International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Extended Producer Responsibility on E-waste Management in India: Challenges and Prospects

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Abstract: ***Extended Producer Responsibility (EPR) is an important strategy globally to streamline electronics waste (e-waste) for effective managing and disposing the end of life products. E-Waste (Management) Rules 2016 has provisioned the responsibility of every stakeholder in the e-waste value chain for effective EPR. The producers are, however, not adequately aligned to embrace EPR effectively. Implementation of EPR in India faces serious challenges including effective coordination between the producers and Central Pollution Control Boards (CPCB) for authorization and clearances, awareness generation and physical and financial responsibility of the producers. E-Waste (Management) Rules 2016 has introduced collection targets; however, possible solutions need to be brought out to integrate the robust informal sector currently engaged in handling e-waste, which poses serious challenges in effective implementation of EPR in India. Attempt has been made in this article to find out a solution of effective implementation of the EPR in India. The article has discussed various best practices around the world to understand the relevance to the issues concerning India and suggested some effective models for the country.***

Keywords: Extended Producer Responsibility, E-waste Management, Producer Responsibility Organization

1. Introduction

The electronics waste (e-waste), which comprises of discarded electrical and electronic equipment, is posing serious challenges globally due to improper disposal. Developed and few developing countries are preparing themselves in addressing these challenges. The increasing "market penetration" in developing countries, "replacement market" in developed countries and "high obsolescence rate" of the products make e-waste one of the fastest growing waste streams. Environmental issues and the trade associated with e-waste at local, trans-boundary and international level has driven many countries to introduce interventions. One of the most promising policy options to address this issue is to extend the producers responsibility for their products beyond the point of sale, until end-of-product-life [1, 2].

'Extended Producer Responsibility (EPR)' means responsibility of any producer of electrical or electronic equipment, for channelization of e-waste to ensure environmentally sound management of such waste. EPR is an environment protection strategy that makes the producer responsible for the entire life cycle of the product, especially for take back, recycle and final disposal of the product, at the end of its useful life [3]. Though the EPR is effective in the developed countries, India is facing real challenges in implementing the EPR. One of the main reasons is vibrant and robust functional informal sector. Major e-waste in India is being collected, segregated, and dismantled through an efficient network in informal sector. Informal sector is also processing e-waste in primitive and environmentally unsound means. Though, processing e-waste in informal sector in India is against the law of the land [4].

The informal activity is pre-dominant due to existence of potential secondary markets in the tier 2 or tier 3 cities. These markets are having a significant demand of second hand products, components, or modules [5]. Informal sector is meticulously meeting up this demand in supplying the various parts of the end-of-life products, after cannibalizing the same based on market demand. The remaining parts of the products, which have no market value, are processed to extract precious metals. This robust network is creating real hurdles for original manufactures to get back their products after end-of-life, which possess major challenges in effective EPR implementation in India. Integrating the informal operators with the main collection mechanism would be imperative for successful implementation of EPR.

2. EPR Status in India

India has made producers responsible for managing its own products after end-of-life by introducing the EPR clauses in E-waste Rule 2011, which was enacted since 1st May 2012 [6, 7]. The ground reality was, however, not changed much with this measure. In order to further strengthening, E-waste (Management) Rules 2016 thus further reiterates the primary responsibility of e-waste management on the producers. The E-waste (Management and Handling) Rules 2011 was amended after the stakeholder consultations in the value chain and E-Waste (Management) Rules, 2016was notified on October 1, 2018 [8, 9] for enactment. The present Rule also lists down the responsibility of other major stake-holders in the e-waste value chain. The legislation was primarily introduced to tackle the increasing issues of E-waste as well as to facilitate safe disposal, channelization and environmentally sound recycling of e-waste. The EPR is introduced for 21 items mentioned in schedule-I of the E-waste (Management) Rules, 2016. These items are divided in to 2 categories information technology & telecommunication equipment and consumer electronics.

In order to extend major responsibility of e-waste management on the producers of the electrical and electronic equipment, the new E-waste Rules mandates collection targets for the producers. A comparison of collection target in India and globally are described in below mentioned in **Table 1**.

