.

EPR's applicability is especially remarkable when it comes to managing e-waste. At the end of their lifecycles, complex resources, such as electronic products, can be hazardous. Without a system of producer-based responsibility, e-waste management is still dispersed, underfunded, and hazardous to the environment. Producers must create system to take-back used products achieve collection and recycling targets and make sure materials are recycled in an environmentally safe way. EPR pushes companies to design sustainable products, reducing waste and promoting recycling.

In India, EPR was first introduced under the E-Waste (Management and Handling) Rules, 2011, and strengthened under the E-waste (Management) Rules, 2016. A significant reform occurred with the notification of the E-Waste (Management) Rules-2022, which established a centralized digital EPR portal and introduced certificated based recycling targets. These regulatory developments reflect India's attempt to formalize the recycling sector, improve compliance, monitoring, and enhance material recover from e-waste.

However, the effectiveness of EPR depends on number of factors such as collection infrastructure, recycler capacity, producer compliance, and integration of the informal sector. Therefore, extended producer responsibility is a step toward a more accountable and circular governance framework, replacing the linear

waste management model. Recycling e-waste, EPR advances the goals of the circular economy, lower environmental risks, and encourages sustainable resource management in addition to acting as a regulatory mechanism.

Objective of the Study

1. To assess EPR target setting and actual achievement in India for FY 2023-24 and 2024-25.
2. To analyse material-wise performance in EPR achievement.
3. To identify implementation gaps in India's EPR governance framework.

Research Methodology:

This study is based on secondary data from official sources including CPCB Reports, MoEFCC responses, and Government filings. The data analyses include the EPR targets and achievement reported for 2023-24 and 2024-25. Disaggregated by material type (iron, aluminium, copper, and gold). A descriptive comparative approach is used to assess differences across years, alongside analytical interpretation of systematic challenges.

Literature Review:

1. **According to Government of India (2022)**, "The E-Waste (Management) Rules, 2022 strengthened India's EPR mechanism by expanding producer obligations and introducing digital tracking systems. The regulatory frameworks aim to formalize the recycling sector and enhance material recovery from electronic waste."
2. **According to Fort et al. (2020)**, "E-Waste is one of the fastest growing waste streams globally, which create a significant environmental and economic challenges."
3. **According to Lindhqvist (2000)**, "Extended Producer Responsibility (EPR) was introduced as an environmental policy principle aimed at shifting the responsibility of post-consumer waste management from governments to producers. The core objective of EPR is to encourage eco-friendly product design and ensure that producers remain accountable for the end-of-life management of their products."
4. Different research studies shows that the recovery efficiency varies across materials. Precious metals such as gold and copper often face technological and economic barriers, while bulk materials like iron and aluminium show relatively higher recycling performance. This trend showing differences in materials-wise EPR achievement rates."

The Status of Recycling Target: From 2023-24 to 2024-25-

Recycling: Meaning and Target-

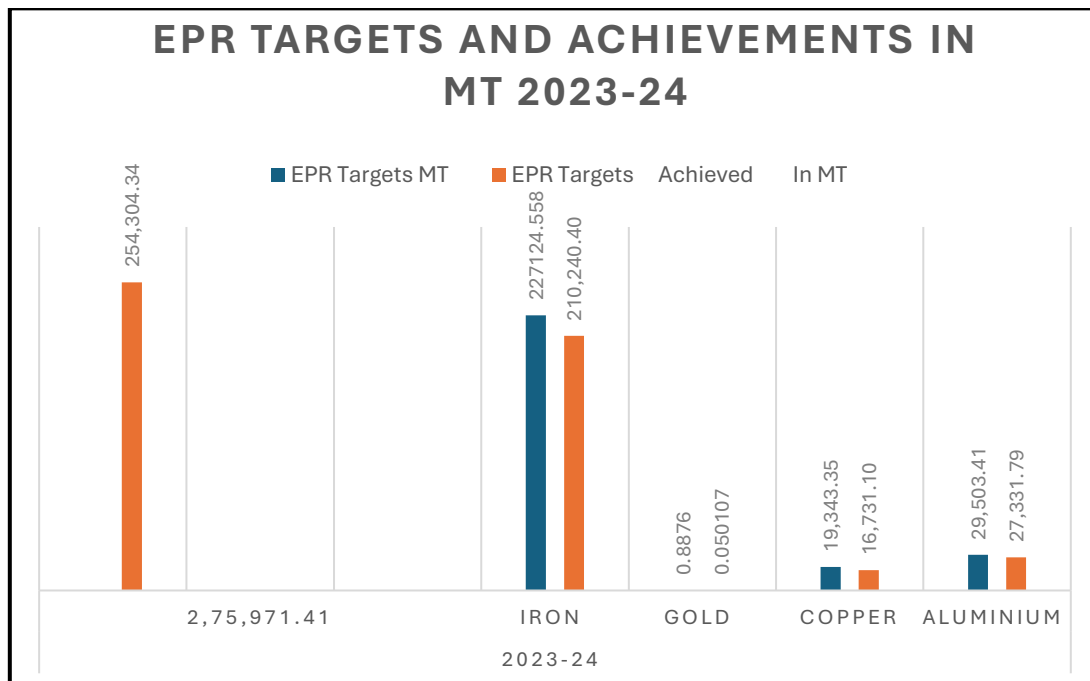
Recycling means collecting waste materials and processing them so they can be used again to make new products. Instead of throwing things away, they are treated and converted into useful raw materials. In the case of e-waste, valuable metals and parts are taken out safely. Recycling helps reduce waste and protects the environment.

