E-waste Roadmap 2023 for India

A compilation of thought pieces by sector experts

Women waste pickers in Patna, Bihar, India. These women are organized by an NGO, Nidan, which helps them develop self-help groups and find opportunities for economic development.

Photo Credit: Verena Radulovic

E-waste is often a misunderstood black box. If recycled properly,
it is an urban mining treasure. In this picture, you can see the circuit
inside a keyboard, lined with precious metal.

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ABBREVIATIONS

ADF	Advanced Disposal Fee
ARF	Advanced Recycling Fee
CAG	Comptroller and Auditor General of India
CE	Consumer Electronics; Circular Economy
CENELEC	European Committee for Electrotechnical Standardisation
CII	Confederation of Indian Industry
CIPET	Central Institute of Plastics Engineering & Technology
CPCB	Central Pollution Control Board
CRT	Cathode Ray Tube
C-MET	Centre for Materials for Electronics Technology
DGFASLI	Directorate General Factory Advice Service and Labour Institutes
DoE	Design for Environment
EEE	Electrical and Electronic Equipment
EPEAT	Electronic Product Environmental Assessment Tool
EPR	Extended Producer Responsibility
ESDM	Electronics System Design and Manufacturing
E-waste	Electronic Waste
GoI	Government of India
GST	Goods and Services Tax
IEEE	Institute of Electrical and Electronics Engineers
ILO	International Labour Organisation
IPR	Individual Producer Responsibility
IT	Information Technology
ITEW	as per Schedule I of E-Waste (Management) Rules, 2016
KPI	Key Performance Indicators
MeitY	Ministry of Electronics and Information Technology
MoEF&CC	Ministry of Environment, Forest and Climate Change
MoLE	Ministry of Labour and Employment
MRV	Measurable, Verifiable, and Reliable
MSTC	Metal Scrap Trade Corporation Limited
NGO	Non-Government Organisation
NITI Aayog	National Institution for Transforming India

OSH	Occupational Safety and Health
OEM	Original Equipment Manufacturers
PCB	Printed Circuit Board
PGM	Platinum Group Metal
PRO	Producer Responsibility Organisation
RE	Resource Efficiency
RoHS	Reductions of Hazardous Substances
UN SDGs	United Nations Sustainable Development Goals
SDG	Sustainable Development Goals
SPCB	State Pollution Control Board
WEEE	Waste Electronic and Electrical Equipment

By
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Editor's Note

Electronic waste (e-waste) is the waste arising from end-of-life electronic products. It is the fastest growing waste stream in the world today. Annual global production of e-waste is estimated to surpass 50 million tons in 2020, with India contributing over 2 million tons. With the rapid growth in the consumer electronics market, e-waste management is a growing concern and needs to be addressed systematically through policy and practice. The first regulation to manage e-waste in India was introduced in 2011 and became effective from 2012. The E-waste Rules have since been amended in 2016 and 2018. There have been several further developments in the sector since the introduction of the Rules.

The **E-waste Roadmap 2023** is an initiative under IFC's 'India E-waste Program' and is supported by the Government of Japan and the Korea Green Growth Trust Fund of the World Bank Group. The objectives of the Program are to (1) Facilitate the establishment and scaling up of a responsible industry-led solution for e-waste management in India which will serve as a long-term cost-effective solution (2) Raise awareness among all stakeholders about the hazards of not managing e-waste responsibly (3) Develop a Toolkit to support key stakeholders in the sector and (4) Assess the growth, bankability and investment potential of the sector with the goal of mobilizing investment.

This collection of thought pieces is a valuable contribution to the field of e-waste management in India. It reflects the thoughts of different Indian and global experts who have considerable experience of working on these aspects in India and other countries. The experts come from diverse backgrounds – governments, international organisations, developmental organisations, civil society organisations, industry, and academia. As a part of the India E-waste Program, a number of seminars, meetings, workshops and events were held between March 2017 and March 2019, which witnessed participation and knowledge sharing among different stakeholders. This collection also highlights some of the points that emerged from these multi-stakeholder discussions.

These thought pieces do not represent the opinions of IFC in any way. The views expressed are solely the opinions of the authors and may not represent the viewpoints of their respective organisations. Further, there may be differences in the viewpoints of the different contributors. We hope that such varying viewpoints will add to the richness of the discourse on e-waste, and enhance the reader's understanding of the diverse and complex facets of the e-waste sector.

The pieces are organized into four sections: (A) Policy, (B) Business, (C) Environmental, Health & Social, and (D) Technology.

We thank all the authors for their time and valuable contribution to this compendium.

By

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Policy and E-waste

Introduction

Environmentally sound management of electrical and electronic waste is currently one of the most critical and challenging issues, not only for India but across the world. Going through a phase of accelerated industrial activities for the past three decades, India is one of the fastest growing markets for electronics and the demand is projected to reach USD 400 billion by 2020. In this direction, the Government of India (GoI) has launched the National Policy on Electronics 2012 with the vision to make India a globally competitive destination for Electronics System Design and Manufacturing (ESDM). The massive growth in terms of industrialisation and urbanisation has also led to a manifold increase in the quantity of E-waste generated. A study by the United Nations University has estimated that India generated 2 million tonnes of e-waste in 2015.

E-waste, if handled and disposed of in an inefficient manner can lead to extremely damaging impact on human health and the environment. This is mainly because e-waste comprises hazardous constituents such as lead, cadmium, chromium, brominated flame retardants or polychlorinated biphenyls (PCBs) that contaminate soil, water and food.

All e-waste is valuable as it is highly rich in metals such as copper, iron, tin, nickel, lead, zinc, silver, gold, and palladium. Printed Circuit Boards (PCBs) contain rare and precious metals such as ruthenium, rhodium, palladium, osmium, iridium and platinum – which are together referred to as the Platinum Group Metals (PGM). The rate of e-waste collection is very high in India owing to its valuable content. Unfortunately, the collection and recycling of e-waste is predominantly being done by the informal or unorganized labour through highly environmentally degradative ways, which cause serious health hazards. The informal sector comprises of unskilled workers, sometimes even children who live in close proximity to dumps or landfills of untreated e-waste and work in dangerous working conditions without any protection or safety gear. Most of the e-waste recycling is done by the informal sector in India, wherein recovery of valuable materials ranges between 10–20% only. Non-environmentally sound practices – such as burning cables to recover copper and unwanted materials in open air – caused environmental pollution and severe health hazards to the operators. Practices like disposal of unsalvageable materials in fields and riverbanks has led to leaching of heavy metals/chemicals into land and water. Even within the formal sector, PCBs are generally exported to developed countries to recover precious metals. Some of the e-waste is extremely complex in constitution and hence difficult to recycle, while the other does not even have environmentally sound recycling technologies.

Emerging Issues

Apart from the large informal sector, India faces a number of other challenges in effective management of e-waste, such as:

1. **Lack of infrastructure:** The gap between e-waste that is being collected and recycled by authorized dismantlers/recyclers and the total quantum of e-waste being generated is huge. The existing recycling facilities face issues from lack of suitable environmentally sound technologies to lack of steady supply of raw materials. This is mainly because consumers, owing to lack of awareness about the hazardous impact of inappropriate e-waste recycling, sell their electronic waste to informal recyclers for quick money as it is easier and faster. Thus, registered recycling units are deprived of a regular supply of e-waste which is crucial for their sustenance. Currently, the authorized e-waste recycling facilities in India capture only small amount of the total e-waste generated and the rest makes its way into informal recycling.

2. **High cost of setting up recycling facilities:** Advanced recycling technology is expensive and makes large investments risky, especially when sourcing of e-waste is a challenge. Most of the formal recycling companies in India limit their role to only pre-processing of e-waste, wherein the crushed e-waste with precious metals is exported to smelting refineries outside India. An end-to-end solution for e-waste recycling is still not available in India.

New and Future Initiatives

Since the implementation of the erstwhile E-waste (Management and Handling) Rules, 2011 (henceforth referred to as 'Rules 2011') and the more recent E-waste (Management) Rules, 2016 (henceforth referred to as 'Rules 2016') there has been a growing change in perception of e-waste in the waste recycling market in India. Electrical and electronic waste with its rich content of valuable metals is increasingly being seen as a harvest point for urban mining. Recognizing the potential of the formal e-waste recycling sector in alleviating the environmental issues caused by unscientific methods of handling and disposal of e-waste, GoI has taken the following new initiatives:

1. **Stringent provisions under Extended Producer Responsibility:** The linchpin of Rules 2016 is the provision on extended producer responsibility (EPR). Based on the 'polluter pays' principle, it brings in producers who have the wherewithal to collect the end-of-life products placed in the market in the past and, thereby, effectively serves to channelise the electrical and electronic product from cradle-to-grave. The collection targets were revised in 2018. So far, 1151 producers of electrical and electronic equipment in the country have been given EPR authorisation by the Central Pollution Control Board (CPCB).

2. **Boosting the formal e-waste recycling industry:** The Amendment to the E-waste (Management) Rules, 2016 was made with the objective of channelizing e-waste generated in the country towards authorised dismantlers and recyclers in order to formalise the e-waste recycling sector. The number of e-waste recyclers have increased substantially from 23 registered recycling facilities in 2010, to 275 dismantlers/recyclers in 16 states/union territories in 2018 with a total recycling capacity of about 0.5 million ton per annum.

3. **Developing an online mass balance system:** The government is currently in the process of developing an online mass balance system to monitor the e-waste flow in India. This would enable automated data management, transparency, reduce administrative burden of authorities, shift from traditional paper-based systems to electronic recording, and better enforcement of EPR provisions of Rules 2016. The mass balance system will include all the major stakeholders of e-waste channelisation: producers, importers, port authority/customs, bulk consumers, PROs, dismantlers, and recyclers.

4. **Conducting a national inventory of E-waste:** All State Pollution Control Boards/Pollution Control Committees have been mandated to develop inventories of e-waste in their respective states/union territories.

So far, eight states have completed the e-waste inventory. The Ministry of Environment, Forest and Climate Change (MoEF&CC) along with the Ministry of Electronics and Information Technology (MeitY) is currently in the process of developing a set of guidelines on conducting the inventory of e-waste which may be uniformly applicable to all the Indian states.

5. **Facilitating Producer Responsibility Organisations:** The e-waste rules provide producers with the option of using Producer Responsibility Organisations (PROs) to implement EPR. In order to facilitate this process for producers, the Government has now made it mandatory for PROs to get themselves registered with CPCB. CPCB has also formulated guidelines for PROs in 2018. So far 19 PROs have been granted registration.

In a move to implement effective management of e-waste in India, MoEF & CC notified the E-waste (Management and Handling) Rules, 2011 which introduced EPR – an important policy instrument currently used across the world to address the problem of e-waste. EPR entrusts producers with physical and financial responsibility for the post-consumer stage of a product in order to channelize e-waste to formal recyclers and to ensure environmentally sound management of the same. CPCB has issued EPR authorisation to 1151 producers. Further, the Rules aim to reduce the use of hazardous substances in electrical and electronic equipment by specifying thresholds for the use of hazardous substances including lead, mercury and cadmium.

When the Ministry had first notified the Rules for e-waste management in 2011, there existed limited understanding and awareness regarding various aspects of its management – including strategies to be adopted as well as infrastructural capacity and capability to manage the waste stream. Even the provisions of the Rules were not time-tested as they were framed for the first time. Rules 2011 were subsequently superseded by Rules 2016, and the latter further strengthened EPR as well as the

provisions for reduction in the use of hazardous substances (RoHS) in the manufacture of electrical and electronic equipment. The e-waste so collected is channelized to authorised dismantlers/recyclers. Currently, there are about 275 dismantlers/recyclers in 16 states/union territories in the country which have been given authorisation under Rules 2016 by the concerned State Pollution Control Boards or Pollution Control Committees.

Furthermore, the Hazardous (Management and Transboundary Movement) Amendment Rules, 2017 prohibits the import of hazardous and other wastes from any country into India for final disposal. This includes waste electrical and electronic assemblies or scrap containing components mercury-switches, glass from cathode ray tubes, etc. Import is only permitted for recycling, recovery, reuse and utilisation including co-processing.

Some of the future initiatives are listed as follows:

1. **Addressing the informal sector**

   a. Bridging the gap between formal and informal sectors.

   b. Improving the working conditions and minimising the work related to toxic exposure at the e-waste collection, processing, recovery and disposal sites.

2. **Access to environmentally sound technologies**

   a. Cost-effective technologies for recycling e-waste such as Li-ion batteries, printed circuit boards, etc.

   b. R&D on innovative technologies for processing e-waste and effective metal extraction methodologies.

3. **Development of sustainable e-waste business models and implementation of pilot projects for different innovations**

Conclusion

To conclude, management e-waste has been a challenge for a developing country like India, however, the scenario is gradually improving. The electrical and electronic industry has been cooperating with the Government in the efficient management of e-waste and has taken various initiatives for handling e-waste responsibly. If the responsibility is shared between the Government, producers and consumers then efficient management of e-waste can be achieved successfully in India.

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Public Policy for E-waste Management in India

Introduction

India's e-waste regulations, employing the EPR approach, came into effect in May 2012, with further amendments in 2016. These seven years of implementation have had limited impact on the larger e-waste management system in the country. On the positive side, the regulations may have led to the establishment of hundreds of new recycling and dismantling units, formally registered with regulatory authorities. The 2016 Amendment, which set collection rate targets for producers of electronic products, appear to have generated greater seriousness among the producers to comply with the regulations. More generally, the regulations could be credited with bringing greater attention to the e-waste problem among the various stakeholders. Clearly, however, we are a long way from developing a policy framework that could facilitate a robust e-waste management system in the country.

E-waste Policy Challenges

1. **Poor information on e-waste generation rates:** The 2012 regulations acknowledged the lack of waste inventories as a limitation and placed the responsibility of developing state-wise e-waste inventories on the respective state pollution control boards (SPCBs). Seven years since these regulations, to our knowledge, no SPCB has publicly released an inventory as yet. The sales data on electronic products, which is an important input in the estimation of e-waste quantities, is often available at the national level for aggregation, making it challenging to produce inventories at the subnational levels. In addition to domestic generation, e-waste is also imported from developed economies, often illegally. There is little understanding of the nature and the amount of e-waste that is imported into the country. Designing systems for effective collection, transportation, and processing requires reasonably accurate knowledge of waste generation, composition, and flows.

2. **Environmentally unsustainable informal sector practices:** Despite the growth in the formal dismantling and recycling sector (in terms of the number of such facilities), the actual waste processed in the formal sector still remains very low. Anecdotal evidence indicates that most of these formal facilities are operating well below their approved capacities because of their inability to source enough waste. The lack of awareness regarding e-waste and the costs of returning the end-of-life equipment to formal collection centers are reducing the willingness of household and institutional consumers to return their waste to the formal sector. Most importantly, the informal sector, through the convenience of household collection and monetary incentives (even if nominal), makes it more attractive for consumers to dispose their waste with them, relative to the formal sector, which is yet to invest in robust systems for collection and processing. The informal

e-waste sector provides livelihoods to millions of people, often belonging to the most marginalised groups; on the other hand, the sector's waste management practices pose serious environmental and health hazards to the workers themselves as well as to the larger public. This presents a potential moral dilemma for public policy and the sustained success of any e-waste management system will hinge on our ability to resolve this dilemma.

3. **Frictions in markets for the end-of-life products:** The inability to reliably source e-waste quantities that create economies of scale restricts the entry of private players (such as PROs), to set up e-waste management systems in the formal sector. For example, employing effective recycling technologies for e-waste may require significant upfront capital expenditures, which may not be justified for private entities in the absence of certainty around sourcing of enough quantities of e-waste. Also, these markets suffer from information barriers. First, given that e-waste recycling is a relatively new business, potential lack of information on cost-effective recycling technologies itself could be a market barrier. Second, the low awareness, partly because of the lack of reliable information on e-waste management among consumers, affects the functioning of markets. Public policy may have to play a greater role (beyond the current e-waste regulations) in enabling better markets for e-waste.

4. **Inadequate regulatory design and enforcement:** In the 2012 regulations, the mandatory take-back system for producers, without accompanying collection targets, provided no incentives to take responsibility and thus induced little improvements in e-waste management practices. This was addressed in the 2016 Amendment, which provided more regulatory certainty by specifying gradual and increasingly stricter collection targets. Nevertheless,

the regulatory design places a significant burden on the already ill-equipped regulatory agencies. The regulators are expected to review the EPR plan submitted by the producers, grant authorisation, and enforce the provisions of the EPR plan. The regulations also specified elaborate standards and processes for other entities – collectors, dismantlers, recyclers, and bulk consumers – and require the agencies to enforce compliance with these standards. Regulatory capture by lobbies that benefit from poor enforcement, lack of transparency, and unwillingness to publicly share information on compliance and regulatory actions have long afflicted environmental regulatory enforcement in India and e-waste regulations are no exception. This poses a significant public policy challenge to the future of e-waste management in the country.

A Vision for Policy 2030

The next ten years must see much greater progress in establishing a robust and sustainable e-waste management system. The vision should be geared towards addressing the challenges identified in the previous section. A few important goals that contribute to the objective of a robust e-waste system are outlined below.

1. Facilitate an e-waste management supply chain that integrates informal sector in a manner that recognizes the right to livelihoods of the workers.

2. Develop a regularly updated and publicly available inventory of district-wise generation of e-waste quantities by e-waste type (e.g. computers, mobiles, appliances), waste composition, and flows.

3. Create a policy framework for the development of indigenous technologies and/or technology transfer to encourage widespread application of environment-friendly e-waste recycling technologies.

4. Identify and employ public policy instruments that incentivize the manufacturers/producers to invest in achieving 'design for environment' changes in their product design.

5. Generate greater awareness on e-waste and its impacts on society, responsibilities of various stakeholders under current regulations, and responsible actions that citizens can take. The emphasis of these campaigns should include the need to move more towards prevention (i.e. reducing consumption of electronic products) than towards cure (i.e. managing the generated e-waste).