Table 1: Comparison of Yearly Collection Targets of EPR in India and Other Countries

Year	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025- onward
India Old Producers	10%(*)	20%(*)	30%(*)	40%(*)	50%(*)	60%(*)	……..70%(*)……..		
New Producers	…….	5%(**)	5%(**)	10%(**)	10%(**)	15%(**)	15%(**)	20%(**)	20%(**)
EU(***)									
weight wise	45%	45%	65%	65%	65%	65%	65%	65%	65%
generation wise	45%	45%	85%	85%	85%	85%	85%	85%	85%
China	*No regulation at present, EPR framework to be finalised by 2020 and EPR Rule to be finalised by2025*								
Japan	Refrigerators/washing m/c:50%, Air conditioners: 60%, TVs: 55%			-	-	-	-	-	-
South Korea	3.9 kg / capita	6.0 kg/ capita	-	-	-	-	-	-	-

The EPR collection targets in India were kept very conservative (10%) in initial year (2017) for providing adequate time for the producers to prepare themselves and align with complex collection mechanism of the end-of-life products. Gradually this target has been proposed to enhance to 70% in 2023. The target calculation for the known brands (old products) has been considered the quantity of generation, however, for new brands (new products) sales figures has been considered as the basis.

The rules also simplified the EPR authorization for better implementation of the rule, single EPR authorization for producers is now being made Central Pollution Control Boards (CPCB)'s responsibility to ensure pan India implementation. The rules provisioned much flexibility for producers for effective implementation of the rules such as option for setting up of Producer Responsibility Organization (PRO), e-waste exchange, e-retailer, Deposit Refund Scheme (DRF) etc. These are explained in **Table 2**.

Table 2: Registered PRO in India

Name of the Companies and Address	Types of Affiliations	Major Activities
Karo Sambhav Pvt. Ltd., 408-409, 4th Floor, Suncity Business Tower, Sector 54, Golf Course Road, Gurugram- 122002 Haryana	Registered with CPCB	Legally required EPR plan Channelization of e-waste Create awareness on disposal of e-waste
RLG, Reverse Logistics India Pvt. Ltd., Assotech Business Cresterra, Upper Ground Floor, Tower 2, Plot No. 22. G01, Sector-135, Noida, Gautam Budha Nagar (U.P)	Registered with CPCB	Legally required EPR plan Channelization of e-waste Create awareness on disposal of e-waste
Terrapro Recycling Solutions Pvt. Ltd. RZ-83B, Dabri Extension, Dabri Palam Road, Opp. Dada Dev Govt. Hospital, New Delhi 110045	Registered with CPCB	Provide EPR plan for collection & recycling/disposal
PRO Connect, G-7, New Market, Near Khasa Kothi Circle, Jaipur- 302016	Registered with CPCB	EPR obligation of Producers (Importers, Manufacturers and Refurbisher) of EEE products registered with CPCB
Attero Recycling Pvt. Ltd., H-59, Sector-63, Noida, UP-201301	Registered with CPCB	Take back and Channelization of e-waste Authorized recycler
Auctus E Recycling Solutions Pvt. Ltd. A-58, Udyog Kendra-1 Ecotech-III, Village Habibpur, Noida-Dadri Road, Surajpur, Greator Noida, UP (201306)	Registered with CPCB	Recycler-PRO Company
EPR Compliance Pvt. Ltd. 422, The Summit Business Bay, Andheri Kurla Road, Near WEH Metor Station, Andheri (East), Mumbai-93	Registered with CPCB	
Hulladek Recycling Pvt. Ltd. 4 D.L. Khan Road, Block B, Flat-401, 4th Floor, Kolkata- 700025	Registered with CPCB	Collection & Channelisation of e-waste Fulfill the compliance of e-waste collection target for the producers
Mahalaxmi Metalloys India Pvt. Ltd. Plot No. 87, 91/92, Sikhera Road Industrial Area, Modinagar, Dist. Ghaziabad (U.P.) 201204	Registered with CPCB	Recycler-PRO Company
Pregasus Support System Pvt. Ltd, F-6, 1st Floor, 4648/1, 21, Ansari Road, Daryaganj, New Delhi-110002	Registered with CPCB	
R2 PRO Pvt. Ltd. B03-Jain Height-Altura, Kalkondrahalli, Sarjapur Road, Bangalore- 560102	Registered with CPCB	
Saahas Waste Management Pvt. Ltd, #21, Ground Floor, MCHS Colony, 5th C Cross, 16th Main, BTM Layout 2nd Stage, Bangalore-560076	Registered with CPCB	e-waste collection and channelization
TES-AMM (India) Pvt. Ltd, A 18, SIPCOT Industrial Growth Centre, Panrutti 'A' Village, Oragadam, Sriperumbudur Taluk, Kanchipuram District, Tamilnadu- 631604	Registered with CPCB	Recycler-PRO Company Recycling of e-waste Take-back scheme
Earth Sense Recycle Pvt. Ltd, Plot No: 37, TSIIC Industrial Park, Mankhal, Maheshwaram Mandal, Rangareddy Dist, Telengana-501359	Registered with CPCB	Authorized recycler Comply EPR
Vardhman Sales Agency 1A/255, Neelam Bata Road NIT, Faridabad- 121001 Haryana	Registered with CPCB	
Sanshodhan, An E-waste Exchange Pvt. Ltd., Hyderabad, Telangana	Supported by Government of Telangana (Dept of IT, E & C and Dept of Industries)	Collect & channelize e-waste to the Govt. authorized recycler, digital platform to connect with e-waste recycler

