



# Green Prakriya

Assessing, evaluating and mapping risks  
involved in the informal e-Waste sector in India



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Year of Publication:

**2019**

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# green prakriya

India is the fifth largest producer of E-waste in the world. It currently generates 1.8 million metric tonnes of E-waste per annum which is expected to grow to 5.2 million metric tonnes by 2020. The volume of E-waste in India is growing at a compound annual growth rate of 30% with 95% of it recycled through the informal sector and only 5% recycled through formal recyclers. The Green Prakriya research and advocacy project

aimed to identify the gaps between policy and social reality. It delved deep into the world of men, women, children and families who form a part of India's informal E-waste sector in Seelampur (New Delhi), Moradabad (Uttar Pradesh), and Saki Naka (Mumbai) to understand risks inherent in their precarious livelihoods and how these must be factored into policy-making processes for a inclusive, equitable, and sustainable future.

## Green Prakriya

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# INTRODUCTION

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Discarded electronic products (waste electrical and electronic equipment also known as ‘e-waste’ or ‘WEEE’) have become one of the world’s fastest growing waste streams. Till date, India generates more than two million tonnes of E-waste annually and also imports E-waste from developed countries like US, Australia and European countries. Besides creating tonnes and tonnes of E-waste by electrical and electronic goods, there are other problems, which are not only dangerous to human health but also it is alarming for environment. If it is not recycled properly, it releases toxin that increases concentration of lead and other harmful chemicals in soil, water, air and human tissue and if it is not recycled, then it barrens the land if it is not stored properly. Illegally ‘dumping of E-waste’ from developed countries to emerging economies like China, India and Bangladesh is still happening but domestic E-waste is also a significant issue.

In a country like India most of electronic products are repaired, refurbished, reused and resale rather than junked as E-waste and recycled the products. The biggest risks from E-waste processing in developing countries emanates from the informal sector which has greater access to electronic waste, especially the electronic devices and home appliances from individual consumers and households. Informal sector reach at household level, their network and their collection strategy makes them unique in all possible ways. The formal sector is not able to compete with informal sector because informal sector is not liable for many expenses such as rents, legitimate wages, does not invest in modern technology, follows unscientific processes for recycling and extraction, and is not bound by any laws and regulations. Unless the informal sector is formalised or made to be part of a defined E-waste supply-chain, it will automatically defeat the very purpose of what the

government is trying to achieve. Having said that the government and industry need to make informal sector as part of E-waste ecosystem and engage with them proactively.

This paper provides the current scenario of E-waste management in India. It is created to serve as a guidance for decision makers and authorities to understand the holistic picture; revisit, plan, design, and make necessary changes required to practically implement the current E-waste Rules and Guidelines and its auction process. The paper underlines the challenges of informal sector the problems of informal sector taking the examples from three locations – Seelampur

(Delhi), Saki Naka (Mumbai) and Moradabad (Uttar Pradesh).

The paper compares the recycling process of informal sector with formal sector. The paper also attempts to highlight health and environmental issues created by informal sector. At last, it attempts to identify mechanism to regulate the informal sector and how it will create the job opportunities if it is regulated and integrated with formal sector. This study aims to fill this knowledge gap by presenting findings from discussions with informal sector workers, highlighting the elements for scaling up learnings and initiatives of formal-informal integration.

# ABOUT THE RESEARCH

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The paper is an effort to understand the informal E-waste sector and its implications on the health of people working in an informal sector. The paper attempts to highlight the gaps of E-waste policies, its implementation and its intersection with E-waste sector. The paper tries to evaluate the current E-waste management practices, especially amongst scrap dealers and dismantlers primarily

in three locations – Seelampur (Delhi), Saki Naka (Mumbai) and Moradabad (Uttar Pradesh).

The paper also attempts to reveal the various occupational health hazards related to the informal recycling of E-waste and takes a special interest in creating the public awareness especially for children who are actively involved in E-waste processing.



# RESEARCH OBJECTIVES AND METHODOLOGY

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The paper was conceptualised to understand the cycle of E-waste in an informal sector and the implication of E-waste on the health of people working in this sector.