Policy, a Roadmap to 2023

The next five years should build on the learnings from the last seven years of implementation of e-waste regulations. In addition to constantly evaluating the effectiveness of e-waste regulation and bringing in necessary regulatory changes, the government may have to play a facilitating role to bring together various stakeholders in the system. We outline a few steps that should be considered in the short run to move towards the objectives set in the Vision for 2030.

1. **Informal sector:** The first step would be to more explicitly recognise (like in the case of Municipal Solid Waste Rules in 2016) the informal sector as a critical stakeholder in any future e-waste regime. Addressing the problem of informal sector e-waste practices requires a greater understanding of the sector itself in terms of their incentives and challenges. Engagement with the informal sector workers and the groups that closely work with them through mechanisms that build trust and develop a shared understanding of the problems along with potential solutions is a critical initial step. The government should institute a platform that facilitates consultations among various stakeholders such as the informal sector workers, NGOs working with the informal sector, third party private entities such as

PROs, registered recyclers, and manufacturers. Such forums could be constituted under the MoEF&CC at both the central and state levels. Working towards such cross-sector partnerships while evolving clearly defined roles for each stakeholder would be an important goal in the next five years.

2. **Policy instruments under EPR:** The government would need to rethink the policy instruments under the EPR approach. In the presence of an informal sector with strengths in collection logistics, a mandatory take-back with collection targets may not be the ideal instrument. Producer responsibility could come in many varieties other than the mandatory take-back. Economic instruments such as advanced recycling fee (ARF) or advanced disposal fee (ADF) on every unit of the product sold in the market would relieve the producers of the physical responsibility of collection, and the revenues generated could be used to develop markets for the end-of-the-life products. The revenues, which go into a separate fund, could be used in several ways. Some examples include: (i) subsidize consumers to deposit their e-waste at designated centers, (ii) directly fund recyclers or PROs, and (iii) assist informal sector workers in training or skill development or provide a greater social security net to the workers. These decisions may be made within the consultative forum recommended in the previous point on the informal sector. The key problem with economic instruments would be to determine the 'right' fee. Principles of economics would suggest a fee equivalent to the marginal external cost of the end-of-life equipment. While the assessment of such external costs is difficult in practice, the fee should be high enough to fund a robust, environmentally safe e-waste processing and disposal. A sufficiently high fee would also provide incentives for 'design for environment (DoE) ' changes in product design, which has been one of the primary goals of the EPR approach globally. In the long run, to further incentivise DoE changes, the fee

could be based on such factors as the ease of dismantling, recyclability, and environmental impact of materials used in the equipment.

3. **Regulatory enforcement:** Shifting to economic instruments such as an ADF would also relieve the regulatory burden since the producers need not be regulated anymore. The long experience with tax collection should make it easy to divert the ADF on electronic products to a separate fund. The SPCBs and the CPCB will still be required to monitor and enforce compliance with the standards specified for collection centers, dismantlers, recyclers, and PROs. The MoEF must make the regulatory actions related to e-waste transparent. Regulatory actions such as authorisations and their conditions, data on inspections of registered facilities, and compliance status of inspected facilities should all be made publicly available for scrutiny. A few SPCBs already provide some of these documents publicly on their websites but these practices should be institutionalised as part of the regulations across the country.

4. **E-waste imports:** Under the existing regulations in India, e-waste is not allowed to be imported for final disposal but can be imported for reuse and recycling. In the absence of adequate infrastructure for recycling, we should seriously consider banning all kinds of imports, similar to what China did recently. In order to develop accurate estimates of e-waste, data on imports must be integrated with the e-waste inventory.

5. **Public awareness:** The current e-waste regulations require the producers to provide, on their websites, information on the impacts of e-waste, appropriate disposal practices, and such other issues. They are also required to run awareness campaigns at regular intervals. Many producers have already provided information on their websites but evidence shows that the overall awareness levels, even among bulk consumers, remain low. Stricter guidelines/

regulations to the producers on the frequency and mode of these awareness campaigns might improve the situation. Alternatively, the producers should be mandated to run these campaigns through grassroots level organisations working in the area of e-waste. The government on its part should consider integrating e-waste awareness campaigns with other waste streams such as batteries and municipal solid waste. Research on effective messaging techniques and evaluation of information campaigns could also form a part of the government's role. These awareness efforts should be geared towards not only achieving safe handling of e-waste but also reducing consumption of electronic products in the long run. Overall, the public awareness generation initiatives should be based on partnerships and collaboration among various stakeholders.

Conclusion

The explosion of electronic products over the last decade or so, and the corresponding rapid raise in e-waste pose a significant environmental challenge to the governments, particularly in developing countries. The limited impact that India's seven-year-old regulations have had is an indication of the challenges that the country faces as far as e-waste management is concerned. This paper identifies informal sector e-waste practices, poor regulatory design and enforcement, and low awareness about some of the challenges that India faces. Meaningful engagement of all the stakeholders should be central to developing a robust e-waste management system of the future.

By

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Disrupting the Status Quo via Systemic Transformation: PROs and E-waste

Introduction

Producers can implement Extended Producer Responsibility (EPR) either on their own (Individual Producer Responsibility), or by collaborating with other producers (Collective Producer Responsibility). The E-waste Rules 2016 define a Producer Responsibility Organisation (PRO) as "a professional organisation authorised or financed collectively or individually by producers, which can take the responsibility for collection and channelisation of e-waste generated from the 'end-of-life' of their products to ensure environmentally sound management of such e-waste." PROs, generally, play a central role in implementation of EPR and work with a range of stakeholders including governments, and create systems to bring transparency, and accountability.

In the Indian scenario, a PRO must play a wide range of roles to set-up a responsible and efficient e-waste management system which include:

1. Creating a group of producers and developing the rules of cooperation including a common mandate

2. Creating guidelines for funding which are fair to all, ways of working, rule-book, and operating and allocation procedures. Identifying and setting fair and transparent recycling charges for various waste categories

3. Creating an ecosystem for fulfilling the liabilities of producers. This includes formalization of large numbers of waste pickers and aggregators

4. Developing systems for bringing transparency, traceability and accountability in the full value chain system from collection to recycling (in terms of verifiable proofs of collection, movement, material balance reports, movement of material to secondary recycling stage and beyond)

5. Creating systems for documentation, and compliance management which are coherent with the government mandate

6. Setting standards to optimise each stage of the value chain (for recycling, quality check, work place safety, fair pricing, etc.)

7. Developing processes for mapping risks on a continuous basis and implementing risk mitigation plans

8. Building a holistic system for waste management that goes beyond simple compliance by collaborating with stakeholders from the entire value chain (from Central and State government authorities to municipalities, international multilateral organisations, academic institutions, NGOs and civil societies, etc.)

9. Identifying gaps in the existing value chain (in terms of infrastructure, expertise, domain knowledge, investment, capacity for collection and recycling, etc.) and bridging those gaps including enabling development of responsible recycling infrastructure

A PRO typically provides the following services in the Indian context:

1. Conducting awareness programs for the individual and bulk consumers

2. Developing channels for collection of waste e.g. with the informal sector, bulk consumers

3. Establishing and operating collection channels, and points

4. Collecting waste from multiple points, storing in warehouses if needed, and transporting it to the recycling and treatment facilities

5. Mandating recyclers to treat the e-waste

6. Aggregating and developing all compliance documentation

Challenges – A PRO's Perspective

Despite the new rules and emergence of multiple PROs in India, the e-waste sector, in general, continues to be a black box lacking transparency, accountability and legitimacy. The entry of PROs is, however, bringing in some formal systems of working and a dialogue on accountability.

1. **Challenges being faced by Producers**

   a. Lack of level playing field

      Producers currently complain of not getting a fair play in terms of real work being done on the ground in both the areas they are responsible for: "collection of e-waste" and "awareness on the issue of e-waste". Producers who opt for responsible solutions feel very discouraged as their competitors in the market get away with choosing and participating in below par options fraught with malpractices.

b. Lack of clarity on coverage of products/components/input-output devices

Lack of clarity on which products/accessories/components are covered leads to confusion and mis-reporting e.g. many producers are submitting data-sets of steel cabinets for CPUs under their targets where other producers are excluding it as there are no electronics in the cabinet.

c. Disproportionate targets

EPR plans by producers often have discrepancies in terms of the weight reported for various products as average product weights are not defined. For similar products, two producers could report two different weights. Producer 'X' could for instance report the average weight for keyboard as 1 kg/piece whereas producer 'Y' could report it as 0.25 kg/piece hence making their targets disproportionate. This is especially pronounced for importers who import a large variety of models under the same category thus making it very difficult to determine the average weight.

2. **Challenges being faced by PROs**

a. Lack of a level playing field

At present, there are no systems/criteria/frameworks which producers can use while selecting a PRO. Responsible PROs who are creating grassroots ecosystem for enabling collection and developing systems which ensure full traceability and transparency in the value chain are put on the same platform with sub-standard PROs which indulge in paper trading, multiple accounting practices, mis-reporting.[1]

The only selection criteria being considered for selection of a PRO by most producers, is the recycling charge/kg of the e-waste collected and recycled. This charge is dependent on multiple factors none of which have been clarified under the E-waste Rules or its guidelines. The most important of these factors is the 'Product Mix' - e.g. the percentage of CRT monitors, LCD Monitors, CPU, Keyboard, Mouse, Accessories that are collected to attain the target in the ITEW2 category. CRTs (most toxic) are expensive from a treatment perspective, whereas CPUs are expensive from a procurement perspective. To lower the recycling charges, a PRO can just procure keyboards or even worse plastics from e-waste in the name of desktops. Another example is that in the name of refrigerators only metal parts of refrigerators are being procured and sent to the recycler.

b. Lack of recycling capacity and limited say with recyclers

Most authorised recyclers currently are only dismantling products and do not have the technology or the capacity to recycle. Good recycling facilities for consumer electronics are almost non-existent. There are evidences of systemic leakages from many formal authorised recyclers to the informal sector aggregators/recyclers. Considering these capacity constraints, coupled with the probability of leakages makes it very difficult for a responsible PRO to ensure real recycling.

c. Limited access to e-waste from PSUs/Government Institutions

PROs have very limited access to waste from bulk consumers, especially government organisations as the concept of PROs is still not mainstream.

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1 Paper Trading – Instead of procuring e-waste, fake invoices and paper trails are procured to show e-waste movement and recycling.
Multiple Accounting – E-waste which has been collected and recycled is allocated to multiple brands leading to a situation where a collection/recycling of 100 tons is shown as allocated to 5 brands with targets of 100 tons each.
Mis-reporting – Collection of higher cost categories like laptops is fulfilled by waste from another category. results in short term contracts which inhibit PROs from making significant investments and drive systemic transformation.

For instance, a platform like MSTC which is used for selling scrap material, including e-waste, by most public institutions does not allow PROs to use its platform. CPCB now recognises PROs and issues authorisation as a stamp of approval, however it has so far not communicated to MSTC that PROs can also do transactions on its portal.

d. Low collection from bulk consumers' channel

Bulk consumers are largely unaware of their legal liability for e-waste management and filing e-waste returns. In addition, the absence of a guiding recycling price range for bulk consumers leads to them demanding recycling certificates while forcing refurbishment prices e.g. bulk consumers usually expect over INR 2000 for a laptop when the real price that can be offered if the product is recycled is around INR 200.

e. Consumers not motivated to dispose e-waste without incentives

Unlike European countries, the consumer in India is not motivated enough to drop e-waste for free at collection points without receiving a high monetary return or other incentives. Responsible PROs despite deep awareness and engagement programs are unable to collect e-waste from individuals in meaningful quantities.

f. No-long term commitment from producers

PROs need to develop deep rooted ecosystems and make significant investments to drive collection and enable long-term behavioural change. However, producers are generally more concerned with the charges of the service rather than the PROs commitment to design an accountable system. This results in short term contracts which inhibit PROs from making significant investments and drive systemic transformation.

Policy & Enforcement Issues

This section discusses the issues which if left unsolved can create significant challenges in solving the e-waste problem in India.

1. Absence of a toxicity based criteria in e-waste rules to prioritise products being regulated

    The categorisation of products and components in Schedule 1 of the E-waste Rules are currently not based on the toxicity potential. For instance, even though servers, routers and switches have similar toxicity potential, only servers are included in the targets for collection.

2. Misdeclaration of datasets

    There are currently no systems in place to check if the sales data provided by the producer for getting EPR plans approved is correct.

3. On-paper collection/recycling of e-waste

    Sub-standard PROs are developing paper trails with the support of recyclers who are issuing certificates of recycling for materials that have not even been sent to them for recycling. Aggregators of e-waste have also reported offers from unscrupulous PROs that offered to pay 5% GST and 10% commission just for making an invoice without physical transaction and collection of e-waste.

4. Collecting cheaper waste fractions that fulfill the criteria of the category

    Targets for collection of e-waste are often completed by focusing on collection of components that are the least expensive from a procurement as well as treatment perspective e.g. CRTs (most toxic) are expensive from a treatment perspective, whereas CPUs are expensive from a procurement perspective. Sub-standard PROs avoid collection of both these components when meeting targets under ITEW2 category. Another example - the cost of procurement of a dead phone (full phone) is almost 20

times higher than collecting merely body covers. Hence sub-standard PROs are simply collecting body covers to keep the collection costs at a minimum.

5. Procuring waste from authorised recyclers and importers

    Sub-standard PROs take shortcuts like merely buying the e-waste already collected by recyclers rather than investing in building an ecosystem that can lead to systematic collection from consumers. Many are also known to opt for illegally imported e-waste that has been imported as "refurbishment parts" despite the ban on importing of e-waste.

6. Leakage of e-waste from authorised recyclers to informal sector

    Recyclers are focused on collection of waste that gives higher returns. While this is understandable from a business point-of-view, it also leads to many of them resorting to malpractices like leaking e-waste that fetch low recycling returns (e.g. chargers, keyboards, SMPS) to the informal sector.

7. Multiple accounting of the collected e-waste

    Since recyclers have been given no recovery targets, they are left with room to indulge in multiple accounting of e-waste which essentially means that the same waste is counted multiple times for multiple producers.

8. Merging of PROs and recyclers

    Across the world, PRO concept is used to bring transparency, ethics, and environmental and social accountability into waste management processes. It creates checks and balances which ensure that recyclers follow rigorous scientific processes and standards, and the recycling data sets are not manipulated. Many recyclers in India have also been registered as PRO, which mean that both the auditor and the auditee are the same.

9. Token awareness activities to ensure compliance

    At present, there are no criteria or guidelines on designing awareness plans that lead to real measurable behavioural change in consumers. This prompts producers to opt for the bare minimum options that show impressive numbers but cost less instead of impactful and holistic pan-India plans for long-term behavioural change e.g. showing short films at cinema theatres and claiming credit that all viewers are now aware of the issue vs. a program where people participate in an activity for a long period of time and get deeply involved in the subject matter.

Vision 2030: Indian PROs Emerge as World Class Models for E-waste Management

By 2030 the e-waste sector in India should be in a position that makes it the reference point for developing countries across the world in solving the e-waste problem through EPR and PROs.

1. **Producers sell electronic products that are free of materials of concern (hazardous materials)** and actively strive to close material loops. Environmental responsibility becomes a norm rather than just compliance or even a differentiating factor that shows thought leadership.

2. **Consumers and bulk consumers are very aware of the hazards of improper disposal of e-waste**, understand EPR, the role of PROs in responsible management as well as their own responsibilities. They actively seek out products only from producers that implement circular economy practices.

3. **Globally best available technologies are being used in India for treatment of all Waste from Electrical and Electronic Components (WEEE).** The rules also cover all products beyond the present 21 categories. Dismantlers and recyclers compete to provide the best technologies and transparency in operations.

4. **The entire industry is formalised with fair trade practices** in place across the value chain.

5. **PROs compete to provide the highest standards** as producers actively seek out PROs that best enable implementing circular economy practices.

6. **Strong governance and stringent enforcement** are seen across the e-waste value chain and is enabled by digitally managed systems. Mass balancing and monitoring systems are present that allow traceability of secondary material and high levels of transparency that curbs cheating.

PRO Roadmap to 2023

In order to enable Producers to achieve 70% collection targets by 2023 and pave the way for transformation in the sector as described in the vision above, certain key milestones need to be achieved:

1. **Issues that remain confusing or untouched in the present rules must be resolved:** MoEFCC has already made a great first step with the introduction of targets to fulfil EPR of producers. In order to strengthen these rules, the following steps must be taken:

    a. Bring in measures such that PROs and recyclers exist separately and focus on their core competencies. Encourage recyclers to focus on improving recycling processes and technologies and PROs to set up collection networks and create highly transparent and accountable systems.

    b. Mandate bulk consumers, including government institutions, to only give away e-waste to PROs so that collection mechanisms set up on behalf of producers are strengthened.

    c. Provide a guiding price range for bulk consumers to sell their e-waste depending on the recycling returns that can be generated.

    d. Publish average weight of products, their components, accessories, input and output devices.

    e. Provide clarification on awareness budget to producers so that more programs with long term behavioural change with pan-India reach are implemented.

    f. Introduce recovery targets for recyclers that are coupled with collection targets for producers to ensure everything that gets collected gets recycled.

    g. Include all WEEE in categories of e-waste and bring in toxicity-based criteria for identification of product categories to be covered.

    h. Publish a very comprehensive list on products, accessories, components, input/output devices which are covered under all categories of ITEW and CEEW.

    i. Mandate declaration of EPR plans of producers on CPCB website for effective monitoring by SPCBs and the public at large.

2. **A centralised digital system for effective end-to-end monitoring of EPR implementation is developed:** Digitising the full process of EPR from submission of EPR to recycling will bring in accountability and transparency in the entire e-waste value chain. It should introduce measures for identifying paper trading practices and create systems for traceability of secondary materials and mass balancing. This system should be developed such that the following are monitored:

    a. Submissions: Sales data of Producers is uploaded on a rolling basis and EPR plans covering all states are available for monitoring by SPCBs

b. Reporting: Procurement and movement at all nodes is visible and State-wise awareness activities are recorded

c. Recycling: Mass-balance of input and output fractions and resource recovery percentages are measured

The development of this digital system will require an initial push from MoEFCC and then involvement of CPCB in collaboration with SPCBs.