- Producer Responsibility Organization (PRO): A PRO is a European concept whereby the producer's responsibility of managing the waste is transferred to the PRO. The aim PRO would be to bring in efficiency, cost-effectiveness and awareness while managing the end-to-end operations associated with waste management. A key feature driving an effective waste management under this arrangement is targeted approach towards waste management [10].
- E-waste Exchange: This is an on-line platform to connect bulk consumers (Banks, IT Companies, educational Institutes, Government offices etc) with authorised recyclers. This also helps producers or manufacturers of electronic & electrical products to meet EPR targets.
- E-Retailer: Electronic retailing also called as e-tailing or internet retailing, is the process of selling the goods and services through electronic media, particularly through internet. Simply, the sale of retail goods and services online is called as electronic retailing.
- Deposit-Refund System (DRS): This is also known as deposit-return system, advance deposit fee or deposit-return scheme. This is a surcharge on a product when purchased and a rebate when it is returned. Deposit-refund system is a market-based instrument to address externalities. Deposit-refund systems are used on electronics and electrical products to sustain the recycling value chain. The potential advantages of a DRS are it reduces illegal dumping by giving a financial incentive, it makes monitoring and enforcement easier, and evading the costs is difficult. DRS can be both voluntary and mandated by legislation [4].

The PRO must be registered with CPCB with the certain criteria. The PRO shall have an agreement with producer (s) or a consortium of producers. The PRO is responsible for establishment of collection mechanism, implementation of buy-back/ take-back/ DRS/ e-waste exchange. The collection centres established by PRO must be as per CPCB guidelines. The logistic arrangement and collected and channelized e-waste must be traceable. The awareness programme for consumer/ bulk consumers must be conducted by PRO. PRO is also responsible for filing quarterly/ annual returns as per rules [11, 12].

3. Scope of its implementation

Extended Producer Responsibility may comprise of implementing take back system or setting up of collection centres or both and having agreed arrangements with authorized dismantler or recycler either individually or collectively through a Producer Responsibility Organization recognized by producer or producers in their Extended Producer Responsibility - Authorization. Producer responsibility approach shall also drive producers towards minimizing the end-of-life (EOL) cost of their products. This is based on the assumption that if producers are made responsible for collection and treatment of waste of electronics and electrical equipment (WEEE), they can optimize over-all costs by better design. This has been reflected in the new legislative framework around e-waste, making EPR a mandatory activity associated with the production of electronic and electrical equipments over a period of time [9,13]. The scope of implementing EPR by the producers is explained in the schematic diagram at Figure 1.

The new rules have been simplified the various permission to avoid the delays for effective implementation of EPR. According to E-waste (Management) Rules, 2016, no separate authorization is allowed for collection centre. These centres instead could be part of EPR. The registration/ authorization for dismantling and recycling are carried out through single authorization instead of earlier provision of both registration and authorization. The EPR authorization has also made simpler as single pan India level to be carried out by CPCB. A schematic diagram has been attempted to explain the proposed effective implementation and shown at Figure 1.