The objective of the paper was to understand the E-waste policy and its implementation gaps on the ground. Other specific objectives of the research paper are as follows:

To assess the policy gaps exist in -waste sector

1. To assess the E-auction method and process through MSTC for auctioning E-waste
2. To assess the understanding of E-waste policy within informal sector workers
3. To gain a better understanding of the benefits and issues associated with processing of E-waste by the informal sector
4. To compare the potential benefits and key challenges of the informal sector in comparison to formal systems
5. To assess implications of E-waste on health of workers in an informal sector

More specifically, the research paper seeks to explore the following research questions:

1. What is the nature of transactions defining the formal – informal linkages in the process of E-waste disposal and recycling?
2. How does the regulatory environment influence the informality of E-waste processing?
3. What are the main environmental and health hazards in the E-waste sector?

In order to fill this gap, we realised that documentation and compilation of such incidents, based on on-ground research and analysis, is necessary. Hence we used the following methods to conduct the research.

### **Policy Analysis**

The paper draws upon the existing E-waste policies of India. The paper tries to analyse the existing E-waste policies – E-waste Rules 2011; Rules 2016 and E-waste Management (Amendment) Rules 2018 to understand the process of E-waste management in the country.

### **Literature Review**

The research paper draws on existing insights made by Basel Convention recommendations and the existing reports such as ITU Global E-Waste Monitor Reports to measure the generation of E-waste in India in comparison to other neighbouring countries. It also looked at the reports by NGOs, industry and academic papers to understand the generation and collection of E-waste papers in globally and in India and understanding the formal and informal sector. The paper also uses

these resources to understand the occupational health hazards due to informal recycling of E-waste.

### Interviews

As part of this research paper, our research team conducted one-to-one interviews with workers in three locations – Seelampur (Delhi), Sakinaka (Mumbai) and Moradabad (Uttar Pradesh). For the purpose of this research, we selected three types of locations – Seelampur (Delhi) where segregation and trading happens, while Saki Naka (Mumbai) where aggregators collect E-waste and Moradabad (Uttar Pradesh) where dismantling happens. The case studies have collected from the following stakeholders:

Scrap buyers and sellers – those who deal in trading of E-waste

Scrap dismantlers – those who deal in dismantling the metal from E-waste

As part of this research study, we also conducted in-depth discussion with non-profit organisation heads to understand the scenario of formal and informal sector. One of the limitations is this paper is dependent on discussion with informal workers and could not able to engage with formal recyclers due to time-constraint. To fill this gap, we have used academia and industry papers to understand the common elements and differences between formal and informal sector.

The paper frames the discussion around the definition of E-waste, further linking with Sustainable Development Goals (SDGs), focusing on the global and national E-waste collection and generation.



# DEFINING THE E-WASTE

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Waste Electrical and Electronic Equipment (WEEE) includes all parts of computer and mobile and its accessories and electrical equipment(s), including LCD/TV, air conditioner, refrigerators and other household appliances. The definition of E-Waste is very broad (Baldé, 2015 a) and categorised them into five categories - temperature

exchange equipment; screens, monitors; lamps, including fluorescent lamps, high intensity discharge lamps, and LED lamps; household appliances and small IT and telecommunications equipment(s). The table 1 represents the different definitions based on different conventions.

OECD (2001)	“Any appliance using an electric power supply that has reached its end of life.”
EU WEEE Directive (EU, 2002a)	<p>“Electrical or electronic equipment which is waste including all components, sub-assemblies &amp; consumables, which are part of the product at the time of discarding.” Directive 75/442/EEC, Article 1(a) defines “waste” as “any substance or object, which the holder disposes of or is required to dispose of pursuant to the provisions of national law in force.”</p> <p>The directive also classifies E-Waste into 10 categories and its extent as per voltage rating of 1000 volts for alternating current and 1500 volts for direct current. The EEE has been further classified into ‘components’, ‘sub-assemblies’ and ‘consumables’ (Jain, 2008).</p>
Basel Convention Action Network (Puckett & Smith, 2002)	E-waste encompasses a broad and growing range of electronic devices ranging from large household devices such as refrigerators, air-conditioners, cell phones, personal stereos, and consumer electronics to computers which have been discarded by their users.”
Sinha (2004)	“An electrically powered appliance that no longer satisfies the current owner for its original purpose.”
STEP (2005)	E-waste refers to “...the reverse supply chain which collects products no longer desired by a given consumer and refurbishes for other consumers recycles or otherwise processes wastes.”
(Widmer, Oswald-Krapf, Sinha-Khetriwal, Schnellmann, & Böni, 2005)	‘Electronic waste’ or ‘e-waste’ for short is defined as “a generic term embracing various forms of electric and electronic equipment that have ceased to be of any value to their owners”