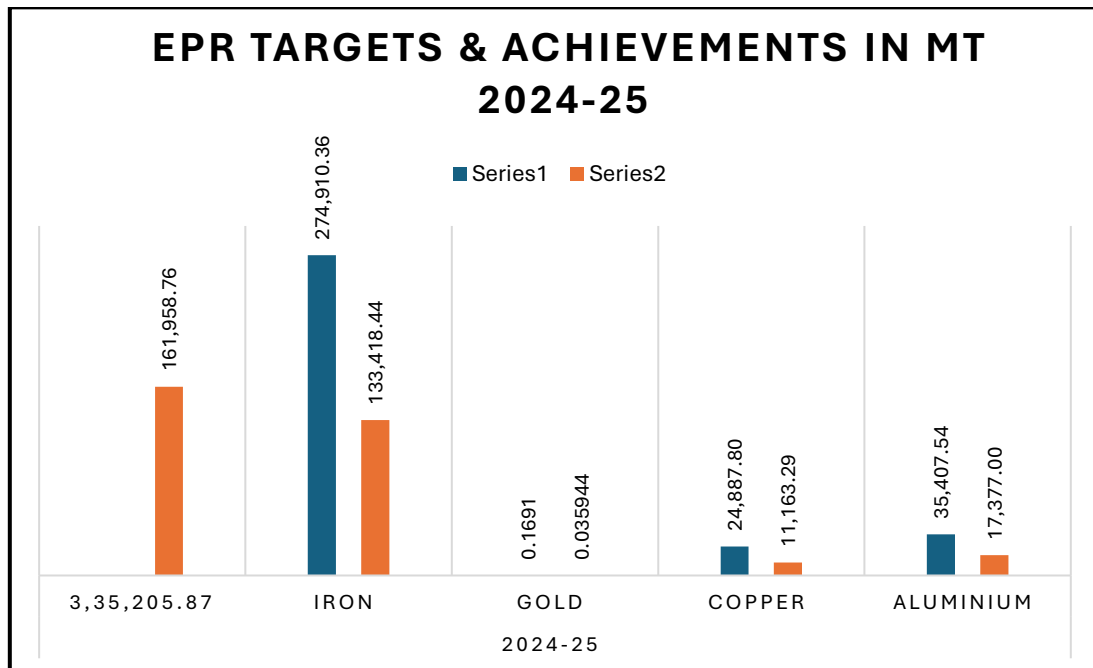
Recycling target means the fixed amount of waste that producers are required to collect and recycle within a certain year. It is a goal set by the government under waste management rules. The target tells producers how much e-waste they must handle responsibly. It helps ensure that recycling actually takes place and is properly monitored.