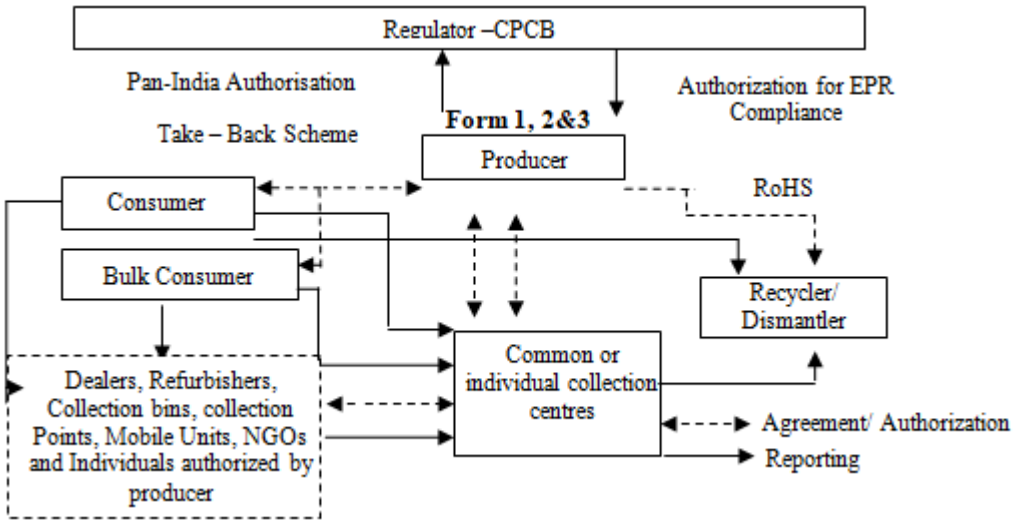

Figure 1: Schematic diagram for effective implementation of EPR

4. Opportunities and Challenges

In order to implement the EPR in India, the responsibility should be ensured through producers. The range of instruments could encourage or require manufacturers to bear the financial or organizational responsibility for their products throughout their lifecycle.

The electronics product design will help in easily re-use, repair and/or upgradeability, recoverable and recyclable as well as use of less toxic materials. The information based instruments would require public awareness, which includes imposing information requirements on producers such as reporting requirements, labeling of products and components, communicating to consumers about producer responsibility and waste separation, and informing recyclers about the materials used in products. Economic and market-based instruments such as deposit-refund schemes, Advanced Disposal Fees (ADF), material taxes etc incentivize the producer to comply with EPR. In South Korea for example, ADFs are imposed on importers and producers of products that are hazardous and more difficult to recycle. Producers are also required self monitoring and regulation for EPR implementation (Figure 2) [14]. It may also include the selection of recyclers, contracting procedures and management, e-waste channelization, recycling and disposal mechanisms. These options have a potential to conserve the energy and keep the environment free of toxic material that would otherwise have been released.

Figure 2: EPR implementation instrument

4.1 Current Challenges

EPR faces various challenges in India, which needs to be addressed to streamline the collection process of e-waste for effective management. Some of the issues are narrated below:

- Clarity on implementation of the rules: There is different interpretation of the rules by the different stake-holders as well as pollution control boards in different states. This variant understanding leads to lack of compliance and implementation
- Coordination between Producers and State Pollution Control Boards: The system of producers' authorization is not streamlined, which resulted in many producers avoiding mandatory authorization. The system needs to be seamlessly streamlined and regulated more effective manner to ensure that all producers are on-board for e-waste management
- Collection points and channels: The efforts of producers for EPR implementation are mostly varied. Major has not done much to set-up easily accessible disposal points for consumers.
- Absence of Economic Instruments: Currently, no economic instruments have been applied for streamlining recycling of e-waste. Though, some producers have introduced take-back and exchange policies, however, they are not proven as effective in terms of collection of e-waste.
- Awareness and sensitization: Most consumers are not aware of disposal points and even about e-waste. No information about disposal is provided to consumers at the point-of-sale which focuses entirely on sale of the product. Some Brands like Microsoft have initiated a take-back campaign encouraging youth and schools for awareness on e-waste, however, much more efforts would be required for awareness and sensitization of individual.

5. Some Effective Models on Producer Responsibility Organisation

Dutch Model

The targets for waste collection were introduced in certain countries under their respective environmental policies with

the rising concern of waste. The Dutch model for e-waste management involves targets for producers under EPR [15,16]. The model ensured an important role for the municipality and producers before the introduction of the WEEE directive. The producers are responsible for collecting e-waste from municipal collection points and sending them to recyclers for further processing. The NVMP Foundation (the Dutch Foundation for the Disposal of Metal and Electrical Products) and the ICT Milieu (ICT & Environment) are the two PROs responsible for handling WEEE in Netherlands. Initially, individual receipts were sent out to producers based on the collection of individual brands. However, since the WEEE directive and targets in place, the producers comply with EPR based on their market share and individual sorting of brands is not carried out.

In India, municipality is only responsible to collect orphan e-waste, however strong existence of informal sector makes the difficulties for the producers to meet the targets. It is proposed that the informal sector needs formalization and municipality should provide land for setting up the collection centers and integrating these formalized informal operators. Producers can be linked with these collection centres for channelization of collected e-waste by formalized informal sector. A schematic diagram of the proposed model is shown in Figure 3.