E-Waste in India is defined as Waste Electrical and Electronic Equipment (WEEE) including all components, sub-assemblies and their fractions except batteries

falling under these rules. Batteries are regulated by the Batteries (Management and Handling) Rules, 2001, according to the E-Waste (Management and Handling) 2011.

# E-WASTE & ITS RELATIONSHIP WITH SDGS

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The United Nations and its member states adopted the ambitious Agenda 2030 for Sustainable Development on September 2015, identifying 17 Sustainable Development Goals (SDGs) and 169 targets to end poverty, protect the planet and ensure prosperity for the next 15 years. The Goal 3, Goal 6, Goal 8, Goal 11, Goal 12 and Goal 14 are linked to the management of e-Waste. The relationship between SDG and e-Waste management involves the link between deaths and illnesses due to hazardous substances across their life-cycle; air quality and municipal waste management and the reduction of waste generation through use of the waste hierarchy. However, it is also possible that implementation

of Agenda 2030 will generate huge amount of e-Waste. Following SDGs are directly or indirectly linked with E-waste management:

## **Goal 3, Goal 6 & Goal 14**

The target 3.9 of Goal 3 refers to the number of deaths and illness caused by hazardous chemicals and air, water and soil pollution and contamination. The Target 6.1 of Goal 6 discusses to achieve universal and equitable access to safe and affordable water for all. The Target 6.3 aims to reduce pollution, eliminate dumping and minimize release of hazardous chemicals and materials. Targets 14.1 and 14.2 of Goal 14 states about the marine pollution and the protection of the marine ecosystem.

### Goal 8

The target 8.8 of Goal 8 is related to safe and secure working environments for all workers including migrant workers, particularly migrant pregnant women workers. The ethical practice of e-Waste will create new employment and also able to contribute to economic growth in the recycling and refurbishing sector.

### Goal 12

The Target 12.4 of Goal 12 is to achieve environmentally sound management of chemicals and

all waste throughout the life cycle in accordance with agreed international frameworks. This will significantly reduce the release of hazardous gas in air, water and soil in order to minimize adverse impacts on human health and the environment. The Target 12.5 aims to reduce generation of waste by reduction, repair, recycling and reuse of it. Thus, it is essential to raise awareness of recycling, repair and reusing of electrical and electronic equipment to make production and consumption more sustainable.

# E-WASTE: THE GLOBAL CONTEXT

The first major international multilateral, Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal was adopted in 1989<sup>1</sup>. 182 countries ratified the Convention, excluding USA, which is the largest generator of E-waste. One of the major drawbacks in the convention was that it did not mandate any specific penalties and implementation and enforcement because of ambiguous definition between ‘used equipment’ and ‘end-of-life’ waste. (Khan, 2014) identified that the convention imposes the trading regime that allows transfer of hazardous waste between contracting parties for the ‘purpose of recycling and recovery’. Various initiatives like Japan’s 3Rs (reduce, reuse, recycle), EU’s WEEE

Directive and Waste Shipments Regulation and the US NGO-led Basel Action Network encourage responsible e-waste recycling and import/export practices. EU WEEE Directive 2007 established the clear system of collection and recycling based on the extended producer responsibility (EPR), which is adopted by EU member states (Cahill, Grimes, & Wilson, 2011)

The Electronics and Electrical Equipment (EEE) are manufactured and disposed worldwide. Around 44.7 million metric tons (MT) e-waste was generated worldwide in 2016 it exceeded by 46 MT in 2017. Based on this growth rate of rising E-Waste, it is estimated that it will increase to 52.2 MT by 2021, with an annual growth rate of 3 to 4%. The E-waste comprise of 8% of municipal waste (Annamalai, 2015) which is nearly the same amount of all plastic packaging which is 6 and it is growing steadily.