Table (I) The Status of EPR Targets-

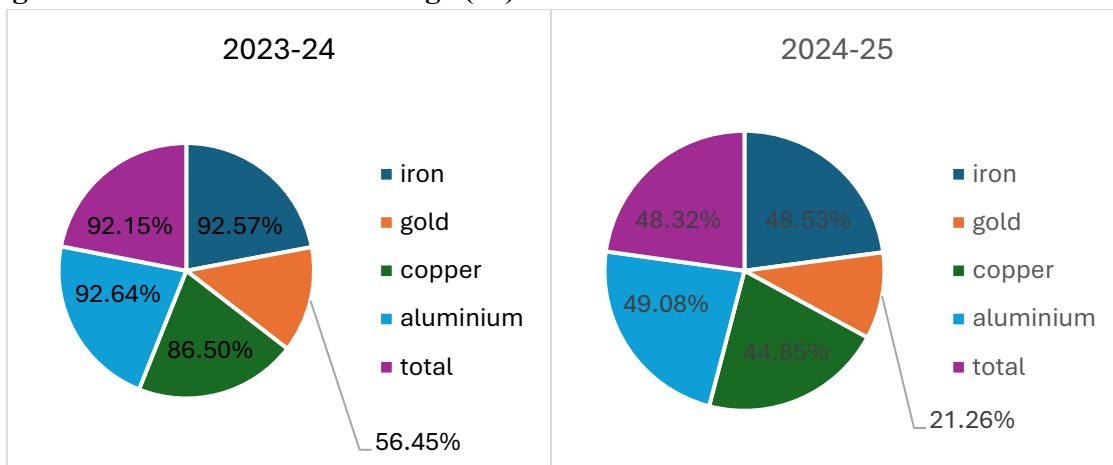
Financial Year	EPR Targets (in MT)		EPR Targets Achieved (in MT)	EPR Targets Achieved in %
2023-24	2,75,971.408		2,54,304.337	92.15%
	Iron	2,27,124.558	2,10,240.396	92.57%
	Gold	0.8876	0.050107	56.45%
	Copper	19,343.347	16,731.098	86.5%
	Aluminium	29,503.413	27,331.791	92.64%
2024-25	3,35,205.865		1,61,958.758	48.32%
	Iron	2,74,910.358	1,33,418.439	48.53%
	Gold	0.16910	0.035944	21.26%
	Copper	24,887.796	11,163.285	44.85%
	Aluminium	35,407.542	17,376.997	49.08%

Source: Central Pollution Control Board -2024





EPR Targets Achievements in Percentage (%)



The data presented for the financial year 2023-24 and 2024-25 show to compare EPR targets with actual achievements, expressed both in metric tonnes and as a percentage of compliance. This comparison serves as an important indicator of the effectiveness of e-waste governance, regulatory enforcement, and recycling infrastructure in India.

In the financial year 2023-24, the overall EPR target was set at 275,971.408 metric tonnes, out of which 254,304.337 metric tonnes were successfully achieved, resulting in a 92.15% achievement rate. This high compliance rate suggests that EPR mechanism was operationally effective during this period. A 92.15% achievement rate reveals that;

- Producers mostly completed their responsibility under EPR.
- Authorized recyclers had enough facilities and equipment to manage the waste properly.
- The system for collecting e-waste was working fairly well.
- The monitoring and reporting system was also working properly, though there was still some scope for improvement.

Material-wise Performance:

Material-wise Performance means checking how much of each material—like iron, copper, aluminium, plastic, or precious metals—has been recycled. It compares the recycling target set for each material with the amount that was really recycled. The result is usually shown in percentage form. This helps us understand how well the recycling system is working for each material. Material-wise performance in 2023-24 indicates;

- Iron (92.57%) and aluminium (92.64%) demonstrated almost total success. Because these materials are relatively easier to recover using current recycling technologies and makeup a significant portion of e-waste by weight.
- Copper (86.5) also exhibited strong performance reflecting established recover process and high economic value.
- Gold (56.45%) however recorded significantly lower achievement.

The lower gold recover rate does not signify governance failure. The challenges in gold recover are due to its low presence in e-waste and need for capital intensive technology.

The 2023-24 data represent a mature phase of EPR implementation, where regulatory targets were aligned with existing recycling infrastructure, collection capacity and administrative capabilities. This year can be interpreted as a benchmark year demonstrating what the Indian e-waste management system can achieve under favourable conditions.

In contrast, the financial year 2024-25 presents a very different picture. The overall EPR target increased sharply from 275,971.408 (2023-24) to 335,205.865 (2024-25), while the achievement stood at 161,958.758 metric tonnes, resulting in an achievement rate of only (48.32%).