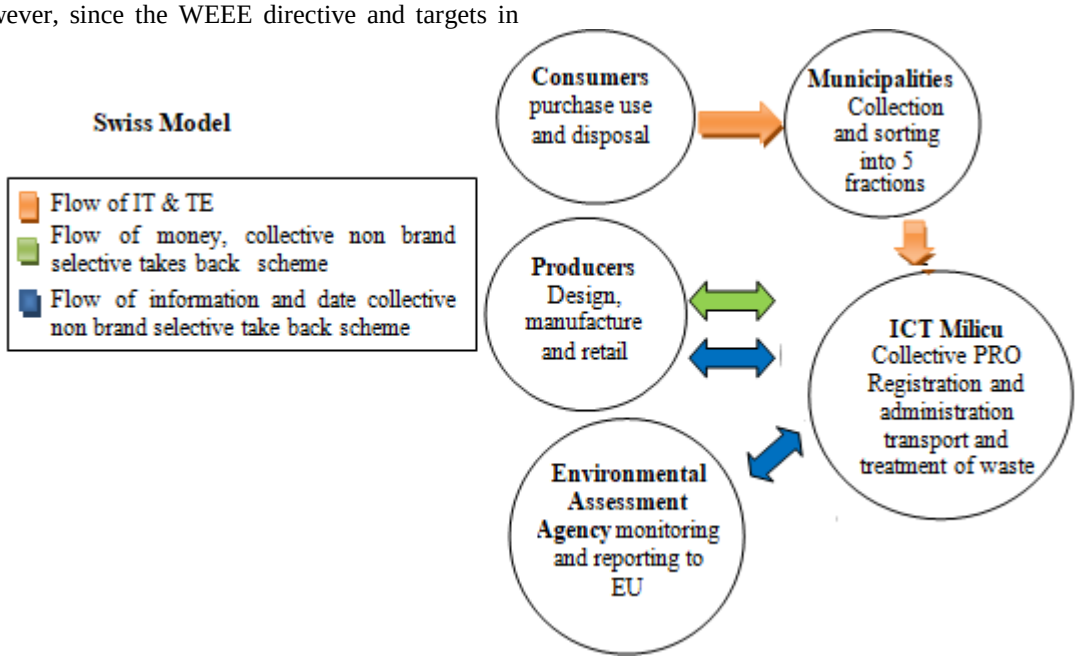

Figure 3: Dutch Model for e-waste management

In Swiss e-waste management system, an EPR based system clearly defined the roles and responsibilities of all stakeholders engaged. In this model, the federal government plays the role of an overseer, framing the basic guidelines and legislation. While manufacturers, importers, PROs have the role of managing the day-to-day operations of the system, including setting the recycling fees, as well as, licensing and auditing recyclers. Consumers are responsible and obligated by law to return discarded appliances to retailers or designated collection points.

The consumers in India are not well aware about E-waste management and their responsibilities towards channelization of e-waste for environment friendly recycling. On the other hand the infrastructure and technology are also not well developed. To implement this model in India awareness infrastructure and technology both are required for better implementation of this model (Figure 4) [17].

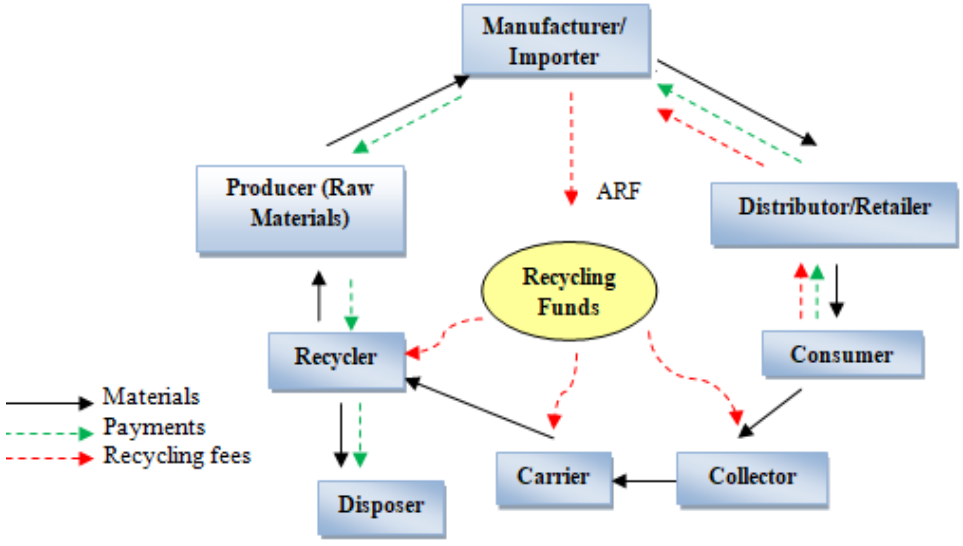

Figure 4: Swiss Model for e-waste management

Taiwan Model

In Taiwan, Environmental Protection Agency (EPA) constituted the Fee Rate Reviewing Committee to avoid the traditional treatment of e-waste. The committee is responsible in monitoring and advising the authority on the means to reduce the waste, promoting resource collection and ensuring efficient use of resources. The committee also takes the decision for rate and subsidies. Under the Recycling Fund Management Committee (RFMC), manufacturers and importers pay fees for the collection and recycling of e-waste. Meanwhile through the incentive of subsidies, the consumers, retailers, collection firms and commercial recycling companies performing the actual tasks of collecting and recycling are inclined to operate within the RFMC system.