3. **Standards are introduced in the entire e-waste value chain including producers and PROs:** Global standards like WEEELabex, E-Stewards, R2, CENELEC can be used to refer to for developing India specific standards.

These standards must be developed and contextualised by Bureau of Indian Standards in collaboration with CPCB, and consultation with NITI Aayog and MoEFCC. The national standard should aim at:

1. Setting **recycling and recovery targets** and benchmarking.

2. Creating a transparent **level playing field for all stakeholders**.

3. Ensuring **compliance with legislation**.

4. Promoting adoption of **best available technologies**.

Conclusion

The success of PROs is dependent on the success of EPR implementation and maturity of the e-waste sector. Producers will need to have a long-term vision and play an enabling role in the development of collection channels and recycling infrastructure. For true transformation, this sector needs a systems-thinking and a step-up approach on year on year enhancement. The key driver for this transformation is enforcement at all levels and regulators will play the key role.

By

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Financing E-waste Management

Introduction

In 2019, in spite of EPR-based e-waste legislation being in place for over eight years, the industry is only now beginning to grudgingly accept the need for a systematic and securely financed e-waste management system. E-waste Rules, 2016 provide a strong legal framework, creating a level playing field for producers while also giving the impetus to recyclers. The obligatory take-back targets have created the need for an evidence-based system that can be tracked and traced. The legislation, importantly, does not specify how such a system should be financed, instead giving the producers the flexibility to design the system that achieves the overall environmental objectives. The main challenges resulting in financing gaps are given below.

Challenges to E-waste Financing

1. **Cherry-picking:** While the E-waste Rules cover both IT waste (computers, mobile phones, etc.) and Consumer Electronics (CE) (televisions, refrigerators, washing machines, air conditioners and lamps), there is a large misperception that e-waste is only about IT waste – predominantly computers and mobiles that are a gold mine. Unsurprisingly, cherry-picking – whereby only the positive value fractions are recycled – is rife. Negative value fractions, such as CRT TVs or lamps, are not found attractive and are, therefore, not accepted by many recyclers.

2. **Trends in value, composition and technology:** Whether a product has a positive or negative intrinsic value depends on the amount of each type of material and the total costs and revenues' potential. Products such as lamps have a negative intrinsic value, while desktop computers and laptops have a positive intrinsic value. *However, the intrinsic value is, more often than not, insufficient to pay for the total cost of collection, aggregation depollution, recycling and recovery.* The material composition of electronics is also changing with technological advances. Over time, the non-ferrous and precious metal content of PCBs has been declining as producers seek to make products more affordable by replacing or reducing expensive materials. For example, modern circuits have a thin contact layer between 300–600 nm, compared to the thick layer of 1–2.5 µm in the 1980s. There is also a significant push towards plastics replacing metal parts, together with other light-weighting techniques. *Miniaturisation, technological developments and changing material composition has an impact on the intrinsic material value and thereby on the economics of recycling.* An overriding trend in the past decade has been digitalisation and increasing hardware intelligence. This has resulted in refrigerators coming with touch-screens, lamps coming with wi-fi connectivity, automatic self-operating vacuum cleaning robots and even suitcases and umbrellas with digital circuits that enable them to connect to smartphones. *From a recycling perspective, this makes products not only more complex to dismantle and recycle, but also more difficult to collect, as electronics are now dispersed in a much wider range of products and more widely diffused in urban and rural markets.*

3. **Mindset of minimal compliance:** From large multinational original equipment manufacturers (OEMs) to small importers of electrical and electronic equipment (EEE), companies are focused on keeping compliance costs for e-waste management at the minimum possible, and willing to cut corners where possible. Indicative of this mindset is a large multinational lobbying to have volumes collected over the minimum collection target for 2018 count towards the collection target for the following year.

4. **Access-to-waste costs:** Consumers, whether small household consumers or large bulk consumers, expect a monetary compensation for the perceived value of their e-waste. This access-to-waste cost is often based on the functional[1] value of the product that is much higher than the material value that can be recovered from the fractions and often does not cover the cost of collection, transport and treatment. The informal sector, through activities such as refurbishment and harvesting of individual parts, and by externalising environmental costs, is able to absorb the higher access to waste costs. In the presence of a thriving informal sector, producers and PROs fear a price spiral in case competition for e-waste intensifies, skewing the economics further.

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1 'Functional value' is understood as the value of a product that is derived from using its functions as a working product. 'Material value' is the value of the materials used (such as plastic, steel, copper, aluminium, etc.) in the products that are recycled and recovered.

5. **Absence of financing for monitoring and control:** Although there is agreement by both recyclers and producers that monitoring, and control are essential – while recyclers want monitoring to ensure that more producers are financing formal recycling and that there is a crackdown on informal recycling; producers want monitoring to ensure that recyclers meet standards and are not paper-trading. However, there is no specific financing available to ensure a trusted and well-monitored system, with the regulatory agencies bearing the brunt of the blame for insufficient monitoring.

6. **Poor logistics complicated by geographic realities:** Poor logistics networks add to the costs of aggregation and storage. These coupled with the country's recycling capacity being concentrated mainly in a few urban areas, make transportation of e-waste expensive. Although the single tax regime and e-way bills have simplified the administrative burden of transportation of e-waste, there still remain inefficiencies in the system that make collection and transportation costs prohibitive.

7. **Inefficient recycling processes:** Poor recycling and recovery processes mean lower revenues from the materials, creating larger financing gaps. Moreover, the weakest link in the chain determines overall efficiency; while the efficiency of final recovery technology has physical limits, the overall efficiency of a take-back and recycling system is determined by the weakest link in the chain. Currently, many critical raw materials are either not recovered because they are lost in current treatment and recovery processes, or not economically viable. A highly efficient system with good collection and recovery rate is able to capture a higher share of the intrinsic value, than a system with a high collection rate but low recovery rate. For example, the informal sector collects a very high volume of the e-waste generated, but it then uses very inefficient treatment and recovery processes, thereby losing a large proportion of the intrinsic value.

Vision 2030: Secured financing for current and future e-waste management system as a whole

The overarching vision for 2030 is to achieve a system that provides secured, ring-fenced financing for the proper collection, treatment and disposal of e-waste. In order to achieve this vision, we need the following supplementary actions to concurrently occur:

1. **Full cost pricing of the entire reverse supply chain,** including the cost of awareness, access-to-waste, collection, aggregation, transport, depollution, disposal, recycling, recovery and monitoring and regulating the system. This is possible through the proper implementation of the EPR mechanism already mandated in the rules.

2. **An all-inclusive scope** of products that covers not only the current narrow scope, but is flexible to also include upcoming e-waste streams – from solar products to electric vehicles, and cross-over products such as electronic textiles, etc.

3. **A competitive market mechanism that fosters greater efficiencies and innovation** in the collection, logistics and recycling domain. The system provides opportunities and rewards for entrepreneurs that improve the overall system performance through innovations in technologies, processes and business models.

3. **A framework for forward-looking financing** that supports the development of the recycling industry. This includes policy level support that enables access to capital, particularly for early stage recycling businesses as well as financing for research and development of technologies required for the treatment and recycling of future e-waste fractions.

4. **A robust monitoring and control system** that checks free-riders, paper-traders and other illegal and unethical activities which undermine the economics of a fair system.

Financing E-waste – A Roadmap to 2023

The road to achieving the vision described in the earlier section is well known and well-travelled. Most producers have the experience from the building of and participating in e-waste take-back systems that are operational around the world, many for more than 20 years. In the context of the specific challenges described for India, suggested here are five key milestone markers that should be reached by 2023:

1. **Milestone: There is clarity on funding mechanism**

   Start by asking the right questions: Who pays? To whom? For what? How much? The answers are both political as well as technical. The question, "Who pays?" is, by legislation, obligatory for producers, although effectively passed on to the consumer. Nevertheless, from a system perspective, it is the producer who should pay to create the financing required to make the system operational. There are still ambiguities in the understanding and interpretation of a producer and the products in scope under the Rules. By expanding the product scope to include all EEE, and thereby all EEE producers, it would provide a more level playing field for the industry and simplify compliance monitoring. A clearly communicated roll-out plan, notified well in advance, will help the producers make the necessary strategic and budgetary plans. The roll-out of additional products in scope can be gradual with periodic updates of categories in scope, or in a single instance from a fixed date. The question, "To whom this funding should go to?" is entrusted to market forces in India – producers may choose to finance the system individually or collectively, through one, or multiple vendors. Producers currently contract directly with recyclers, PROs or compliance service providers – and negotiate directly 'what' they are willing to pay for and 'how much'. There is a corollary question of 'when' should the producer pay into the system which is both an accounting and political decision. The clarity on the funding mechanism would also ensure that cherry-picking by recyclers is eliminated as there is a clear financing to cover the cost of recycling negative value products.

2. **Milestone: Robust data is available to support evidence-based decisions**

   A robust baseline and inventory supports both compliance and monitoring efforts as well as provides crucial data for setting standards and targets. As a first step, an inventory, ideally based on international standards should be commissioned. Such a baseline would also provide lifespan profiles relevant in the Indian context that would help align the lifespan for target calculations provided by the CPCB, with on-ground reality of the age of products in the waste stream. Combined with batch sampling of incoming waste streams at formal recyclers, a material composition profile of the various products/ product categories would be a

necessary precursor to mapping the flows and routes, and monitoring overall mass balance of the system. This would provide evidence-based data on the scale of the informal sector; the actual volumes processed in the formal and informal sectors and identify newer hot-spots beyond the ones currently known such as Moradabad. A validated inventory and material flow would provide the basis for recyclers, producers and PROs to price and negotiate contracts. For the regulator, in this case the CPCB, it would provide the basis for the monitoring mechanism.

3. **Milestone: A technology-enabled monitoring mechanism is in place**

   All stakeholders agree that enforcement action by the government is essential. This requires the regulator to establish a robust monitoring and control mechanism by leveraging technology so that reporting, auditing and compliance checks can be synchronised and intelligence-based. A first step on the road would be to introduce an online registry system for reporting by producers, PROs and recyclers and that is able to identify and raise red-flags for regulators to have more intelligence-based monitoring – similar to systems implemented by other government departments such as the revenue authorities. The next step would be to link to GST (Goods and Services Tax) and import-export data to validate reported figures as well as provide inputs to inventory and stock and flows data for estimating future e-waste volume, and the associated financing aspects of managing it.

4. **Milestone: Technical standards and key performance indicators are defined**

   Adhering to technical standards has a bearing on costs – as discussed in other articles, especially in the distinction between the informal and formal sector. Therefore, it is essential for the regulator to establish clear standards for collection, transport, dismantling, treatment and disposal. There are several international standards such as CENELEC (European Committee for Electrotechnical Standardisation) and R2 as well as voluntary standards for dismantlers designed for the Indian context developed by the Confederation of Indian Industry (CII) that can provide the basis to define technical standards and identify Key Performance Indicators (KPIs). A time-defined and inclusive multi-stakeholder process, led by the regulator, should be

initiated, with a specific Term-of-Reference defining the composition of the committees and tasks. As the technical standards should be continuously revised, the stakeholder process should also provide recommendations on the formalisation of the process for technical review and updating of these standards to keep them relevant.

4. **Milestone: A mechanism to build capacity on e-waste management is established**

The scale and diversity of skills and knowledge required for proper e-waste management necessitates building capacity at all levels and of all stakeholders – from policy makers and regulators at the federal and state level, managers at PROs and other compliance services providers, dismantlers and recyclers, to entrepreneurs and investors, researchers and academicians. The investment in skills and capacity has a direct bearing upon the overall costs of the system. This would mean establishing funding mechanisms and structured programs that build the capacity required to achieve the vision.

Conclusion

The economics of e-waste hinges on many factors, some a result of technological developments, some on macro and micro-economic aspects while others are defined by the laws of Physics. The overriding techno-economic trends and factual realities of the system means products are not only more diffused and more difficult to collect, but also, combined with lower intrinsic material value necessitating additional financing to ensure the system is environmentally, socially and financially sustainable.

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E-waste Management and Businesses in India: What Lies Ahead?

Challenges faced by Businesses for E-waste Management

Indian E-waste Rules are based on the principle of extended producer responsibility (EPR). It is therefore no surprise that the focus of governments and regulators has largely been on producers of electronic goods. A review of published reports, research articles and anecdotal evidence suggests that the response of producers to the Rules has been far from satisfactory and businesses, that include producers and the bulk consumers, face the following main challenges:

1. **Lack of sufficient regulatory capacity:** Businesses' response to e-waste management in India has been almost completely driven by compliance. In the absence of other drivers like consumer demand, environmental leadership, and resource efficiency, businesses tend to design their response to keep compliance costs as low as possible. The lack of sufficient regulatory capacity at central and state levels, in terms of manpower, financial and non-financial resources also contribute to businesses' decisions to bank on the possibility of escaping with minimal compliance.

2. **Lack of awareness:** Business response to e-waste regulations has also been impacted by lack of awareness about negative externalities of environmentally unsafe e-waste management practices. This lack of awareness is not just restricted to key decision-makers in businesses, but also extends to consumers – which in turn impacts consumer behaviour – while dealing with e-waste. There is also a lack of awareness about alternative technologies and processes to manage e-waste in an environmentally safe manner.

3. **Challenges in working with the informal sector:** Despite more than seven years of the Rules being in force, the informal sector continues to manage more than 90% of e-waste generated in India. As such, businesses – be it producers or bulk consumers – have to deal directly or indirectly with the informal sector. There are numerous challenges in such dealings that pertain to the absence of an established model of engagement between large formal players and informal waste management sector, lack of trust between businesses and informal sector, challenges for businesses in identification of key actors or players in the informal sector to engage for different steps of e-waste management (e.g. collection, storage, dismantling, recycling, etc.), difficulties in scaling up initiatives across cities and states, price related aspects, and issues related to transparency, corruption, and other practices employed by the informal sector.

4. **Insufficient waste management capacity in the formal sector:** The waste management capacity of the formal sector has witnessed impressive growth since 2011 but is still only about 0.4 million tons. This is a fraction of the total annual e-waste generation that is estimated to be 1.6 million tons. The insufficient waste management capacity in the formal sector further limits the scope for businesses to work with the formal waste management sector.

5. **Other challenges in implementing EPR:** EPR originated in the West and has largely been used for the management of different waste streams in developed countries. Due to several differences in markets and institutions, the implementation of EPR in developing countries like India which are categorised by fragmented forward distribution networks (from producers to retailers), large informal waste management sectors, and different cultural and social norms for waste, will be different and difficult. However, little is known about mechanisms in which businesses can fulfill their responsibilities in such circumstances. This lack of an established body of knowledge and business models further limit businesses' response to regulations on e-waste management.

Vision for Business and E-waste 2030

The vision for India E-waste 2030 is that a) business response to e-waste management will no longer be driven mainly by compliance, and b) e-waste management will no longer be restricted only to producers' response. Three key trends are likely to help shape this vision:

1. **Emergence of sustainability as a key agenda:** One of the biggest developments that will impact business response to e-waste in India leading up to 2030 will be the *increased prominence of sustainability* globally as well as in India. The dynamics of businesses worldwide are increasingly being influenced by sustainability concerns. Topics like environmental degradation, climate change, and resource scarcity have increasingly come to the forefront of government and public attention. The changed business environment, evolving domestic and global policies and regulations, and increased demand from multifarious stakeholders like consumers, investors, governments, and non-government organisations are driving the sustainability agenda in businesses today. As a result of all these developments, sustainability is increasingly becoming an integral part of corporate strategy. Corporations like Unilever are increasingly aligning their vision and operations to global, regional, national, and local sustainability goals. From changing the business model from selling to renting or leasing, emergence of a sharing economy, to increased supply of greener products driven by increased consumer demand, businesses are responding in various ways.

   The Indian government is a signatory to the United Nations Sustainable Development Goals (SDGs) and NITI Aayog is tasked with aligning the initiatives of the Indian government with the SDGs. There have been some recent attempts to connect e-waste management with SDGs and such attempts and interlinkages will become even more prominent in the future. As we move towards 2030, we will find sustainability becoming an even more important agenda within Indian businesses. As these developments take place in India, the Indian e-waste sector will not be left untouched. While the local context and circumstances may cause a time-lag between global and Indian developments, the trajectory in India will not be different because of some key reasons. Those reasons

include presence of foreign electronic producers in India, increased export-oriented nature of Indian electronics producers, rise in pro-environmental behavior among Indian consumers driven by a rise in income, and further rise in Internet penetration leading to the convergence in consumer demands globally for greener products and more responsible businesses.

2. **Compliance no more the only driver of business response:** A business mindset that is driven by compliance or fear of regulations is more likely to consider options like resisting the regulations and shirking from accepting complete responsibility as mandated by the regulations. However, as collection targets rise multi-fold from 20% currently to 70% in 2023 (and maybe even higher later on), producers will be forced to think of more innovative ways to meet their targets. Producers will also try to align their efforts in streamlining e-waste with other business approaches and practices to gain double dividend from such efforts.

   One important aspect of the developments mentioned earlier will be that we will increasingly see other drivers gaining more prominence (refer to Figure 1). While cost control may be the initial driver behind producers' search for options, other organisational levers like process optimisation (e.g. reducing costs of e-waste channelisation from consumers to end recyclers), product design changes (e.g. simplifying product design to reduce product weight without compromising on functionality, reduced weight of product helping in transporting finished products as well as collected e-waste), reduced material consumption (e.g. going for an eco-friendly or recycled option to save costs and material consumption), and change in revenue or business model (e.g. more revenue from selling services on sold products than selling new products) will increasingly lead to producers trying innovative approaches to meet targets.