1 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal; <https://www.basel.int/portals/4/basel%20convention/docs/text/baselconventiontext-e.pdf>; accessed on 5th March 2019

According to ITU's Global E-Waste Monitor 2017 Report, Asia generated 18.2 MT or 4.2 kg per inhabitant e-Waste in 2016, whereas approximately 2.7Mt were reported to be collected and recycled. In Europe, including Russia, generated 16.6 kg per inhabitant and Oceania generated 17.3 Kg/inhabitant E-Waste. Thus, in total, 4.3 Mt of e-Waste was collected to be recycled in Europe. The lowest amount e-Waste per inhabitant was generated in Africa that is 1.9 kg/inhabitant. Irony is that developed countries generated 19.6 kg/inhabitant in comparison to developing countries, which generated only 0.6 kg/inhabitant. Besides using E-waste for landfills, developed countries are also exporting E-waste to developing

countries like India, Pakistan and China import E-waste illegally.

Globally, about 8.9 Mt of E-waste was reported as formally collected and recycled by official take back system, while total of 1.7 Mt of E-waste was not reported and ends up being in a waste bin. Moreover, the large majority of the E-waste was not managed officially but it went unreported and not documented. This way, together with unreported data for the transboundary movement of E-waste, which is mostly from developing countries is likely to be the gap between officially collected and unreported waste. In 2016, approximately 34.1 Mt of E-waste generated worldwide is untraced and unreported. The Table 2 shows E-waste generation and collection per continent:

Indicators	Asia	Africa	Americas	Europe	Oceania
Countries in region	49	53	35	40	13
Population in region (millions)	4,364	1,174	977	738	39
WG (kg/inh)	4.2	1.9	11.6	16.6	17.3
Indication WG (Mt)	18.2	2.2	11.3	12.3	0.7
Documented to be collected and recycled (Mt)	2.7	0.004	1.9	4.3	0.04
Collection Rate (in region)	15%	0%	17%	35%	6%

Asia is one of most complicated continent in terms of generating and recycling E-waste. On the one side United Arab Emirates (UAE) generates the lowest amount of E-waste annually with 13.6 kg/inhabitant, while Saudi Arabia and Kuwait produce the highest amount of e-Waste per inhabitant. Afghanistan and Nepal are least E-waste generating countries with 1 kg/inhabitant. China, the top E-waste producer by generating 7.2 Mt of E-Waste plays an crucial role in refurbishing, reusing and recycling of E-waste<sup>2</sup>. According to study by (Song, Q, Wang, Li, Duan, Yu, & Zeng, 2017), the amount of E-waste in China is expected to grow to 27 Mt by 2030. China's national legislation regulates E-waste collection and treatment of electronic devices. However, the consumption of electronic devices is much higher in China, so the

business of recycling and collecting of E-waste in informally will also increase. Other countries like Japan and South Korea have more restricted countries legislations for example Japan was the first country to implement EPR based system for E-Waste. In South Asian region, India not only generates E-waste but also imports from developed countries. Other countries like Sri Lanka has no regulations to deal with E-waste specifically, while Pakistan currently has no inventory to inform about E-waste generation, but they have made provisions to prohibit importing E-waste from developed countries. According to another study, the many of such items are still imported to Pakistan as second-hand items (M., S. , & Kim, 2017). Bangladesh, which further exaggerates the problems, associated with management of E-waste (Borthakur & Sinha).