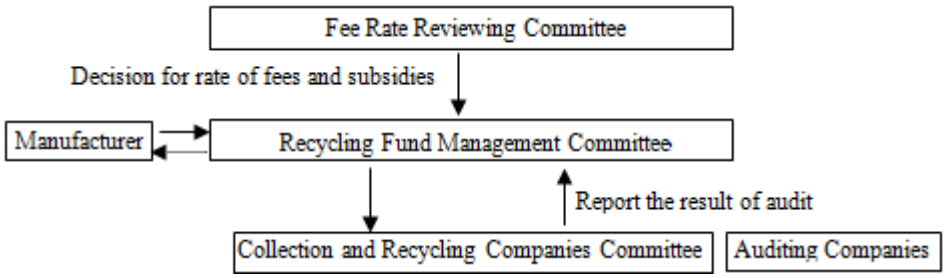

Figure 5: Taiwan Model for E-waste Management

6. PRO model in India

A PRO in India can help in both working towards attaining targets also handle the over-all EPR compliance. The PROs registration with CPCB would aid in creation of an organized and legitimate industry and would pave way for effective and improved e-waste management in India. The model below describes a possible PRO model in India. It shows the various constituent elements of the PRO and the activities that it would be undertaking for EPR compliance and e-waste management.

The effective business model in Indian context could be the participation of different producers, who may pool their resources to make an organization. The proposed organization would then help to fulfill the compliance for EPR, submit the reports, integration of informal sector, facilitate contract mechanism between recyclers and producers, take-back mechanism and collection and storage of e-waste. The PRO needs to initiate the awareness programme for consumers and also to take care of end-to-end reporting and monitoring for member brands and manufacturers and would also prepare reports for EPR compliance, which would help to meet the collection target of the producer. This would be more resource efficient especially in the case of multi-Brand retail take-back. The registration of PRO is required as per E-waste (Management) Rules, 2016. CPCB would be responsible for monitoring and review of PRO. The proposed model has been indicated schematically in (Figure 6).