Figure 1: Current and Future Drivers of Business Response to E-waste Management in India
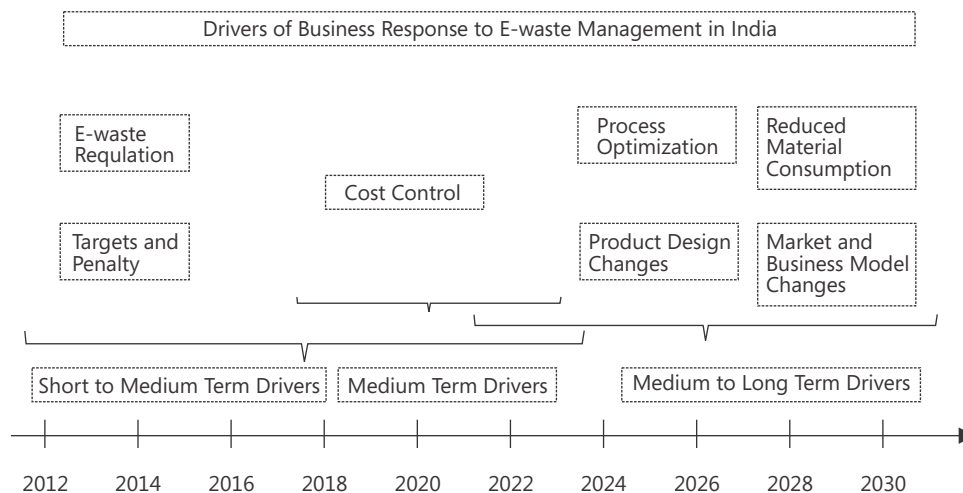
The emergence of other driving factors, however, does not mean that e-waste regulations will not be required. A clear and robust e-waste regulation whose provisions for producers and other stakeholders strengthen and don't dilute the ecosystem is pivotal for driving business response, especially in the medium term. In the short to medium term, robust regulations and fear of non-compliance will provide impetus for businesses to search for different alternatives to manage e-waste in India. The growth of PROs in India and the introduction of deposit refund systems for electronic goods by some producers, after 2016, have been possible mainly because of the regulation. Some of the challenges related to interactions of businesses with the informal sector and the lack of transparency in managing e-waste by producers and e-waste management firms will take time before a solution is found out. Time will also be required for other business drivers to emerge and become stronger. Till that time, steady and robust regulations are essential to drive responsible business response for e-waste management. Robust regulations coupled with enhanced regulatory capacity will also mean that efforts and mechanisms to bring safe and scientific practices into the informal sector will continue.

3. **Increased response from bulk consumers:** The sustainability agenda and the emergence of other drivers will lead to more demonstrable action being demanded by the stakeholders from bulk consumers and an increased response from bulk consumers in managing e-waste in India. The emphasis on P (for producer) in EPR has so far meant that almost all the attention is centered on the producers. However, since electronic goods sales to bulk consumers comprises close to 3/4th of all electronic goods sales in India, increasingly more will be expected and demanded from bulk consumers. Many of these bulk consumers have active sustainability teams and the response to e-waste management will increasingly come under the realms of these sustainability teams. Increased consumer awareness about e-waste will force not just producers but also bulk consumers to actively focus on e-waste management. All these developments will lead to a combination of responses from producers and bulk consumers. Some of the business responses could include producers shifting from selling to leasing model, increased collaboration between producers and bulk consumers in managing e-waste, and preference in public procurement of goods made from recycled materials.

Business Roadmap for E-waste 2023

For Vision 2030 (as stated earlier) to be achieved, the roadmap to E-waste 2023 should be strongly shaped by, and in turn strongly shape the longer-term trajectory. Based on the feedback from stakeholders and learnings from the ground, E-waste Rules 2016 will most likely be revised before 2023.

Among the changes that should take place include:

- Strengthening norms for producers

- Expanding the definition of e-waste to include all electrical and electronic products that are currently excluded from the rules

- Removing the ambiguity around terms like producer and manufacturer existing in the current versions

- Increasing product take back percentage for producers

- Introducing recycling targets for producers and

- Increasing the cost for non-compliance.

Furthermore, there should be other changes in the type of information being asked from the producers. While initially the producers were asked if they have a plan for consumer awareness or not, now the producers are being asked about their EPR plan. In the future, producers should be required to abide to certain **standards for recycling and to provide measurable, verifiable, and reliable (MRV) data on e-waste collected**. In the next five years, producers might also be expected to provide audited figures for products collected using different take back mechanisms and demonstrate evidence of instances where the collected e-waste has either been sent to a recycling facility or used after material recovery in production processes. Similarly, **bulk consumers should increasingly be scrutinised by regulators** and should be asked to provide evidence about their organisational practices in dealing with e-waste.

Another development expected in the next five years is the **standardisation of a process to inventorise e-waste data**. Already the central regulators, CPCB and MeitY, have started pilots to inventorise e-waste data. As collection targets increase in the future, there will be more scrutiny of e-waste numbers being provided by different stakeholders. The adoption of a standardised procedure that is aligned with global practices should lead to better enforcement of the rules by regulators and governments. All these developments would mean that compliance becomes a stronger driver for business response to the rules. The stronger compliance becomes a driver, the faster will be the pace at which businesses will look at deriving other benefits from improved compliance. For producers, this could mean emergence of cost control as a key driver.

Producers will be forced to do an exhaustive cost-benefit analysis of different ways of meeting EPR requirements. From doing it on their own to tying up with a formal recycler or a PRO to joining hands with other producers or an association of producers, will now look at the relative tactical and strategic gains from these different approaches. For different product categories and different market structures, the most optimal mechanism to select could differ for each producer. Some producers may find it efficient to adopt different approaches for different product categories while others may find it better to adopt one approach for the entire portfolio of their products.

Another development that may complement the points mentioned above will be **greater industry academia interface** on these topics. E-waste Rules was the first waste management regulation in India to explicitly be based on EPR. In 2018, alarmed by the growth of plastic waste, several state governments have introduced measures to ban plastic in their respective states. Many of these regulations are based on EPR. The resulting market developments will be closely watched by governments, regulators, businesses, the waste management sector, non-government organisations (NGOs) working in these sectors, and academia. There has been an increase in academic focus on understanding the different aspects of EPR and the role of businesses. Increased adoption of EPR in India would mean an even greater focus on these aspects and a rise in instances of industry and academic collaboration to find better ways to manage waste streams and implement EPR.

By

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The Role of Standards in Sustainable E-waste Management

Introduction

Creating a transparent and robust e-waste management system that ensures safe dismantling and recycling of obsolete electronics remains a challenge in India. In other countries, the combined use of regulatory and voluntary standards has helped foster more sustainable e-waste management. Stakeholders could consider developing and leveraging standards specific to India's context to improve its e-waste management.

Over nearly the past two decades, global sustainability standards in the electronics sector have improved product design and end-of-life management of used electronics. Regulatory, or mandatory, standards have spurred manufacturers to design more energy efficient products or replace toxic substances with alternatives. For example, the European Union's 2003 Restriction of Hazardous Substances (RoHS) Directive, bans certain materials, including cadmium and hexavalent chromium, in electronic and electrical goods, and the Waste Electrical and Electronic Equipment (WEEE) Directive mandated the creation of collection schemes for consumers to return obsolete WEEE free of charge. Producers must meet these regulatory standards to operate in the European Union.

In contrast, voluntary standards have helped to drive improvements that go beyond regulatory requirements, providing a uniform means by which higher performing products and services receive reward and recognition. Specifically, voluntary consensus standards are developed through a multi-stakeholder process, usually with representation from government, NGOs, industry, academia and other experts, to develop leadership criteria. For example, the Institute of Electrical and Electronics Engineers (IEEE) 1680. 1 computer standard, which includes measures for environmentally safe e-waste recycling, was developed by dozens of international stakeholders and serves as the basis for the Electronic Product Environmental Assessment Tool (EPEAT), an ecolabel for the IT sector used by institutional purchasers. In using voluntary consensus standards as procurement criteria, institutional purchasers (bulk consumers) have increased demand for sustainable products and services, which has incentivised producers to deliver more of them.

In India, precedent exists for using standards to accelerate market changes to improve environmental conditions. For example, despite mixed reactions from the automobile industry, but with support from public interest groups, Government of India enacted Schedule VI emissions reductions ahead of schedule to improve air quality, forcing industry to leapfrog to more advanced technologies to be able to sell vehicles in the market. In other instances, industry has asked the government to develop standards to provide a level playing field in the market. For example, media content providers, including Amazon and Netflix, recently called for the development of a common standard for streaming Internet protocol TV content.

Challenges Facing the Adoption of Standards in E-waste

1. **Collectors and aggregators face financial incentives to sell e-waste to informal recyclers:** Over 90 percent of e-waste is managed by a complex, well-networked, informal sector that offers collectors competitive prices for material. Formal recyclers with overhead expenses often cannot compete on price with informal recyclers that employ harmful extractive, inefficient techniques. Informal collectors and aggregators often 'cherry pick' valuable material, which they sell at higher margins to informal recyclers, resulting in lower value material available to formal recyclers. Given the informal sector's size and influence, stakeholders acknowledge that producers must engage the informal sector to meet their required recycling quotas under the current e-waste rules. Some producers have hired PROs that provide value-add services – such as business development skills – to informal collectors and aggregators so as to entice them to work with them. Scaling up such efforts requires building local trust, providing value to workers, and offering them competitive prices.

2. **Corrupt practices occur among formal recyclers:** In 2018, two PROs discovered that some formal recyclers resold material back into informal markets instead of safely recycling it and/or issued multiple certificates of destruction, thus double or triple counting the same amount of e-waste recycled. A commonly used tracking system including both financial and mass balance data would help reduce such corruption.

3. **Lack of adequate metals recycling capacity exists:** Most formal recyclers in India are dismantlers, with few formal facilities capable of extracting precious metals. PCBs and other precious metal-containing e-waste components are recycled informally or exported. Government-supported efforts have developed smaller scale processing capabilities, but such technology transfer has yet to be implemented on a large scale within the formal sector or piloted for safe implementation in the informal sector.

4. **Monitoring and enforcement efforts face constraints and lack coordination:** Government enforcement bodies face resource and staff constraints to ensure that registered formal recyclers adhere to safe recycling practices. Some formal recyclers received government-issued registrations for facilities lacking the processing capacity stated in their approved documentation, raising the potential to sell excess material back into informal markets. Moreover, since e-waste management responsibilities and activities are spread across different ministries at the central and state levels, creating a coordinated and robust system to detect violations remains an administrative challenge.

5. **Bulk consumers lack awareness of their obligations under the E-waste Rules to safely recycle their used electronics:** The current E-waste Rules require producers to raise awareness but do not provide parameters or guidance for doing so. Bulk consumers often sell their e-waste to informal collectors, mostly due to pre-existing connections or because they do not receive favorable prices from formal recyclers. Some producers are beginning to offer leasing and take-back programs to ensure safe collection and processing, though such business models are still not mainstream.

6. **Many producers lack a forward-looking response:** Many producers view e-waste management as a compliance issue rather than as a business opportunity to demonstrate a competitive edge in the marketplace and/or adherence to social and environmental corporate responsibility efforts, as producers have begun to do in other countries.

Vision for Standards in 2030

Vision: a robust market for collecting, refurbishing, dismantling, and recycling electronics that protects human health and the environment and supports economic growth. The following market conditions are envisaged, supported by regulatory standards that set minimum requirements for specific activities and a voluntary standard that rewards producers for improving their e-waste management programs and serves as the basis for procurement criteria used by bulk consumers:

1. **Greater traceability of e-waste flows and transparency into formal recyclers' operations exist.** Better monitoring and enforcement of illegal activities and improved transparency of e-waste flows have fostered a more level playing field for formal recyclers to thrive. Producers track and report their e-waste flows into a system managed by the government or a neutral third party that accounts for both mass balance and financial data and helps authorities monitor and enforce the Rules. Such a system could be codified into a regulatory reporting standard. Regulatory definitions provide greater clarity on the distinctions between formal dismantlers and recyclers who extract materials via chemical processes. Greater guidance exists to help state enforcement officials evaluate companies seeking registrations for establishing local dismantling and recycling operations.

   Guidance also exists for producers and PROs seeking evidence of safe processing operations when selecting dismantlers and recyclers.

2. **Employment opportunities in formal and informal sectors have improved.** Producer-funded recycling initiatives work with informal collectors, aggregators and dismantlers and help them improve their skills and operations, as needed. More material is diverted to formal recyclers for end processing, leading to a more financially robust formal sector. Though the informal workforce remains diverse and decentralised, informal collectors

and dismantlers are in a better financial position to modify their operations to reduce negative health impacts; some informal workers transition to the formal economy. Technology has streamlined transactions and reduced costs of doing business with both informal and formal workers. Building on the CPCB's 2018 PRO guidelines, new regulations strengthen requirements for PROs to reduce the risk of unscrupulous actors in the market. A voluntary consensus standard could further require PROs to demonstrate measurable progress in upskilling informal workers or helping them create safer working conditions. Guidance exists for producers to select PROs or other third-party organisations with proven success in organising, upskilling, and/or formalising informal workers.

3. **Most bulk consumers are aware of their responsibilities under the E-waste Rules; households are more aware of recycling options.** Producers and the government jointly implement best practices for raising awareness on e-waste recycling obligations for bulk consumers and on e-waste recycling options for households. Producers report to the CPCB annual outreach metrics (e.g. media coverage, campaign participation) using a standardised reporting framework. The CPCB receives higher quality data, MEITy can better target participation from producers in education campaigns, and civil society groups can better assess progress on producers' public education efforts.

4. **Greater circularity exists.** Circular economy features prominently within a government policy framework encouraging resource efficiency across industrial sectors. To incentivise more reuse of products, producers offer bulk consumers leasing and competitively priced product take-back services and design products that meet standards promoting universal interoperability. More efficient and environmentally safe metals and plastics recovery systems are in place due to

investment in technology transfer and private sector-supported entrepreneurial ventures. These materials are increasingly refined for use across domestic industrial sectors or exported for sale. By working with government and/or private sector-supported technology transfer initiatives, some informal metals recyclers have adopted cleaner technologies and become more transparent, formal recyclers. A voluntary consensus standard provides a means to recognise such innovations in reuse and recycling.

5. **Bulk consumers leverage their purchasing power to drive sustainability.** To demonstrate their commitment to sustainability, bulk consumers – including central, state, and local governments – use voluntary consensus sustainability standards as procurement criteria, rewarding producers who offer more sustainable e-waste management services (e.g. deposit refund schemes, working with organisations that upskill informal workers, and ensuring material is diverted for safe recycling). Bulk consumers value demonstrating how they support the United Nations' Sustainable Development Goals (SDGs), where investors and the public are increasingly interested in the effectiveness of their corporate social responsibility and environmental initiatives. Potential criteria for a voluntary consensus standard could align with the following key SDGs:

a. (Goal 8, Target 8.2) – "Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high value added and labour-intensive sectors."

b. (Goal 12, Target 12.5) – "By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse."

c. (Goal 12, Target 12.8) – "By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature."

d. (Goal 12, Target 12.6) – "Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle."

Greater demand from bulk consumers for more sustainable e-waste management incentivises producers to offer more comprehensive e-waste solutions. Producers shift from viewing their e-waste programs as means to fulfill a compliance requirement to a business opportunity that provides them a competitive edge in the market.

Developing a Roadmap for Standards in 2023

To achieve a 2030 vision, wherein market conditions will have transformed, in part, due to the use of regulatory and voluntary consensus standards, such standards would need to be developed within the next few years. Stakeholders would need to determine where regulatory standards or a voluntary consensus standard could best address barriers to progress. Proposed here are options for consideration:

Regulatory standards might be better suited for outlining mass balance and financial flows reporting requirements; definitions distinguishing dismantlers and recyclers; basic requirements for safe recycling operations; minimum qualification criteria for PROs; and a framework for producers to report on their outreach and education efforts. Such standards would help level the playing field for different market actors and provide greater clarity to producers developing e-waste collection and recycling programs under the Rules.

A voluntary consensus standard could be developed in parallel, to accelerate improvements in e-waste management, foster innovative solutions, and help stakeholders meet other environmental objectives, such as SDGs and resource efficiency/circular economy initiatives in India.[2] Below, proposed strawman criteria, unique to India's context and targeted toward producers, are based on draft criteria proposed in December 2018 by the Green Electronics Council, a U.S.-based international NGO, in collaboration with India's Centre for Responsible Business:

1. Producer shall collect material from informal workers through third-party programs/collectives that build capacity among informal collectors, aggregators and dismantlers via training, education, and/or direct technical assistance.

2. Producer shall publicise annual achievements in e-waste management and include information on how accomplishments fulfill social and environmental (e.g. resource efficiency) goals.

3. Producer shall promote product reuse by offering a buyback, deposit refund scheme, or similar programs for products sold to bulk consumers.

4. Producer shall invest in technology transfer innovations that promote safe materials extraction and/or procure recycling services from recyclers using such new processing technologies.

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2 Given the focus on materials security and resource efficiency by National Institution for Transforming India (NITI Aayog), an opportunity exists for stakeholders to discuss how policy makers can help foster greater product reuse and better extraction and refining of valuable materials from e-waste within India.

2019–2020

Under a neutral third-party convener, the following key stakeholders could assemble to determine where regulatory standards can best solve existing challenges and where a voluntary consensus standard provides the greatest opportunity to drive improvements:

1. Government entities including MoEFCC, CPCB, National Institution for Transforming India (NITI Aayog), and ministries engaged in sustainable purchasing initiatives

2. Producers and electronics industry associations

3. NGOs

4. Any additional groups representing informal workers

5. PROs

6. Formal recyclers

7. Bulk consumers and industry associations focused on sustainable procurement and

8. Private or public sector financing representatives seeking to invest in resource efficiency and new recycling technologies.