At first sight, the decrease may look worrying. However, a deeper and more careful interpretation reveals that this drop does not signify failure of the EPR system but rather reflects a transition phase in policy implementation. One major reason for the lower EPR achievement in 2024-25 was the sharp increase in EPR targets. Compared to the previous year, producers were required to recycle a much larger amount of e-waste, showing the governments strong push toward a circular economy and better material recovery. However, this sudden rise in targets put heavy pressure on existing collection systems, recycling and reporting processes. In many situations, the recycling system was not able to expand quickly enough to meet these higher requirements, which led to lower achievement levels.

Material-wise analysis indicates (2024-25) that the iron and aluminium rates declined to approximately 48 to 49%, even though these materials are relatively easy to recycle. This indicates that the primary constraint not technological capacity, but rather inadequate collection, reporting delays, and insufficient integration of informal waste streams.

Copper achievement fell to 44.85%, reflecting both collection inefficiencies and market fluctuations that influence recycling incentives. Copper recovery depends heavily on steady supply chains, which are disrupted when e-waste remains outside formal systems.

Gold recorded the lowest achievement rate at 21.26%, reinforcing the persistent challenges associated with precious metal recovery. Advanced metallurgical processes required for gold extraction are available only in a limited number of facilities and recovery is often deferred until economically viable quantities are accumulated.

Comparative Interpretation of EPR Target Achievement Rate and Government Signals During 2023-24&2025-

Aspect	2023-24	2024-25
EPR Targets	Moderate	High
Achievement Rates	Very high	Low
Government Signals	Stability	Transition stress

This comparison highlights a policy ambition-implementation gap, rather than a collapse of governance mechanisms. The decline in achievement percentage in 2024-25 reflects a situation where;

- The ambition for regulation has grown quickly.
- However, the reporting system, collection effectiveness, and institutional capacity are still being adjusted.

This phase is typical in evolving regulatory systems and should be interpreted as growing pain, not a failure. The rules have become stricter and more ambitious, but the system needs time to catch up.

Conclusion

Extended Producer Responsibility (EPR) is a global policy approach making producers financially or physically responsible for products throughout their lifecycle, covering waste collection, recycling and disposal. Over 400 EPR schemes exist worldwide, notably in the EU and OECD countries, primarily targeting plastics, electronics, and packaging to enhance circularity.

The e-waste management system in India is going through huge changes, and the results are sometimes positive and sometimes challenges. The numbers from the last two years show a big jump in EPR targets, but also these are some challenges along the way. In 2023-24, we saw a 92.15% achievement rate-that is pretty impressive! but then in 2024-25, it dropped to 48.32%. Sound bad, right? That's not necessarily the case. The important thing is that India's trying to do something really ambitious regarding EPR framework. We are talking about managing e-waste in a country with tons of people and rapid technological growth. It's like trying to change the wheels on a moving car. The lower performance in some areas like gold recovery. It is not easy task. It is really hard. Gold is present in tiny amounts in e-waste and extracting it requires some seriously advanced technology. So, what the main idea? we are not failing; we are figuring things out as we go. The EPR system is evolving and with some fine-tune and improvement. We can get it working even better. It is a continuous journey, and we are on it.

Suggestion/ Policy Recommendations-

Throughout the world as well as in Indian scenario, e-waste is rapidly increasing. After some decade e-waste will create serious environmental, social, and cultural hazard. If we want to manage this problem, we should follow some necessary steps, at individual and national level. Some steps are;

- **Improving the Official Collection Process:** There is a requirement to broaden and upgrade formal e-waste collection infrastructure statewide, ensuring sufficient e-waste supply to authorized recycling facilities.
- **Integration of the Informal Sector:** Informal recyclers should be gradually integrated into the EPR framework through training, registration and incentive-based mechanisms to improve reporting and environmentally safe recycling.

- **Enhancement of Recycling Infrastructure:** Financial and technical assistance should be provided to investment in cutting-edge recycling technologies, particularly for the recovery of precious metals like copper and gold.
- **Improved Monitoring and Data Transparency:** Strengthened digital reporting systems and reducing delays in certification will improve transparency and help in accurate assessment of EPR performance.
- **Training and Awareness Program:** Implementing periodic training programs for producers, recyclers and regulatory authorities, alongside public awareness drives can augment an overall adherence and effectiveness.

For the success of EPR in India, it is not crucial to have ambitious policy goals, but also strong institutional frameworks and collaborative governance structures. To adopt managerial and institutional management, we can achieve the successive waste management and by this adoption we can boost our economy.

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