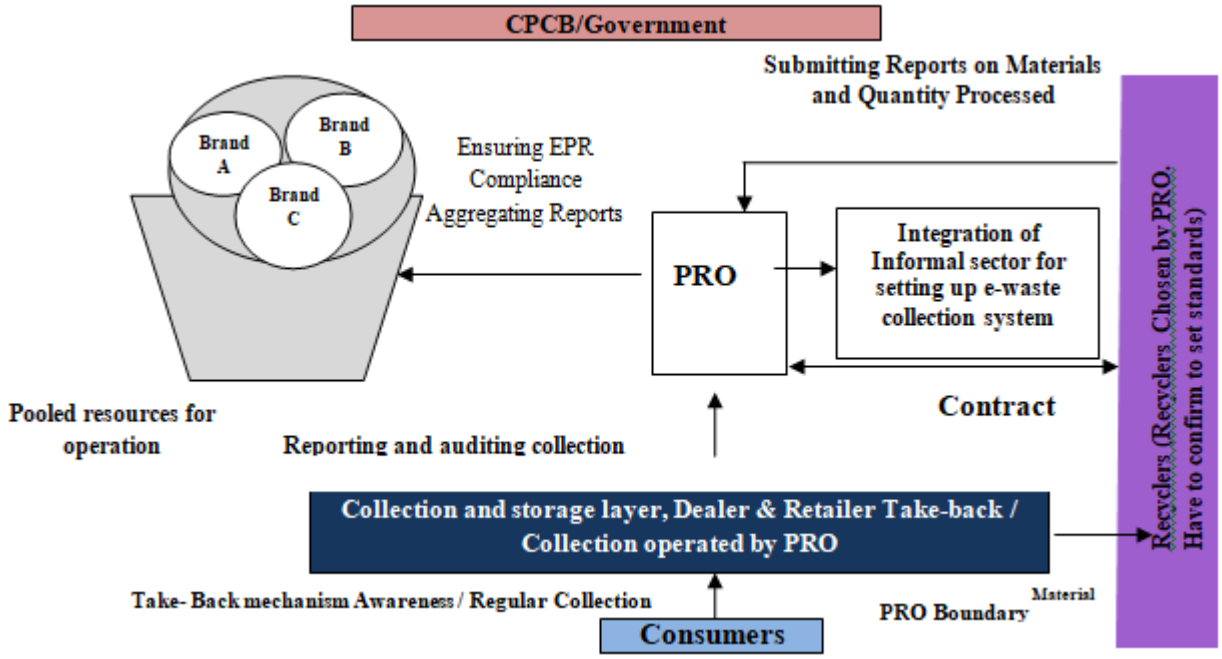

Figure 6: Possible PRO model for India

In India, due to strong existence of informal sector, it would be very difficult to implement take- back mechanism. Approximately 90% of the recycled E-waste volume is handled by the "informal" sector comprising of unregistered enterprises and informal players. Informal sector does not possess the knowledge and technology of e-waste recycling process. They are engaged in extraction of precious metals from e-waste in primitive method and do not aware of its ill effects on environment and health. Environmental problems resulting from these informal recycling operations include increasing evidence of land and water contamination.
An extensive awareness among consumers, supply chain players and other stakeholders as well as integration of informal sector are required for effective implementation of EPR. The primary activities of the EPR would entail

- Collection and channelization of e-waste
- Reporting and auditing
- Contract with recyclers

It would comprise of resources pooled in by major manufacturers. These resources could be equally split during the initial phase of the PRO establishment and later divided based on the market share of the brands on board. The PRO would be responsible for handling the collection of e-waste and facilitate collection through regular awareness sessions among both bulk as well as individual consumers. Facilitating and stream-lining collection would be one of the core tasks of the PRO. It would also handle the reporting on behalf of the brand for EPR compliance [8]. These reports would require to submit to the State Pollution Control Boards. The administrative burden of the producers would be lessened through this and the task would be taken care of by them individually in the case of Individual Producer's Responsibility (IPR) models.

The PRO would also be associated with recyclers and could set up standards based on best norms available in the industry. The advantage of this process would be to create healthy competition among ever increasing number of recyclers in India. With improved regulatory environment, the proposed PRO might force recyclers to associate with major producers to handle waste in effective manner. If one ensures strict guidelines and audits, the PRO could also ensure handling of e-waste in a safer manner with recyclers being extra cautious owing to the contract with major producers at stake [11].

Collection Models for PRO

The various models which could be adopted for collection in a PRO are narrated in Table 3.

Table 3: Various Models for Collection of e-waste via PRO

PRO Take-back	Dealer Take-back	Existing Informal Sector
•PRO take care of collection from sources and also serve as a disposal center. Generators could be paid for the material based on a standard price fixed by the PRO	•Dealers take-back the e-waste from generators who get a discount in return on the new item being purchased	•Informal sector could be involved in collection and storage of waste via a contract with the PRO. This will also help in addressing the problem of waste leaking to the informal sector.

Financial models for PRO

One of the most important features needs to be addressed in a PRO is its financing. Several financing options exist for implementing an EPR system is elaborated in Table 4.

Table 4: Financial Mechanism for PRO

Type of Financing Mechanism	Details
Advance recycling fee (ARF)	A fee collected from consumers at the time of sale, to recycle the products they purchase. This fee could be embedded in the retail price or included as a separate fee. In some versions of the model, this cost is also borne by the producer and directly pooled into the PRO
Disposal Fee	Collected from the end-user where they pay for the cost of recycling
Recycling Subsidy	a tax on production and/or consumption is associated with a subsidy proportional to product recycling, where the financing of subsidies can be handled through the taxes collected
Deposit-refund model	a tax on production and/or consumption is associated with a subsidy proportional to product recycling, where the financing of subsidies can be handled through the taxes collected

7. Effectiveness of PRO Model for India

Unlike other developed countries, India has huge network of informal sector, which is widely engaged in collection of waste including e-waste. For a successful PRO model in India requires an integration of informal sector to meet the collection targets of the producers as well as channelization of e-waste in proper manner. Apart from this, an intervention from regulators (MoEFCC/CPCB/SPCBs) is also required to complete the regulatory mechanism and monitoring process. The PRO also requires self monitoring and audit systems to track the e-waste channel. For example in Belgium, only single PRO, called Recupel, exists for entire State. Recupel works in non-profit model and manages and collects e-waste for all the member producers. The PRO also has self monitoring mechanism and auditing systems without any intervention of regulators. Recupel submits report to the regulators as and when required [18].

8. Government's Intervention in Effective E-waste Management

Integration of informal sector in India

The PRO can be linked with existing informal sector, which will help them in collection and storage of e-waste. The informal sector have vast network and collect the e-waste door-to-door. The informal sector in India is kwon as *"Kabariwalahs"*. The formalization of informal sector will provide strength to informal sector with legalization, secured livelihood and a healthy environment with all occupation health and safety aspects. On the other hand, the challenges of reverse process in leakage of e-waste will also be addressed and producers will get a group of collection network to meet their collection targets.