2020–2022

Regulatory standards would be developed by government entities under their defined timeline. Should stakeholders agree to develop a voluntary consensus standard, under the purview of a standards development body, they should aim to draft, refine, and finalise the standard within two years to ensure that its criteria remain relevant to address current challenges.

2022–2023

Any new regulatory standards would, ideally, take effect in 2023. Stakeholder groups would conduct outreach to bulk purchasers, encouraging them to reference the voluntary consensus standard in procurement criteria starting in 2023.

Conclusion

In India, government-issued standards could support market conditions for more sustainable e-waste management practices by setting more rigorous operating requirements for PROs, dismantlers, and recyclers and by creating a required financial and mass balance data-reporting framework. The government could consider leveraging internationally developed standards if they could be appropriately tailored to India's context. A complementary, voluntary consensus sustainability standard designed to address challenges in India could promote further transparency and build capacity. For example, the Confederation of Indian Industries (CII) GreenCo rating for e-waste recyclers already exists and could inform some criteria under a broader e-waste management standard. Several stakeholders representing multilateral institutions, NGOs, producers and PROs cited concerns that producers are focused on compliance and are not ready to consider voluntary action. Stakeholders also have yet to engage bulk consumers to leverage procurement to create more demand for sustainable e-waste management.

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The Informal Sector in E-waste Management

Introduction

The promulgation of a national rule for e-waste management based on the principle of Extended Producer Responsibility (EPR) in 2011 was perceived as a serious effort in the right direction but its effective implementation is yet to be witnessed on ground. While the Rules have expressly conceived a system based on the integrity and honesty of stakeholders and the state being the singular monitoring agency, the on-ground situation is ultimately proving to be much more complex and challenging.

The most formidable challenge has been the existence of the informal sector and their non-inclusion in the current regulation; the informal sector has not even been acknowledged for their role, although performing a significantly important role in the management of this waste stream. On another front, the producers, identified as the principal stakeholders in the law, have always mentioned the presence of the informal sector as a line of defense in challenging their ability to fulfill their mandated EPR obligations. The ground reality, as it exists today is a competitive situation on multiple accounts between the formal and the informal sector. It's about better access to waste centered around value extraction at multiple levels of the waste trade that poses a serious challenge to EPR compliance.

It is the nature of the organisational structure and the extensive network established across the country that provides the informal sector a unique advantage to access waste from both businesses and households while keeping their overheads low. The seamless network and hierarchical business operations from collection, transportation, waste aggregation, dismantling to material extraction provides them a business opportunity in each of the verticals. Understanding fund flows in the informal sector can be very deceptive since the informal sector has the capacity to handle extremely large volumes and aggregated trade are usually businesses of scale operating on smaller margins suggesting the existence of deeper financial pockets engaged in this trade. Urban poverty and the availability of low skill migrant rural population that are exposed to unsafe working conditions make sourcing labour relatively cheap. The availability of waste and the existence of the urban poor also provides unique livelihood opportunities and a very fertile ground for innovation and newer business models; these require careful examination and in-depth understanding for them to benefit the society and drive sustainability.

Challenges Pertaining to the Informal Sector in E-waste Management

1. **Access to waste and flexibility:** The informal sector's structure and its inherent flexibility are of extreme importance and are an advantage to its sustenance, however it poses a serious threat and challenge to the formal sector. Its ability to access waste from both individuals and businesses is extremely critical as it captures most waste that is generated across the country; its wide network supports the aggregation of the waste in large volumes making the trade vibrant and profitable. While this is recognised as an advantage to the sector, it poses a serious challenge to the formal sector and its ability to compete, making implementation of the Rules extremely challenging.

2. **Hazardous processes:** The informal sector processes involved in material refining are perhaps the biggest challenge to the environment because of poor resource efficiency and the absence of appropriate technology. It is also well established that collection and aggregation do not compromise environmental integrity and most proponents have advocated for the continued use of the informal sector in this vertical of business operations. The role of the informal sector in collection and transportation requires recognition. It is hard to understand the rationale to define activities around waste collection and aggregation as hazardous since forward supply chains of goods and products with similar material composition are not treated as hazardous; hence it can be established that it is not the nature of goods but the invisibility of the informal sector that is a matter of concern and which requires to be addressed.

3. **Invisibility of the informal sector:** There is an inherent component of invisibility and unlawfulness associated with the informal sector. Their ability to melt away and re-establish at short notice from the glare of the law is an advantage to their operations, but this nature of business operation is also perceived as a serious challenge. It is the illegality associated with their activities that compels the operators to wear this cloak of invisibility and this requires resolution and reconsideration by regulation. They are also viewed as free riders and a problem to society, especially given that they carry the additional burden of environmental degradation.

4. **Capacity and response of the state:** The state regulatory and oversight mechanism is inadequate to address the challenges posed by the informal sector. The state does not engage with the informal sector though it tacitly understands its existence which perhaps is on account of the livelihood opportunities that it provides to the urban

poor and the inability of the state to mitigate the issues around urban poverty. The inability of the state to effectively implement the Rules also supports the existence of a parallel informal system that helps mitigate some of the visible challenges of waste management. The inability of the state is also starkly played out in not acting against some of the most polluting processes that are openly carried out in clusters and perhaps right under the noses of the regulators.

5. **A case of two arms of the government treating the same issue in a diametrically opposite manner:** The informal sector has been completely omitted in the current Rules, but on the other front, the national tax regime (GST) recognises waste trade and shipments, thereby creating a very unusual situation. This tax regime creates a situation where collection and transportation of waste by any individual or group is being legitimised and accepted by the state. E-waste is being taxed at a 5% rate for both inward and outward movements, while there is no effort to inquire about the destination and owners of such goods – thus providing legitimacy and yet a disguise to the goods creating a very piquant situation.

The illegality in transporting these goods is explicit in the E-waste Rules which is completely overlooked by charging a tax granting it some legitimacy. The rationale for seeking permission under the Rules is also conflicting since forward trade of new goods and its storage is not being covered under the ambit of hazardous substances. This situation requires to be discussed at the highest levels and concessions should be granted to an individual or agency to collect, store and transport e-waste for the purpose of refurbishment and recycling. All this needs to be done while effectively encashing on the inherent strength of the informal sector and increasing availability of waste in the formal sector, also increasing revenue to the state.

This concession will also provide legitimacy to the informal sector with minimal oversight and control but with increased tracking of goods.

Vision for the Informal Sector in 2030

1. **E-waste will persist as a serious environmental issue** while many of the current complexities will get crystallised and many solutions will have been attempted to address them. The informal sector will continue to exist and engage with this waste stream more vigorously with enhanced access to waste. Cherry-picking by the formal sector will continue to result in the not so valuable goods flowing into the informal sector. The ambivalent approach of the state of levying taxes on e-waste without seeking any information on movement of such goods is expected to lead to some serious rethinking and steps will be taken to grant some legitimacy to the informal sector in the collection and transportation of such goods. Inadequacy of the state in effective implementation of the Rules will require remedial action by 2030.

2. **Governance:** The current e-waste management regime is completely driven by regulations and unfortunately the regulatory infrastructure is highly inadequate to monitor compliance and enforce the Rules. This situation may not improve much in the next few years since the state currently doesn't acknowledge its inadequacy. Judicial interventions may likely yield results but to a limited extent because of its dependence on the executive for action. This situation can only be altered by another revision to the regulatory framework and governance mechanism; the current arrangement of state and central pollution boards requires a serious rethink, perhaps by incorporating more powers, faster decision-making capability and accountability of individual officials.

3. **Recognition of the informal sector:** The limitations of the current Rules are multiple and they will continue to get exposed due to the increasing collection targets leading to another set of revisions. This will perhaps also be very opportune for the legislators to review the current status of the informal sector and perhaps grant them some recognition in the current Rules providing legitimacy in waste collection and trade of e-waste. This altered status is expected to impact waste access by both the formal and informal sectors, and would also probably create seamless waste movement between these sectors. Waste access by the current informal sector could increase exponentially since the informal sector is capable of extracting value from such products that do not have high intrinsic material value.

A Roadmap for the Informal Sector 2023

The role and existence of the informal sector is perceived as a major challenge to the effective implementation of the current Rules. Producers also continue to highlight the existence of the informal sector as a major challenge in fulfilling their mandated responsibilities and EPR targets. This perception is perhaps true to an extent and the country will have to draw up a distinct and a well-defined roadmap for handling the challenges posed by issues around the informal sector and the poor environmental governance mechanism. Some components of the roadmap are discussed as follows:

1. **Waste inventorisation and data generation:** Inadequacy of data on e-waste has been a matter of serious concern; the issue of waste generation and its inventorisation has never been seriously attempted. Inventorisation and the assessment of the life span for a product require a scientific and rational approach. The current estimations on the volume of waste that flows into the informal sector and the population directly or indirectly engaged in e-waste management is based on weak or inadequate information which inhibits the development of a sound legal framework and effective implementation mechanisms.

2. **Review of current regulations:** Inadequacy of data can be a serious bottleneck in developing solutions since the magnitude of the problem is shrouded in a web of fuzziness and a weak foundation. With the current limited enforcement capacity and monitoring mechanism of the state, it appears difficult to effectively implement the current Rules resulting in serious implementation gaps and slippages in compliance of progressive EPR targets. The role of the informal sector and its ability to access increasing waste volumes will also necessitate discussions on the need to review the current regulations. The role of the informal sector will need to be addressed clearly defining dos and don'ts in view of the current tax regime. The list of items that are currently placed in the schedules will need to be reviewed based on their hazardous components rather than generic criteria, while acknowledging the need for repairs and refurbishments both in the formal and informal sectors, thus minimising waste generation.

3. **Development of online systems:** The current regulatory and monitoring mechanisms draw immensely on the strength of human resources and the current opaque system of paper trails will be almost impossible to manage. An online portal is essential to bring transparency and accountability into the system. Lessons must be drawn from the GST system that tracks movement of goods and identifies free riders. Waste generation and its movement till its final disposal should be tracked by an online system and technology must be used to identify and track all goods till their final disposal. This should also include all goods that are handled by the informal sector that are being transported inwards and outwards by paying GST. Such a system

would support the immediate and long term objectives of generation of credible data and effective monitoring thus reducing the environmental load and fostering circular economy.

4. **Effectiveness of evaluation:** It is often mentioned that the country has an abundance of good laws but highly deficient implementation and enforcement of such laws which must be attempted. One approach can be through a mandated systematic process for effectiveness evaluation of such laws and subsequent corrections. The E-waste Rules must be evaluated for their effectiveness by a statutory body at a periodic interval of two years and the report be discussed at the highest levels. One such institution could be the Comptroller and Auditor General of India (CAG) which may constitute a body of experts drawn from multiple sectors such as governments, academia, civil society, and industry to carry out such a task. This would be immensely helpful due to its nature of being independent and holding people and institutions accountable.

5. **Awareness generation:** One of the important and critical reasons for the current failure in implementation has also been sighted as the low levels of awareness among consumers and waste generators. Most consumers are unaware about the end-of-life management of electronic products and most producers have been resisting the responsibility to take this on in full measure. The country has witnessed some success under the Swachh Bharat Mission and some of these lessons can and must be replicated in e-waste management regime. It might be taken up at an appropriate scale by the Ministry of Environment, Forest and Climate Change at a national level thus ensuring mass awareness among all sections of the society. It can be a critical driver in changing the status quo in consumer behaviour and aiding them in placing waste in clean channels.

Conclusion

The informal sector – with its vast reach and access to waste both from urban and rural areas – has played a critical role in managing e-waste in India. Its ability to collect and aggregate must be recognised as a unique strength and advantage and this should be tapped and put to good use to benefit both the environment and the urban poor in India. The challenge lies in finding the right connect between the law and the informal sector and this can only happen if the former acknowledges their existence and their contribution to the e-waste sector. Our current legal framework largely draws from the European framework, and it must be tweaked to meet the specific needs of our country. The process may be difficult and the road may not be easy, but we should be willing to take the risk to learn and adapt.

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Improving Safety, Health and Working Conditions of E-waste Workers

Challenges to Occupational Safety and Health of E-waste Workers

Workers engaged in e-waste collection, disposal and recycling are exposed to a number of occupational safety and health (OSH) hazards and risks. These workers manually dismantle e-waste containing toxic metals (such as lead, mercury, chromium), remove components from printed circuit boards, use open-pit acid baths to recover gold and other metals, or burn cables to recover copper.[1] Exposure to toxic metals and chemicals poses the risk of damage to the brain, liver, kidney, and other organs. Recent studies[2] have shown changes in thyroid function, cellular expression and function, adverse neonatal outcomes, changes in temperament and behaviour, and decreased lung function as plausible outcomes associated with exposure to hazardous e-waste.

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1   Jayapradha Annamalai. 'Occupational health hazards related to informal recycling of E-waste in India: An overview'. Indian Journal of Occupational and Environmental Medicine. Volume 19(1): 61–65. 2015.
2   Kristen Grant, et al. 'Health Consequences of Exposure to E-waste: A Systematic Review'. Lancet Global Health. Volume 1: e350–61. 2013.

Observational research undertaken by the International Labour Organisation (ILO) in an e-waste recycling community in Delhi, India, showed the OSH challenges associated with e-waste work. Workers had to manually carry and deal with large quantities of heavy e-waste material, carrying the risk of falling down, cutting injuries and musculoskeletal injuries. Their workplaces were packed with e-waste materials and there were no clear passageways – increasing the risk of trapping accidents. Workers were engaged in their e-waste dismantling work in narrow workplaces. They worked on the floor without any proper workstations and worked with strenuous, sustained forward-bending work postures. Their workplaces were lacked proper ventilation, increasing their exposure risks to toxic chemicals and dust. Their workplaces were hot in the summer and cold in the winter. They also tend to accept long and irregular working hours. In addition, there appeared to be work-related stress because their workload and e-waste volumes change day-by-day, resulting in unstable income generation.

For e-waste recycling, India is heavily dependent on the unorganised sector as only a handful of a organised e-waste recycling facilities are available[3]. There are no specific labour protection measures provided by the government to prevent their occupational health risks and usually no labour inspector reaches the informal sector. There is also no support from business communities to improve production methods and productivity. Workers have no opportunities to be trained on the practical ways to improve their safety, health and working conditions.

E-waste workplaces also adversely affect the surrounding community environments through the leakage of toxic metals and chemicals[4]. Stakeholder need to work together to improve occupational and environmental health conditions of e-waste workers across the country.

Vision for the Occupational Safety and Health of E-waste Workers 2030

Along with scientific and technological progress, India recognises the need for sound socio-economic developments which are sustainable and environment-friendly. Establishing responsible e-waste management systems is the overarching vision for 2030. Securing the safety and health of e-waste workers should be recognised as an essential, integrated element for building sustainable and responsible e-waste management systems. Every day, e-waste workers are collecting, dismantling and recycling e-waste. Improving their safety, health and working conditions directly links to effective and efficient e-waste management.

There are three key issues for effectively improving OSH of e-waste workers and achieving vision:

1. A coherent national policy on OSH for e-waste workers is required, in particular, through close coordination and cooperation between the government environmental agencies and the Ministry of Labour and Employment (MoLE). The former has the authority to establish and implement sustainable e-waste management systems, while the latter works for regulating working conditions and environments and providing labour inspection visits for enforcement. MoLE is currently planning to develop the 1st National OSH Programme (National Action Plan for OSH). Issues relating to OSH of e-waste workers should be incorporated into the Programme as an important element. Joint action plans should be planned and implemented with the environmental agencies to achieve synergies.

    ILO's International Labour Standards provides sound technical guidance for preparing the government's OSH policy in the e-waste sector. In particular, ILO Safety and Health Convention (No. 155, 1981) defines the responsibilities of the government and

3   Michelle Heacock, et al. 'E-Waste and Harm to Vulnerable Populations: A Growing Global Problem'. Environmental Health Perspectives. Volume 12(5): 550 - 555. 2016.
4   Tsuyoshi Kawakami and Ton That Khai. 'Improving Safety and Health of Waste Collectors in Fiji. Promoting Cooperation between Waste Collectors and the Community. Asian-Pacific Newsletter on Occupational Health and Safety. Volume 17(3). 2010

employers in OSH and also the duties and rights of workers. ILO Guidelines on OSH Management Systems (known as ILO-OSH 2001) offer systematic approaches for continuous improvements of OSH at the workplace.

2. Practical support programs directly targeting e-waste workplaces should be developed and implemented. There are many opportunities to improve OSH by starting with simple, low-cost methods[5]. Owners and workers in e-waste workplaces and the government should take practical action to make their workplace safer and healthier. It is well known that safe and healthy workplaces significantly contribute to higher productivity and business competitiveness. Practical guidelines showing how to improve OSH of e-waste workplaces and good practice case studies will facilitate making positive changes in e-waste workplaces. In parallel, e-waste business owners and workers should have access to training opportunities for joint improvements of OSH and productivity.

Possible improvement opportunities in OSH are, for example, organised materials handling and storage, improved work stations that can prevent musculoskeletal disorders, safe electrical wire connection to prevent fire and electric cushions, guards to cover moving parts of machinery, enclosing the sources of hazardous substances, and use of exhaust ventilation for cleaner air. Proper working hours and resting time prevent fatigue and work-related accidents. Better welfare facilities including clean drinking water, hygienic toilet facilities and pleasant eating places will also help workers to work safely and comfortably. Improved workflow and layout eliminate unnecessary movement of workers and can increase production outputs. Cooperation between different e-waste workplaces will facilitate exchanging experiences in OSH improvements and making their businesses more competitive.

3. E-waste businesses should be mainstreamed to the country's socio-economic developments. Their potential roles for sustainable economy need to be well recognised. Successful and transparent e-waste business models should be established in which owners and workers can receive stable job opportunities and incomes as part of the waste management value chains. It is also crucial for e-waste businesses to receive support from employers' and business organisations and become their members.