Skill development of informal sector

Informal sector is the highly networked and skilled workers engaged in sale/ purchase and dismantling of e-waste. Their widespread and active network and manual skills make recycling of e-waste a profitable business venture. At the same time, the informal sector is lacking skills and technologies, and manages hazardous material without any regard to Occupational Health and Safety (OH&S) requirements and in an environmental harmful manner [19]. The skill upgradation is required in technology as well as communication for effective e-waste management. Hands-on trainings on skills upgradation, current e-waste (management) rules, process efficiency, do's and don'ts and soft skills of communication would be prudent step towards formalization process. This will create a transformational impact on the current scenario of e-waste management, which could reduce challenges for informal sector collectors to link to the formal sector, on topics such as: The PRO can choose to work with them and support them to provide such trainings will help in formalization process of informal sector. The training and education may be provided in person or virtually.

Awareness and Capacity Building

The participation of State Government Departments and other Ministries would be important for the successful implementation of the Rules so as to address the challenges being faced in e-waste management in the country. Ministry of Electronics & Information Technology (MeitY), Government of India has been implementing E-waste awareness programme, where awareness is created among all the stakeholders in e-waste value chain. The capacity building of all Government Departments is also being created in pan India basis. This would help in regulating and monitoring e-waste management in the country. Government schemes like Swacchh India Mission, Skill India and Make in India and others could also be leveraged for requisite support in creating awareness. The successful implementation of the awareness programmes also requires the active participation of States and Urban local bodies who could also provide support in proper segregation and disposal of e-waste.

Availability of affordable technology

Ministry of Electronics & Information Technology (MeitY) is also engaged in developing R&D solutions for affordable technology to recycle e-waste in environmentally sound manner. Few such technologies have been up-scaled and demonstrated in the country. This recycling technology would be immediate solution to upgrade informal units. This handholding would definitely attract more informal units to upgrade their operations for staying in the business to ensure the mandatory compliance on healthy, hygienic, legally acceptable livelihood.

The concept of eco-park with private and public participation could also be important Indian condition. The integrated informal sector with trained skill sets can be engaged in collection, segregation and dismantling of e-waste. The Government might assist in providing capital equipment, land, subsidized power, water, other utilities and local approvals. These ecoparks could be operated in designated place in each State. The activities could be monitored for regulatory purposes. The formal and informal sector could work together to optimize business and revenue earnings.

The regulator would also then be empowered to implement the Rule more stringently and close down the remaining illegal informal operations. This revolution in the country would be able to concentrate feedstock at some designated places, which are presently scattered in various informal sectors, which is actually de-motivating the state-of-art recycling industry to set-up their units in the country. These could be cost-effective immediate solutions to improve the present on-ground situation of e-waste management, and would also address the challenging concern of the environmental degradation due to rampant e-waste recycling in informal sector.

9. Conclusion

Effective implementation of EPR requires proper enforcement of the Rules to create a strong will among producers to set up an implementation mechanism. Solutions need to be developed for setting up a mechanism for handling the operations and logistics of collection and channelization of e-waste. This could be handled jointly by a consortium in the form of a PRO as proposed in the present article. With PRO taking care of authorization and reporting, one of the major concerns of producers, i.e. the administrative aspects of EPR would be taken care-of. A PRO will also help separate, campaigns for awareness generation from the regular campaigns of branding. The producer consortium can then work on awareness campaigns in a joint way leading to better outreach.

Without effective intervention from the producer's side, the collection and take-back cannot be stream-lined since retail-point is an effective take-back point in terms of the customer convenience. EPR will also encourage producers to stream-line their designs to reduce overall costs. The PRO model also provides opportunities to integrate informal sector into its collection system there-by also aiding the formalization process. The integration of informal sector can help in meeting the collection target to the producers and formalized system will also help in resource recovery of the material from e-waste, which will impact in circular economy. On the other hand environment pollution due to improper handling of e-waste will also be reduced. The formalized informal sector will also get the legalization and business opportunity.

A truly enabling framework for implementation of EPR would need commitment especially from the global brands, stringent implementation of the rules by the regulators, effective awareness amongst the consumers and utilizing the existing potential of the informal sector for better collection and channelization of e-waste.

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Table Legends

Table 1 Comparison of Yearly Collection Targets of EPR in India and Other Countries
Table 2 Registered PRO in India
Table 3 Various Models for Collection of e-waste via PRO
Table 4 Financial Mechanism for PRO

Figures Legends

Figure 1: Schematic diagram for effective implementation of EPR

Figure 2: EPR implementation instrument

Figure 3: Dutch Model for e-waste management

Figure 4: Swiss Model for e-waste management

Figure 5: Taiwan Model for E-waste Management

Figure 6: Proposed Model for EPR implementation in India