Roadmap to 2023 for Occupational Safety and Health of E-waste Workers

1. **Promoting workplace action through training**

   a. Action-oriented research and situation analysis on OSH of e-waste workplaces in India should be carried out. Although general OSH challenges have already been studied or reviewed, e-waste workplaces now need practical solutions. The research team should visit e-waste workplaces, see the workplace OSH conditions and listen to the voices of owners and workers, aiming to understand their challenges in OSH and businesses and identify necessary support measures. The team should also look at existing good practices and efforts for improving the situation. The good practices found should be compiled and used for designing successful OSH and business models. They can be shared with other e-waste workplaces and the general public through a website.

   b. A practical training program for e-waste workers and managers should be developed based on ILO's participatory training methodologies and experiences. The existing OSH good practices collected in the first step should be used as part of the training materials. The training

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5   ILO. Global Manual for WISE – Work Improvements in Small Enterprises. 2018.

program should be practical and easy-to-apply among the busy e-waste business owners and workers. They may not be familiar with participating in OSH trainings, so the program needs to be made attractive and easy to apply. The training content should focus on simple, low-cost improvement methodologies. An easy-to-apply action checklist should be devised for owners and workers to jointly identify OSH risks and solutions in their own workplaces.

c. By using the training program developed, pilot trainings for owners and workers should be conducted. These training can be done in their own workplaces to facilitate immediate improvement action. Focus should be placed on joint improvements of OSH, productivity, and other business requirements.

Once the training programs and content have been tested and established, the government of India should plan and organise the OSH training courses directly for e-waste business owners, ecosystem partners and workers in different states. State Pollution Control Boards (SPCBs) and Directorate General Factory Advice Service and Labour Institutes (DGFASLI) of MoLE should work together to plan and scale uptraining activities for wide coverage. DGFASLI's four regional institutes (in Chennai, Faridabad, Kanpur and Kolkata), in addition to the central institute in Mumbai, can become the training providers.

2. **Coordinating government policy and action**

a. A coherent national policy for improving OSH of e-waste workers should be developed as an integrated part of the e-waste roadmap. A national workshop to discuss OSH improvements of e-waste workplaces and a coherent national policy should be organised. Employers' and workers' organisations should be invited together to actively contribute to the policy discussion.

b. The research findings and training experiences mentioned in section 1 above should be presented in the workshop. The workshop should discuss the ways for increasing training coverage, facilitating improvement activities and promoting safe and healthy e-waste workplaces.

c. The national policy and action plan for OSH of e-waste workers should be developed in coordination with the overall national policy on OSH. At present, DGFASLI/MoLE is planning to develop a strategic National OSH Programme (National OSH Action Plan). National OSH policy of e-waste workers should be incorporated as an integral part of National OSH Programme. The goals and implementation strategies should be set clearly in the program.

d. Necessary legal frameworks, regulations or guidelines to promote OSH of e-waste businesses should be discussed and adopted. Regular labour inspection visits should be carried out at e-waste workplaces to ensure compliance.

e. An online information platform should be developed for disseminating the experiences of successful e-waste workplaces and their OSH improvement examples.

f. Research should be planned and carried out for inventing and applying safer and healthier e-waste management methodologies at the workplace.

E-waste collection, dismantling and recycling workplaces are core elements in the roadmap to 2023 for establishing an effective e-waste management ecosystem in India. Owners and workers in these workplaces need to be mainstreamed into the wider e-waste management systems and their business should be modernised and upgraded. Through training and national policy support, they can improve safety, health and productivity and contribute to the sustainable socio-economic development of India.

By

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Informal and Formal Partnerships in the Indian E-waste Sector

Introduction

Despite the first E-waste Rules coming into force in India in 2011 and being recast in 2016, it is estimated that some 90-95% of e-waste is managed in the informal sector in India. Informal collectors are still receiving the major volume of e-waste disposed and collected. If these actors are bypassed by new formal systems for e-waste management, there is a risk that newer formal operators simply will not be able to get access to the e-waste stream.

Informal collection networks are more effective than formal ones, whilst formal treatment processes are able to recover more resources from the e-waste. By bringing these two systems together, the collection and end-processing efficiency of the e-waste value chain can be maximised, whilst employment can be assured through the development of new inclusive business models. Inclusive business models integrating the formal and informal allow for higher efficiencies, not only for material recovery but also for bringing in compliance, trust among the value chain actors, and transparency in the waste management scenario.

Challenges Facing Informal and Formal E-waste Management

Outlined here are a few of the challenges in integrating formal and informal e-waste management:

1. **Informal collection networks are highly effective, but informal end-processing techniques are inefficient, dangerous and highly polluting.** Informal workers often come from marginalised backgrounds and are reliant on e-waste and other waste streams for their livelihoods. The informal waste sector is well established and highly diverse, carrying out a range of activities, ranging from efficient collection networks, repair and refurbishment, through to dismantling and end-processing. Whilst collection is not a harmful activity, informal end-processing uses dangerous and polluting recycling techniques to recover valuable metals from e-waste, severely harming the health of workers and local communities. These techniques are also inefficient, causing a significant loss of critical resources.

1. **Formal operators can achieve high end-processing efficiencies but struggle to meet collection targets.** Starting from 2004, a rising number of dismantlers and recyclers have set up facilities in India. However, close to 150 formal companies are all struggling to function profitably at their installed operating capacities. The major reason is the lack of cooperation models between producers, recyclers and informal sector workers, as the formal material flows doesn't consider them a value chain actor. This leads to illegal practices, corruption, paper trading, loss of recovery potential and inefficiency in meeting collection targets. The E-waste Rules amended in 2016 and thereafter in 2018 mandated an increasing rate of target collection of the electronic and electrical equipment (EEE) placed on the market by producers. As collection targets increase, producers will need to look beyond the Business-to-Business (B2B) waste-streams they currently control and tap into e-waste currently managed by informal collection networks.

3. **A financing gap exists between informal and formal systems.** In India, individual consumers generating e-waste have become accustomed to being paid for their e-waste when collected by the informal sector. Since informal recyclers externalise health, safety and environmental costs, they are often able to offer a better price for this e-waste than the formalised recyclers who abide by environmental and safety standards. Both the 2011 and 2016 e-waste rules present an opportunity to overcome this price gap through the mandatory obligations of producers based on EPR. Following the 2016 rules, producers are starting to take their EPR obligations seriously, and additional finance to cover this price gap is starting to be made available.

4. **Lack of recognition of the pilot cooperation models set up in Indian cities.** Various actions, interventions and initiatives have been undertaken by variety of actors like civil society (Toxics Link, Chintan), social enterprises (SAAHAS), informal sector associations and unions (SWaCH, HRA SEWA), producers (Microsoft, Nokia), and international agencies like GIZ and EU. Despite working closely with State Pollution Control Boards (SPCBs) and local municipal authorities on receiving the legal permits to operate, these pilot interventions have not been actively supported or scaled up by the government. This demotivates the informal sector workers who have invested in shifting to formal setups as they fail to see any recognition of their investments by the government, recyclers or producers[1].

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1 Adelphi, Toxics Link, and Strategos Advisory. 'Building the Link: Leveraging Formal-Informal Partnerships in the Indian E-Waste Sector.' GIZ. 2017.
https://www.giz.de/en/downloads/giz2017-en-partnership-e-waste-india.pdf

5. **A role for the informal sector is not recognized in current e-waste legislation.** The 2016 E-waste Rules fail to address the inclusion of the informal sector within the compliance framework. Lack of recognition puts these marginalised persons at further risk from harassment by authorities, as well as the loss of their livelihoods. With proper recognition, informal collectors can be an extended arm of the producers and recyclers to cater to the huge amounts of e-waste being recycled in the non-compliant way.

Vision 2030: informal-formal partnerships form an integral part of e-waste management system in India.

Developing a vision for 2030 depends on technological developments which may see changes in the way we track and follow waste-streams. If we are serious about meeting the Sustainable Development Goals and climate targets, it will be necessary to change our current models of production and consumption, moving away from linear, one-way business models of today towards circular business models which prioritise design for re-use, repair and recycling of EEE. Within this context, large networks of well-informed and empowered informal sector workers can be an important value chain actor for sustainable e-waste management. A vision for informal-formal partnerships in 2030 is detailed below:

1. **Informal collection networks form a vital part of the e-waste management system,** giving India one of the most effective e-waste collection mechanisms in the world. Informal collection networks work in harmony with PROs and producers to bring e-waste to qualified recyclers – or indeed to producers for direct re-use in their production. Various interface organisations might collaborate with local associations of organised, formerly informal collectors to deliver e-waste to refurbishment, and then on to qualified recyclers who apply the highest recycling standards.

2. **Informal recyclers have either stopped or formalised dangerous end-processing operations.** Where upgrading or formalisation is not possible, they are offered an alternative livelihood in collection, refurbishment or dismantling processes of formal facilities. Through manual dismantling, a higher return and resource recovery is made possible rather than standard shredding processes.

3. **Informal refurbishment and repair takes on a major role in extending lifetime of products in the circular economy.** Informal repair and refurbishment networks are strengthened with a better exchange of reusable parts and components linked to e-waste management, as well as by offering professional services on repaired goods. The standards for Right to Repair and Refurbishment are brought into formal material flows.

4. **Digital approaches enable optimised utilisation of resource flows.** India utilises its position as an information technology powerhouse in order to track and monitor resource flows across the economy. This not only aids data collection, regulation compliance and transparency, but also ensures that e-waste is sent to facilities which can treat it, and materials are cycled at their highest utilisation in the circular economy.

Roadmap to 2023 for Informal-Formal Partnerships

To make this vision a reality, we will require an informed discussion with the major stakeholders including the government, producers, consumers, recyclers, informal workers and PROs. The first steps by NGOs and PROs following the notification of E-waste Rules are promising. Large producers like Apple, HP, Dell, Lenovo and other multinationals are showing a willingness to engage with informal collection networks, even if the costs are higher than not doing so. The EPR plans with clear potentials on cooperation models (between formal and informal sectors) through the interface agencies by producers/PROs will provide transparency and scope for strict enforcement, by the CPCB.[2]

Some of the steps that can be taken in the next five years are listed here:

1. **Identify existing collection and recycling channels and stakeholders involved.** Cooperating with local interface agencies can help in setting up effective systems for collection and recovery of precious materials. Launching partnerships with larger collectors and aggregators can increase collection rates.

2. **Discuss and determine options for partnering with formal organisations and informal collectors.** Working out the right agreements and protocols (including payment systems) is a key to the success of formal-informal partnerships. Interface agencies should take the role of mediators which communicate the needs of informal collectors and align them with the expectations of producers or PROs. Ensuring transparency is paramount for entering successful partnerships with producers and PROs.

3. **Elaborate inclusive EPR plan.** Providing information on the formalisation of informal collectors in downstream processes can strengthen the credibility of EPR plans.

4. **Establish protocols and provide incentives to foster formalisation among informal collectors. Monitor partnerships and provide long-term support to partnering organisations.** Choosing the right mix of incentives provided to informal collectors is important. The performance of partnerships needs to be closely monitored, regularly evaluated and developed on a long-term basis.

2 Adelphi, Toxics Link, and Strategos Advisory. 'Creating Successful Formal-informal Partnerships in the Indian E-waste Sector.' GIZ. 2018.
   https://www.giz.de/de/downloads/giz2018-en-e-waste-partnerships-india.pdf

Key milestones to achieving the steps outlined for 2023 are:

1. A critical number of producers decide to collaborate with PROs who are working with the informal sector or to organise their own cooperation with informal actors. The government encourages this approach as a way to meet collection targets in their technical guidelines and effectively monitors the operations of PROs.

2. PROs increase cooperation and coordination efforts with their partners and agencies, to increase their outreach and actively advocate the rights and needs of informal actors towards governmental institutions.

3. Informal actors are increasingly brought on board through awareness campaigns and outreach via government, producer and civil society campaigns and empowered by the use of innovative ICT technologies which help in identifying registered off-takers and creating transparent pricing mechanisms. These kinds of approaches are already removing market information asymmetries for informal workers.

4. Informal actors are supported with training on legal framework and working conditions like safety, risks, non-compliance and on organising work procedures under the umbrella of formal associations.

5. Informal recyclers are engaged with and made aware of which activities can be carried out safely in the e-waste value chain, and given alternatives to current activities where these are deemed inappropriate.

6. Standards are developed and implemented throughout the e-waste chain, which support a strict monitoring and verification scheme, allow for effective engagement of informal actors and enable tracking of mass flows to ensure that e-waste channeled out of informal practices is treated appropriately. This could be applied in the framework of the 'ISO Guidance Principles for the Sustainable Management of Secondary Metals'[3] , which outline steps for companies to improve management of materials in their supply chains and steps for formalising informal actors.

Achieving these milestones will not be easy and will require concerted efforts from government, producers and PROs, civil society organisations, and informal stakeholders. Yet, the benefits associated with promoting formal-informal partnerships cannot be understated and will contribute to securing livelihoods, achieving high collection rates, and transforming the Indian economy towards a more circular one.

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3 International Organisation for Standardisation. 'Guidance Principles for the Sustainable Management of Secondary Metals'. 2017.
   https://www.iso.org/obp/ui/#iso:std:iso:iwa:19:ed-1:v1:en

By

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Awareness About Electronics Waste in India

Introduction

Lack of awareness about the safe disposal of e-waste amongst stakeholders is a key challenge in the implementation of the 2016 e-waste rules in India. The channelisation of e-waste for proper recycling and establishing a system of accountability in e-waste management can only be achieved through greater awareness amongst stakeholders including schools, colleges, Resident Welfare Associations (RWAs) and local bodies, bulk consumers, dealers, refurbishers, informal sector actors, and manufactures. The Ministry of Electronics and Information Technology (MeitY), in 2015, initiated a pan-India awareness program on e-waste management. A key finding of the program is that there is a gap in knowledge and capacity amongst all stakeholders in the sector that requires a concerted effort to create an effective proliferation of awareness for e-waste across the country.

Challenges for raising awareness for electronic waste

1. Lack of environmental and health awareness in the informal sector

The informal sector has low awareness about the health and environmental impacts as well as safety precautions associated with the recycling of e-waste. E-waste typically consists of structural metals, plastics and the most valuable parts include PCBs, Li-ion batteries, rare earth materials such as niobium magnet, phosphors amongst others. E-waste contains many toxic substances like mercury, lead, arsenic, chromium, PCB and flame retardant plastics along with the precious metals. The activities involved in metal recovery from PCBs, cables and wires carried out by the informal sector through de-soldering, acid baths and open burning, release dioxins and aromatic hydrocarbons and thus pollute soil, water and the air. These toxic chemicals that are being recycled in poorly ventilated areas without any safety precautions have a dual long-term negative impact on the environment and the health of workers and communities. Such extraction processes have the potential threat of tin and lead exposure as well as inhalation of brominated dioxin, beryllium, cadmium and mercury by workers and the surrounding community. Moreover, fumes of acids, chlorine and sulphur dioxin gases can lead to respiratory problems such as pulmonary diseases, respiratory failure, and death.[1] The challenge to overcome environment and health related problems in India requires adequate capacity building of the PCB officials so as to ensure stringent monitoring of the sources of environmental pollution.

2. Lack of social awareness of the condition of informal workers

The main source of income for informal operators in the e-waste sector is the recycling and separation of e-waste, an increasingly sought after profession in urban areas. For example, according to district administration estimate, around 100,000 to 150,000 people are involved in informal e-waste recycling in the city of Moradabad (Uttar Pradesh, India) alone. The workers are offered a wage of about INR 200 per day for their job in the e-waste recycling sector with women and children earning far less.[2] The recycling is carried out by the workers without any health and safety standards. Although, India has enacted a legal framework and policy to manage e-waste, the e-waste continues to be processed mostly by the informal sector in the country as was the case prior to the legislation. The informal units are mainly located in and around urban centres. The informal sector workers have very low literacy and awareness regarding hazards related to the unsafe handling of e-waste. A large number of women and children are engaged in e-waste collection and handling.

3. Consumer awareness

The awareness amongst consumers regarding e-waste management is inadequate. Moreover, consumers also expect some return from end-of-life products and do not contribute anything towards the safe recycling of products and thereby further promoting unsafe recycling. There is a need to focus on changing the behaviour of consumers. The prices offered by formal recyclers are lower than those offered by the informal sector, which is further driving consumers to dispose of their e-waste through informal channels.

1 Nischalke, S. M., (2008), Sustainable E-Waste Legislation and Social Responsibility in India: Opportunities and Limitations, Master of Arts (M.A.), Albert-Ludwigs-Universität Freiburg i.Br. (Germany), University of KwaZulu-Natal, Durban (South Africa).
2 CSE, (2015), Recommendations to address the issue of informal sector involved in e-waste handling, Moradabad, Uttar Pradesh http://www.cseindia.org/userfiles/moradabad-e-waste.pdf

4. **Low awareness of regulation and its implementation**

   For the current year, the E-waste Rules has a 10% collection target for compliance while many manufacturers are not reporting the correct figure and finding means to show the targets using others' data. There is also limited information and guideline on responsibility for inventorisation of e-waste, getting authorisation for EPR and renewal, recycler registration, monitoring compliance and action against violations of these rules. There is also inadequate strength and resources within SPCBs and Pollution Control Committees (PCCs) to properly enforce the Rules.

Vision 2030 for Awareness

1. Awareness and capacity-building content based on the local need and in local languages are made available. India is a multilingual country; serious attempts would be needed to convert relevant content into local languages. Quality standard technical content is not available in Indian languages, whereas countries like China, Korea, Taiwan and Japan have created suitable content in their languages to create effective awareness among their citizens.

2. For effective generation of awareness, suitable content for social media for every stakeholder is also made available. Social media has become very popular especially among the youth, and owing to the vast outreach due to the large mobile penetration. One should utilise this powerful media to create awareness across various groups and communities. The cost of generating effective awareness through social media would be substantially lesser than other conventional methods. Manufacturers should use these innovative means to reach mass audiences to comply with the mandatory requirement of awareness creation under their EPR plan.

3. Awareness content should be assessed for its suitability to the Indian context. Classroom based awareness programs would be suitable for school and college students, whereas RWAs can be reached through street plays, posters and pamphlets. Organising workshops for dealers, distributors and other manpower engaged in the manufacturing sector would be very difficult – they can be reached effectively through social media. The informal operators can be aware through audio/visual and role play. Therefore, the preparation of suitable content and adequate circulation through media (WhatsApp groups, Facebook, etc.) is critical for effective awareness generation.

4. State governments and industries should adopt the model of creating 'local champions' to engage in creating awareness at the local level, depending on the specific local need. These champions would spread the capacity-building efforts nationwide and effectively create awareness.

5. Best practices in e-waste management are scaled up across the country. Effective creation of relevant skill sets should be targeted by these champions by developing and showcasing best practices among the desired stakeholders, which would further drive efficient management of e-waste in a more environment friendly manner. A pool of champions can be created in every State and they will drive these awareness programs. These would also create jobs and provide recognition for their good work. Many youngsters may join this profession, if state governments, PSUs, and industry use their services and provide suitable compensation.

6. Platforms for massive open online courses (MOOC) are made available for every community. E-waste management is also made a part of the course curriculum at school and college levels. One should also explore the possibility of creating MOOC content on e-waste management and

uploading it on social media platforms for the student community. Effective content and appropriate answers to FAQs would attract many students and then through word of mouth it would spread to other students. These are some examples of more efficient and cost-effective means of spreading awareness. Students in the formal education system as well as school dropouts would benefit from these initiatives. The state governments and industry can join hands to carry out these activities.

7. Effective EPR plans and their implementation are in place. Institutionalisation of awareness programs along with allocated budgetary support for awareness-creation mentioned in the EPR plans of manufacturers/producers is essential.

8. Awareness of e-waste related issues is increased among all stakeholders including regulators and producers. The active participation of states along with academic institutions, policy-makers, regulators and international organisations would also be important for sustainable e-waste management in the country.

9. Increased awareness is translated into behavioural change; consumers are more aware about disposal practices and are ready to dispose their e-waste free of cost for recycling their e-waste in an environment friendly manner.

10. Producers are able to reach their e-waste collection target 70% by 2023.

11. The informal sector is integrated into the formal chain and is more engaged in the collection and channelisation of e-waste.

12. Procurement of green products is initiated by consumers who do not want to use products which are not demarcated as green.

13. The awareness programs become self-sustainable with limited support from state governments and local industries.

Roadmap to 2023

1. **Strategy 1 – Development of suitable content and tools:** Suitable content and various tools may be used for awareness generation among different stakeholders[3]. This content, videos and other materials should be made freely available and one should avoid developing similar contents unless it is required for a specific purpose. Further modifications and development of content for specific purposes can be attempted so that minimum cost can be incurred on these activities.

2. **Strategy 2 – Increasing awareness through the creation of champions on e-waste in each state:** The effectiveness of the awareness programs would depend on the quality of the faculty, which could be addressed by a pool of experts. The strategy should be to enhance engagement by participants across different awareness activities. These champions will enhance engagement with participants to create awareness. These champions would be certified by MeitY and state government departments may also utilise their services for similar awareness programs in the future.

3. **Strategy 3 – Participation of state governments, ministries and urban local bodies:** The participation of state government departments and other ministries would be important for the successful implementation of the programs so as to address the challenges being faced in e-waste management. Government schemes like Swachh Bharat Mission, Skill India, and Make in India among others may also be leveraged for requisite support in awareness programs. Successful implementation of awareness programs also requires active participation of states and urban local bodies which can also provide support for the proper segregation and disposal of e-waste.

4. **Strategy 4 – Transparency in EPR plan and participation of industries/manufacturers:** Manufacturers need to provide transparent and effective EPR plans. Financial expenditure must be provided in a transparent way so that there are clear mechanisms for awareness creation and collection of e-waste in separate budgets. Effective agencies and experts must lead the awareness programs on behalf of the manufacturers. EPR plans should be monitored by CPCB for the effective implementation of the collection targets and awareness programs. Active support across industries and manufacturers will ensure the effective e-waste management in the country.

5. **Strategy 5 – Integration of informal sector:** Recycling of e-waste is largely undertaken by the informal sector in India. They are the backbone of the e-waste management system and play a critical role in making recycling of e-waste a successful business. They are highly networked and skilled workers in sale/purchase and dismantling, but they don't have a secure business due to low literacy and lack of awareness regarding the hazards related to unsafe handling of e-waste. Formalisation may provide legality to the informal sector and manufacturers may also engage them more, so as to meet their collection targets. Other than awareness creation among informal sector workers, hands on training and technology must be made available to them. To integrate them in to the formal chain, the government has also introduced cost effective technology in the country. For example, a table top model of smaller recycling capacity of 100kg (3.5MT of e-waste)/batch has been set up at C-MET Hyderabad, which might be suitable for the informal sector.

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3   A joint collaboration between Centre for Responsible Business and the Green Electronics Council. 'Capacity Building Opportunities and End of Life Management Criteria for a Voluntary Consensus Standard.' 2018.
https://greenelectronicscouncil.org/wp-content/uploads/2018/11/GEC-CRB-Capacity-Building-Opportunities-Report-FINAL-Oct-2018.pdf

**Section D
Technology and
E-waste**

By

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Recycling E-waste

Challenges for Recycling E-waste

1. Electronic products have made our life easier and better and their consumption is rapidly increasing. The rapid upgradation of technology has resulted in faster obsolescence of existing products, and thereby an increased generation of e-waste, which is a new environmental challenge for the 21st century. The rapid growth of the electronic and IT sector, the exponential rate of consumption of electronic products in daily life, and the subsequent disposal of obsolete products have led to significant environmental consequences across the world. India, like many other developing economies, is also facing this challenge – a major concern being the recycling of e-waste in informal units using unscientific, unhealthy and non-environment-friendly methods. The challenge has been further aggravated due to a strong network of informal sector actors, who are processing e-waste through primitive methods causing irreparable damage to the environment. Primitive methods are also being used in other developing countries including China, Vietnam, Philippines and Ghana to recover metals from PCBs which release toxic chemicals.

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1 The author would like to acknowledge the Ministry of Electronics and Information Technology (MeitY).

2. The E-waste (Management) Rules, 2016 have not been able to completely address these challenges. Lack of proper recycling facilities and an inadequate skills and knowledge base among informal operators have further complicated the situation. Foreign technologies, though available, are expensive and are often not suitable for local needs. India is generating 2 million MT of e-waste each year; however, about 90% of the collected waste is recycled in the informal sector, mainly through incineration in the open air, which exposes the operators to hazardous materials. The operators adopt hazardous methods of amalgamation to recover precious metals from segregated components of e-waste; they are only able to recover a small amount of precious metal by heating the amalgam on a hot frying pan in the open air, thus inhaling hazardous mercury vapours.

3. A few authorised recyclers are engaged in manual dismantling and segregation of e-waste and selling the recovered materials in the market. They are, however, solely dependent on the smelters in developed countries for processing the most valuable parts (PCBs), as the technology for this is not available in India. The foreign smelters want only the high value PCBs and leave the low-grade boards in the country. Moreover, these foreign smelters offer only a partial value of the sold boards and the transportation cost is also another additional burden for the Indian recyclers. Exporting the boards to foreign smelters also requires case by case permission from the regulator and the entire process is not sustainable for local recyclers. As a result, they are forced to sell PCBs to the informal sector through illegal back channels, which in turn has created backyard PCB treatment hubs like Moradabad and Seelampur. In the past, some of the recyclers in India have attempted to bring expensive foreign technologies and necessary plant machineries

to India. However, they could not succeed in sustaining business due to high running costs, low volumes of available input materials and the inability of the technologies to address local needs. These informal processing hubs are creating significant damage to the environment.

Recycling of E-waste in 2030

1. **Cost-effective technologies are created to address the current challenges so as to bring an effective end-to-end recycling solution for the country.** E-waste has typically consisted of various components including structural metals, plastics and the most valuable parts are PCBs, Li-ion batteries and rare earth materials (niobium magnet, phosphors, etc). Though smelters are available in India for the recovered structural parts, the PCBs, Li-ion batteries and other materials require high-end technology for processing to recover precious metals such as gold, silver and copper.

2. **Indigenous technology is developed and supported by robust local capacity building.** State-of-the-art PCB processing has been adopted in only a few countries such as Japan, Canada and the EU. It has, therefore, been compelling for other developing countries to export circuit boards to these processing plants involving complications in compliance with the Basel Convention. These exports are also expensive due to the logistics and shipping charges and the high refining charges – leading to further loss in revenue.

3. **Synergies between the informal and formal sector are created.** The operators in informal sector are very innovative in collecting e-waste from consumers at suitable prices. Their dismantling and segregation practices are also acceptable at certain levels of environmental standard.

4. **The informal sector is provided appropriate training and skill-set upgradation.** This will provide adequate and willing manpower in the system, a workforce that understands the dynamics of the complicated materials flow network of e-waste. The presence of a vibrant informal sector could be considered a boon for India.

5. **Informal operators are integrated into a cooperative entity.** The government can financially support this initially to initiate the program to upgrade the skill sets, and the health and safety practices utilised in dismantling and segregation of various kinds of e-waste. The program should be steered by industry associations engaged in the manufacturing of electronics and electrical goods. Thus, these industry bodies would also be benefited by ensuring that the EPR obligation is effectively met.

6. **In the future, the transformed and formalised informal sector in India would also embrace the micro factory concept and setup micro factories.** It is also important that infrastructure support in terms of land and building, including technology, is provided so that they are able to achieve the requisite level of growth in these industries.

7. **Eco-parks are set up in all the Indian states by integrating the formal and informal sector.** Initial financial support can be provided by the central government for capital equipment, whereas, the state governments could provide land, subsidised power, water, other utilities and local approvals. These eco-parks will concentrate the informal operators in a designated place and their activities could be monitored for regulatory purposes. The formal and informal sector could work together to optimise business and revenue earnings. Initial financial support from the government would be essential till these eco-parks become self-sustainable.

Recycling E-waste: Roadmap for 2023

1. Indigenous technology with a unique method for processing the circuit boards exclusively with a capacity of 1000kg/shift capacity and 100kg/shift processes has already been developed and demonstrated by MeitY with acceptable environmental norms. Various other CSIR labs have also established a cost-effective process to recover precious metals from circuit boards, which now need to be scaled up at a demonstration level. These technologies are a low-cost solution, suitable for the needs of the informal sector as well as safeguarding the environment. India has a significant number of informal operators (~20 lac), who have sound knowledge of the materials value chain and the business. Availability of low-cost technology to these informal operators would be a boon in the entire e-waste management chain. Benchmarking the processes and technologies, and requisite standards is required in the country. These are important parameters required to assess the efficiency of the technology, return of investment, and profitability. The acquiring cost for improved technology would be significantly high, which would require large industry houses to invest. Micro-medium-small would still depend on domestic technology or low-cost indigenous technology.

2. The country needs to prepare itself to manage e-waste in a more responsible and organised manner. We can create synergies between the informal and formal sector, through the integration of informal operators as cooperative entities or by creating eco-parks across states. The materials flow could be streamlined from originators to the final destination of recycling centers at a few designated places. Higher materials available for operation, improvement of the recovering yields by using appropriate tools, processes and technology, environmental safeguarding

are some of the additional benefits of these efforts. Technological solutions to these designated places would ensure effective e-waste management in an acceptable environment- friendly manner. This would aim to achieve cost effective recycling technology, while minimising landfill and zero emission to air, land and water. The recovery of valuable materials such as precious metals and reusable recovered plastics would ensure that the recycling business was an economically profitable venture.

3. Through MeitY's e-waste awareness program, it has been observed that the informal operators are eager to upgrade their operations for regulatory obligation. They are keen to invest in affordable technology and continuing this profession. In the initial phase, the informal operators would be provided the low-cost indigenous technology, along with training for them to reach an adequate skill level and safety along with health awareness. In a pilot phase, a number of operational units would be created in various parts of the country so that informal operators could assess the operations and aspire for upgrading themselves. In the next five years, one can expect to have 1000 such micro-industries in the e-waste recycling business. These would create enormous employment generations, improve livelihood and enhance recycling of the secondary resources. The effort would definitely help India achieve the desired SDGs, promote a circular economy and initiate the debate on resource efficiencies.

4. Another reason for emphasising skill upgradation of the informal sector is that the e-waste rules have regulated bulk consumers for compliance, but not the independent consumers. Some electronics products are meant for independent consumers (mobile phones, tablets, laptops, refrigerators, air-

conditions, etc.), whereas, some products are meant for bulk consumers (photocopiers, personal computers, printers, etc.). The end-of-life products from single consumers also reach informal operators.

It is estimated that 70% of the e-waste normally reaches the informal sector even after having the best possible provisions in the e-waste rules. It would therefore be imperative to upgrade the skills of the informal sector.

5. Experts are visualising a disruptive shift in the manufacturing sector, by introducing a new concept of micro factory. These are small dimension factories able to produce small dimension products – first proposed in 1990 by the Mechanical Engineer Laboratory (MEL), Japan. Advantages of the micro factory include significant savings in the amount of resources like space, energy, materials and time. Similar concepts would be utilised for processing waste materials. Due to their miniaturised dimensions, micro factories demand full automation, which comprises automatic machine tools, assembly systems, quality inspection systems, material feed systems, waste elimination systems, etc. New business ventures should certainly look into the micro factory route; UNSW's modular factories have the potential to completely reshape the manufacturing sector.

6. Not all waste can be processed locally because some waste is hazardous in nature and requires technical expertise for its management. Moreover, proven technology is required to process this kind of waste. However, the other less hazardous processes involved in managing waste from collection, segregation, dismantling, recycling to recovery of materials, could be carried out safely through micro factories. There is also a certain scale which is required to manage processes which involve technology. It is

important that the micro factories are able to access the quantum of material that is required to ensure economic sustainability. The management of greenhouse gas emissions during the process in such factories might require significant investment, which would be challenging for small entrepreneurs.

7. The commodities market in India is formalised so that secondary materials can compete with primary ones and their use can be enhanced in products as equivalent to primary materials. This will enhance the possibilities of manufacturing growth as is envisaged in the Make in India mission as well by Government of India. It will also lead to benefits in the Swachh Bharat Mission. The biggest challenge, however, would be regulation, since e-waste recycling in the informal sector is a lucrative business and micro factories can possibly bring about a disruption which is likely to benefit the larger recyclers who are formalised and have access to sophisticated technology – unlike the informal operators who will formalise but will lose out on access to precious metals which are recovered from recycling, albeit in a manner which is detrimental to human health and environment.

By

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Resource Efficiency and Circular Economy Paradigms towards E-waste Management

Introduction

E-waste or WEEE contains 60 elements from the periodic table which are present in complex forms with materials categorised as rare earths, hazardous and precious metals. The intrinsic material value of global e-waste generation in 2014 alone was estimated at €48 billion. In India, the E-waste Management Rules, 2016 mandate Extended Producer Responsibility, a policy principle to ensure environmentally sound management by producers by putting in place mechanisms for better collection, and hence recycling and necessitating the application of systemic thinking for design changes to enhance resource recovery. Being reliant on imports for many of these raw materials for the production of electrical and electronic equipment, India needs to move towards a circular economy so that the resource demands can be met through re-using materials recovered through urban mining.

Electronic and Electrical Equipment (EEE) manufacturing uses metals like iron, copper, silver, gold, aluminium, manganese, chromium and zinc along with many rare earth elements. The rate of extraction of these abiotic resources for manufacturing in EEE and other sectors is significantly higher than the rate of their formation in nature. This is rapidly contributing to increasing resource scarcity of metals whereby accompanied with rising prices of extraction and availability of lower-quality metal grades, there is a relative increase in the price over time. The scarcity gets manifested in rising manufacturing costs, higher environmental damage and risks to human health, import dependency and accentuated geopolitical risks. Urban mining of e-waste has the potential to enhance metal stocks, mitigate scarcity and reduce GHG emissions and stabilise metal prices.

In the last 40 years, demand for metals has increased by 87%. The electronics sector, especially the consumer white goods sector, has been one of the major contributors of this demand along with buildings and infrastructure and the automotive sector.[1] The digitalisation across the world has added more than 1.5 billion mobile phone units in 2017[2] accounting for 2,25,000 tons of material usage during manufacturing (considering an average weight of 150 gram/unit). According to the Global E-waste Monitor 2017, the estimated value of raw materials by mining from e-waste stood at 55 billion euros with mobile phones contributing 9.5 billion euros. The Table 1 shows the quantum and potential value of raw materials which can be extracted from e-waste in the year 2016.[3]

Table 1: Potential Value of Raw Materials in E-waste in 2016

Material	Kilotons (kt)	Million €
Fe	16,283	3,582
Cu	2,164	9,524
Al	2,472	3,585
Ag	1.6	884
Au	0.5	18,840
Pd	0.2	3,369
Plastics	12,230	15,043

Challenges for Resource Efficiency (RE) and a Circular Economy (CE)

1. The application of EPR in India as a policy instrument is a short-sighted administrative planning tool of 5, 10 and 15-year plans. It fails to address the need for undertaking innovation by the industry towards system design thinking for integrated assessment of long-term supply and ensuring adequacy of metallic resources through collection and recycling of e-waste.

2. E-waste also comprises of high value plastics and composites which also require an effective collection, segregation, labeling and upcycling approaches so that large amounts of secondary resources can enter a higher value material chain.

3. Material resource scarcity in the EEE sector will not only occur because of lack of reserves in extractable ores but also because of fragile ecosystems, limited oil reserves and rising energy prices. Government programs and businesses need to plan for a future with increasing metal limitations coupled with an increasing demand for recycling infrastructure.

1 PricewaterhouseCoopers. 'Top 5 Business Trends to Watch Out For.' Search – The Industry Source Book. 2011. https://www.pwc.in/assets/pdfs/industries/search_article_020112.pdf

2 Statista. 'Number of smartphones sold to end users worldwide from 2007 to 2017 (in million units).' https://www.statista.com/statistics/263437/global-smartphone-sales-to-end-users-since-2007/

3 Baldé, Forti, Gray, Kuehr and Stegmann. The Global E-waste Monitor 2017: Quantities, Flows and Resources. Bonn, Geneva, Vienna: United Nations University (UNU), International Telecommunication Union ITU) & International Solid Waste Association. 2017. http://collections.unu.edu/eserv/UNU:6341/Global-E-waste_Monitor_2017__electronic_single_pages_.pdf

4. Current lack of viable collection and recycling business models in the formal chain contributes to continuing prominence of informal sector for e-waste management. In India, the informal sector currently handles 90-95% of the e-waste collected. The lack of dismantling and recycling technologies with the informal sector leads to cherry picking, low recycling efficiency, environmental and health related risks and loss of resources as the focus of recycling operations remains on recovery of 3-4 precious metals.

5. To address the aforementioned challenge, it is important to foster access of technology to informal sector for enhancing resource recovery, providing for higher incomes, mitigating negative health and environment impacts of e-waste recycling, and increasing availability for resources for manufacturing.[4]

Vision for RE and CE 2030

Increased volumes of e-waste coupled with a growing EEE manufacturing industry provides an imperative for moving towards a circular economy by addressing the following aspects:

1. Enhancing resource efficiency in material use and closing the loops for materials will be key towards ensuring resource security towards sustaining growth. The flagship missions of the Government of India envision the path with a potential for transforming India into a resource efficient and circular economy. Initiatives like Make in India, Digital India and Swachh Bharat aim at setting up India as a manufacturing hub, enhance the use of digital technology and management of end-of-life resources. Convergence and linkages between these priorities of GoI needs to be harnessed through strategic and tactical approaches in order to facilitate and achieve the change objective. For instance, the demand triggered through the Digital India mission can be fulfilled by the Make in India mission, which in turn, can draw resources from the Swachh Bharat Mission's thrust on managing end-of-life materials. This will ensure reliable availability of raw materials and innovative mechanisms which will transform India into a self-sustained circular economy.

Figure 1: Transformation to a Resource Efficient Economy: The Role of GoI Missions

Digital India Mission
• Consumption of resources
• Provision of services
• Demand for products

Deeper transformation leading to circular economy and resource efficiency

Swachh Bharat Mission
• Collection of waste
• Extraction of resources
• Channelisation of resources into production stream

Make in India Mission
• Manufacturing of products
• Capacity to meet internal demand
• Exports to earn revenue and growth

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4 NITI Aayog and MeitY's Strategy on Resource Efficiency in the Electrical and Electronics Sector, 2019 aims to address the challenges mentioned earlier through a comprehensive action plan to support India's growing EEE manufacturing industry towards resource efficiency and circularity.

2. Extended Producer Responsibility will play an important role in the EEE sector. This principle requires producers to ensure collection of end-of-life equipment and also mandates them to reconsider the design of the products. In a life-cycle thinking approach, product design is a critical stage for phasing out toxics, enhancing ease of dismantling and recovery of materials. This in turn can help close the loops through different stages of life-cycle.

3. Closing material cycles and waste prevention is key to supporting waste reduction and sustainable resource utilisation. The sector is beset with high obsolescence rates due to rapid technological changes leading to shorter product lives. These need to be replaced with resource efficiency considerations by designing products with less toxic materials, longer lifetimes, modular products like Fairfone that are amenable to repairs by consumers.

4. Design changes will allow for reducing the obsolescence rate of products but policy instruments like 'Right to Repair' should also be introduced for mandating the movement towards sustainable consumption. Indian society has traditionally been ingrained with the ethos of circular economy. A thriving culture of reuse and repair has led to creation of jobs and ensured elongation of life of materials and resources. Demand for such services has ensured sustainability of these jobs. However, changing consumer preference coupled with planned obsolescence of EEE has dented the practices that supported the principles of circular economy and resource efficiency. Strategic and tactical approaches including, Right to Repair, eco-design of products, awareness and capacity building of stakeholders on RE and CE will make consumers responsible towards product usage and disposal.

5. In India, the informal sector is at the heart of waste collection systems and will remain instrumental in helping the close the loops for many material streams. It is important that policies are formulated that recognise and ensure the livelihoods of people dependent on informal occupations. Technological upgradation of the informal sector can support its formalisation, enhance recovery of resources which can then be channelised into the production, and also lead to creation of green jobs.

6. The movement from a traditional linear model of "produce, use and dispose" towards a circular and resource efficient system also has scope of business savings for producers. Extraction of metals and other materials from the WEEE through a product centric approach allows for use of specialised technology for recycling to enhance recovery. Most of these materials are metals which are never lost in terms of their productivity but will not be available unless managed properly.

7. Given the current scenario, it is vital to recognise and account for the roles of municipality and the informal sector in WEEE management. Awareness, advocacy and capacity building of stakeholders are very important in order to ensure that regulations for the sector are implemented and enforced. Environmentally sound management of e-waste will require all stakeholders to work closely in order to close the loops and move towards a resource efficient and circular economy model.

Roadmap for RE and CE in 2023

1. To realise RE and CE in the EEE sector, strategic and tactical interventions with a lifecycle approach are needed. This can be achieved by fostering linkages between policy frameworks, pilot interventions for technology adoption, recognition of other stakeholders in the rules, earmarking responsibilities, building capacities and effective monitoring and implementation of the E-waste Rules.

2. Further, congruence of the Make in India, Digital India, and Clean India missions provide for the development of a circular economy where resource use is optimised, a production stream is created which is likely to never run out of resources and would be self-fulfilling, and resources are generated through urban mining. Resource efficiency needs to be at the heart of the missions which looks at the next generation transformation of the country. The proposed model leads to the attainment of the Sustainable Development Goals including SDGs 6, 8, 9, 10, 11, 12 and 13.

3. In order to enhance the effectiveness of the Swachh Bharat Mission, there is a need to adopt Best Available Technologies which will help to enhance material recovery and secondary resource utilisation in India. This recovery of resources within the country will ensure resources required in the production process will not need to be imported thereby effectively reducing the cost of production and have a favourable effect on the profits.

4. Centre for Materials for Electronics Technology (C-MET), Ministry of Electronics and Information Technology, and Central Institute of Plastics Engineering & Technology (CIPET), Ministry of Chemicals and Fertilizers, have developed indigenous technology for the recovery of precious metals and plastics from e-waste respectively. After laboratory scale experiments, these technologies have now been upscaled to industry level use. Provision of technology to informal actors who are willing to formalise will allow benefits in the form of enhanced incomes, safe and non-hazardous workplace and mitigation of environmental pollution in the vicinity.

5. Policy interventions and schemes with provisions for increasing access to technology available will have the benefit of formalising the informal sector as well as ensuring that e-waste and the material recovered flow into the formal channel without down-gradation of material's value and productivity. Strengthening EPR compliance will bring down the acquisition cost of e-waste which will plug the current leakages from the formal recycling channels to informal sector, and add to the urban mines. The cost for indigenous technologies can likely be brought down by aggregation of demand, and benefit the institution which developed the technology as well as the buyer of the technology. It has the potential to create a platform for large-scale proliferation and enabling access to material in the formal value chain. A disruption of this scale can alter the way e-waste is recycled in the country and can provide fillip to Make in India and Swachh Bharat Mission. This intervention will create an enabling mechanism for proliferation of recycling industry in the country with benefits of access to resources on one hand and creation of jobs on the other.

6. However, for a systemic change, existing policies will need to also steer transition towards sustainable consumption and production through eco-design of products and promotion of service-based models. This can also support development of infrastructure and mechanisms for disposal by individual and bulk consumers. Awareness and advocacy across stakeholders will allow for generation of knowledge on environmental and health impacts of improper disposal and recycling of e-waste. It will keep materials in the formal value chain and provide further impetus for informal sector to formalise. In order to the meet the need provision of land and technology for the informal sector towards formalisation, e-waste management should be introduced in industrial clusters across states.

7. Proper monitoring and effective implementation of the rules will remain central to RE&CE. In this regard, capacity building of regulators is also needed. Furthermore, inventorisation of e-waste is also required for assessing gap between the volume of e-waste generated and the existing formal recycling infrastructure. PROs in the e-waste sector should be promoted so that infrastructure for disposal can be created along with the private sector. Municipalities can work closely with the informal sector to ensure that collection spaces are provided for e-waste. In turn, PROs can work closely with the municipalities to ensure that material flows can be channelised to formal recyclers for environmentally sound management of e-waste.

Conclusion

Economic, social and environmental benefits resulting from RE & CE in the EEE sector, through adoption of comprehensive measures addressing the life-cycle of EEE, can provide impetus to RE & CE transformation. These measures – fostering eco-design systemic thinking in industry, right to repair for consumers, integration of informal sector and its formalisation, piloting the adoption of indigenously developed recycling technology and development of viable business model – are also important solutions to challenges of resource security and sustainable growth.

By

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A Note on Best Practices and the European Experience

Electronic waste or e-waste is an emerging and growing sector in India that presents new challenges and opportunities for integration of e-waste into waste management systems. The E-waste Management Rules of 2016 stipulate that within seven years 70% of all e-waste needs to be responsibly disposed of and recycled.

The policy environment for the e-waste sector in Europe is quite mature with some individual member states issuing national legislation on e-waste already over 20 to 25 years ago. In an effort to harmonise the common market for Europe and to enact legislation that protected the environment, the European Union in 2003, issued the WEEE (Waste for Electrical and Electronic) Directive. This is due to the very specific nature of this waste component, which contains hazardous (to the health of all citizens and our environment) as well as valuable materials (precious, critical and base metals, plastics etc.). Moreover, out of all urban solid waste, e-waste is the fastest growing, and this trend is expected to continue, coherently with the quality and quantity of hi-tech product consumption globally.

Since then the e-waste market has matured; a lot of good processing technologies have been developed and implemented. As the 28 member states of the European Union are quite different when it comes to GDP, average wages of workers and also environmental awareness, we find a lot of different solutions in Europe - from manual dismantling in lower-income countries to highly mechanised recycling processes in countries where the labour costs are high. Also, the collection rate differs enormously between North and South as well as between West and East. All producers joined forces in Producer Responsibility Organisations (PROs) to enable economy of scale for the sound collection and recycling of e-waste. European countries have made significant progress in protecting both the environment as well as saving scarce resources.

When we think about e-waste in India and Europe, similarities and differences come to mind. Except for valuable information technology (IT) products, the e-waste sector in India is completely new and driven by the EPR (Extended Producer Responsibility) regulation that came out recently (similar as in Europe 15 years ago). Therefore, the driving regulation is very similar.

However, the mindset of the Indian citizen is completely different. Most people in Europe have adopted the concept of a "throw away" society and live according to it. When a product does not work properly anymore or a new (more trendy) product (for example a new mobile phone) comes out, Europeans buy the new product and throw away the old one. We are even willing to bring this "waste" to the collection centre and hand it in free of charge.

In India, products are used much longer. When something is wrong, they are first repaired several times before spare parts are harvested and finally it becomes obsolete. But even then Indian citizens attach a "value" to their end-of-life products. And they are used to "kabadiwalas" coming to their

door and buying their gadgets. So the Indian citizen receives a much better service than the European and the collection rates are much higher in India.

The main difference between Europe and India is that in India most of the recycling takes place in the informal sector. Here, valuable resources are lost and health problems are created because of the lack of state-of-the-art processing. In contrast, Europe member-states must assure that 65% of the average weight of EEE placed on the market in the three preceding years will be met by 2019. In addition, the WEEE Directive also contains recycling and recovery targets.

In India, the E-waste Management Rules of 2016 stipulate a collection rate of 70% that has to be reached within seven years. Several lobbyists call this target completely unrealistic and at first sight, everybody would agree based on European experiences. But Europe is a rather saturated market, whereas India still has strong growth rates in EEE. In India, the 70% refers not to the 3 preceding years (ie 2015-2017) like in Europe, but to the amount of products put on the market when they were initially sold (if a product has, for example, an average life of 8 years, then it refers to the sales figure of 2010). A comparison of collection targets shows that in order to compare India's collection rates with Europe, you must divide the Indian targets roughly by 3 or 4 and then they are achievable. When the Indian market becomes saturated at a later stage, this conversion factor will become smaller and smaller until it will ultimately reach parity. Specified recycling and recovery targets are still missing in the 2016 Rules.

With the rapidly evolving technology around consumer products, the sector also faces a number of challenges. Two of these are the most important because of the rapidly evolving technologies of the new products:

First, rapid technological advances make it necessary to keep up with the fast progress and develop constantly new recycling processes. Some of these technologies are only used for a rather short period of time (for example TV-sets and computer monitors had LCDs only for short period of time after the old cathode ray tubes were discontinued and now the LED technology has been rolled out) and then it is really difficult to recover their investments into new processing plants.

Second, the next big disruption is the larger use of 3D printing for manufacturing more customised products. When these products will then reach their end-of-life stage, we will need completely different recycling technologies. Today our processes are mainly mechanical (based on physical properties of the different materials), but in the future I see more and more chemical processes taking over because the products become a more and more complex mix of materials.

On the other hand, we in Europe are facing more and more difficulties to find proper markets to sell our recycled materials to after technological disruptions have occurred. For example, we have a big issue finding buyers of the lead glass from TV-sets and monitors using cathode ray tubes (CRT) as nobody produces large quantities of CRTs anymore. Another example is yttrium from fluorescent lamps that are not used in big enough quantities anymore in LED lamps.

When it comes to best practices, the repair sector and the collection services are much better developed in India whereas Europe is leading in recycling technologies; the "best of 2 worlds" is the best recommended approach. On the one hand, in India you can strengthen the collection and repair services by formalising the informal players and capitalising on their enormous knowledge. On the other hand, you could selectively implement proven recycling processes from elsewhere or developed in India that best fit the needs. This should involve not simply copying and pasting the Western European solution, but starting with smaller scale mobile treatment technologies and then step by step upgradation of their capacity.

Globally where do I see the e-waste sector evolving? The driver for this activity is fundamentally changing. It starts in most countries as a way to protect our health and environment, and it gradually moves to creating and securing our jobs by keeping our scarce resources in our countries in order to create new products out of it. By doing so, we become less dependent on other countries who are rich in minerals and keep jobs in our countries.

Based on the estimated about 1.8 million tons of e-waste arising this year in India, at least 300,000 jobs could be established in a new market sector of more than 3 billion US$ annually. In addition, many more jobs can be secured in the production sector because recycling precious and critical metals is the basis for manufacturing new products in India when resources are becoming scarce and because of that more and more expensive. Thus, we call our high-tech wastes today an "urban mine" and the basis for a sustainable circular economy in Europe.

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Pranshu Singhal is the Founder of Karo SambhavPvt. Ltd. (2017), an organisation enabling EPR in the waste sector. Before this he was Director, Digital Learning Strategy in the Worldwide Education team of Microsoft for 3 years. He had worked with Nokia as Head, Sustainability for 11 years and was based in Finland, Singapore and India. He is an Aspen Fellow, an Ashoka Fellow and a Chevening Gurukul Fellow. He has done his Masters in Environmental Management and Policy from IIIEE, Sweden.

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Neeta Misra holds a doctorate in Development Planning from the Massachusetts Institute of Technology, USA and a post-doctorate in Economics from the University of Cape Town. Most recently she was the lead for IFC's India E-Waste Toolkit. She has worked as a senior advisor for project evaluation at the World Bank, UNICEF, Oxfam India, and she runs an initiative on the SDGs and the private sector at Business World magazine based in New Delhi.

E-waste Toolkit by IFC

The e-waste toolkit is a component of IFC's India e-waste program that is being implemented between 2017 -2019.The toolkit will undertake applied research and develop practical tools on e-waste targeted towards the business sector and Indian regulators. The toolkit is a sector-wide initiative and will engage with the sector through multi-stakeholder consultations. The e-waste toolkit outputs are guided by an advisory panel of sector experts that has been convened for this purpose. A major function of the multi-stakeholder approach is to bring together expertise across the sector and encourage partnerships between various actors. The key outputs of the e-waste toolkit are:

Investment Analysis

Project Learnings & Standard Operating Procedures

International and Local Best Practices

E-waste Toolkit

Support to Enforcement Bodies

Roadmap for E-waste 2023

Expert Group and Stakeholder Consultations

Advisory Panel E-waste Toolkit

Anand Kumar:	Additional Director, Central Pollution Control Board
AS Harinath:	Senior Environmental Specialist, World Bank
B. Ravichandran:	Senior Scientist, ICMR - Regional Occupational Health Centre, NIOH
Bernd Kopacek:	International E-waste Expert, IFC
Deepali Khetriwal:	Managing Director, Sofies India
Dilip Kumar Behera:	Senior Environmental Scientist, State Pollution Control Board, Odisha
Kalyan Bhaskar:	Faculty, XLRI, Jamshedpur
Pranshu Singhal:	Founder of Karo Sambhav, E-waste Producer Responsibility Organisation (PRO)
Rachna Arora:	Deputy Team Leader, Resource Efficiency Project, GIZ
Sandip Chatterjee:	Director, Ministry of Electronics and Information Technology
Satish Sinha:	Associate Director, Toxics Link
Verena Radulovic:	Independent Consultant, U.S. Environmental Protection Agency
Tsuyoshi Kawakami:	Senior Specialist Occupational Safety and Health (OSH) and Labour Inspection (LI), ILO

Objectives of the India E-waste Program
- Generate awareness
- Build a sustainable and responsible e-waste management system in India
- Multi-stakeholder engagement
- Develop a toolkit of useful tools and resources for the e-waste sector
- Support the growth of the sector

About IFC
IFC, a member of the World Bank Group, is the largest global development institution focused on the private sector in emerging markets. Working with 2,000 businesses worldwide, we use our six decades of experience to create opportunity where it's needed most. In FY17, we delivered a record $19.3 billion in long-term financing for developing countries, leveraging the power of the private sector to help end poverty and boost shared prosperity.