2 Global e-Waste Monitor 2017  
Report by ITU; accessed on 5th March 2019



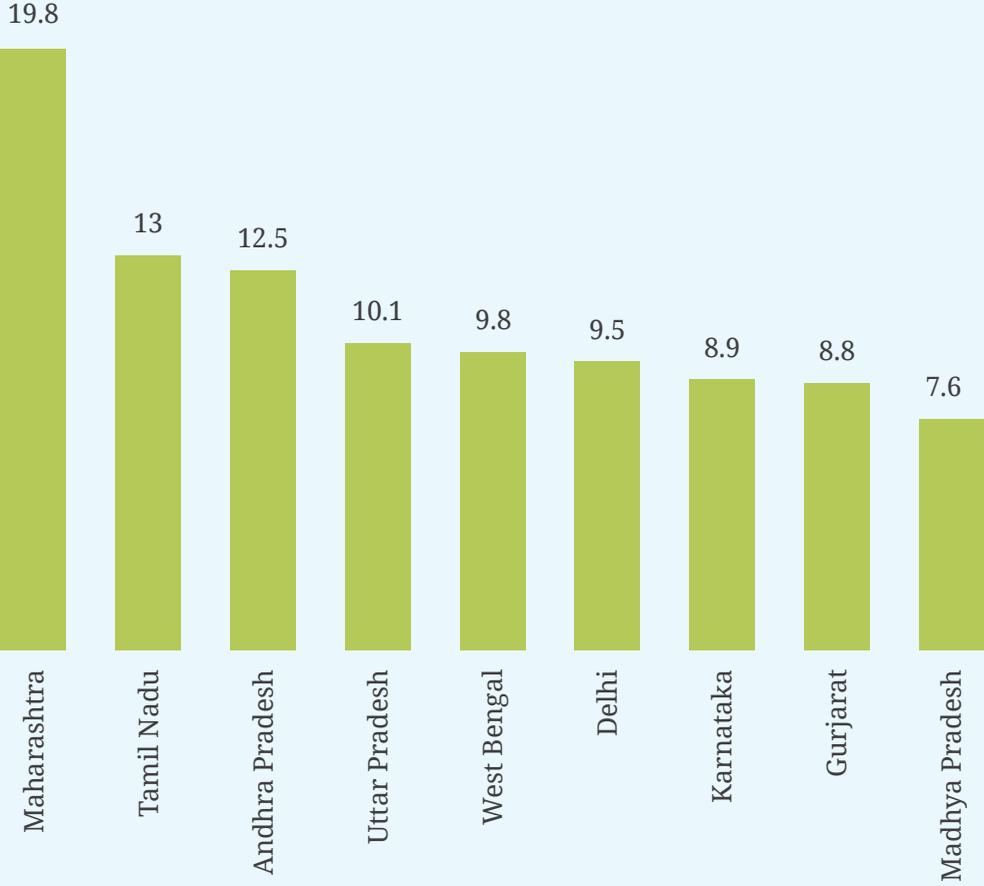
# E-WASTE: THE INDIAN SCENARIO

India lacked the sound E-waste management legislative framework and not backed by a sound technological framework for proper disposal/ recycle. India's electronic industry is growing rapidly, thus disposal and recycling of electrical and electronic equipment have become the serious concern. India was the fifth biggest producer of E-waste in the world by generating 1.7 Mt of electronic and equipment<sup>3</sup> in 2014 that raised to 2 Mt of E-waste in 2016, according to ASSOCHAM & NEC study<sup>4</sup>. The same study identified that India generates about 18 lakh metric tonnes (MT) of E-waste per annum and it is expected to grow 52 lakh metric tonnes (MT) by 2020. E-waste in India is increasing with 30% of compound annual growth rate. According to ASSOCHAM-NEC study, 95% of the E-waste is recycled through informal sector, only 5% was recycled through formal recyclers. The volume of E-waste is growing at an estimated 21% annually due to 500% increase in E-waste from old computers; from 18 times higher in discarded mobile phones, from 1.5-2 times higher in discarded televisions (Pathak, Srivastava, & Ojasvi, 2017) than their respective 2007. Maharashtra, Tamil Nadu and Andhra Pradesh are the top states in the country in producing E-waste with 19.8%, 13% and 12.5% respectively, according to ASSOCHAM-NEC study. The state-wise E-waste generators are given below in table 3.

3 The global e-waste monitor 2014; Indian Environmental Portal; <http://www.indiaenvironmentportal.org.in/content/409469/the-global-e-waste-monitor-2014/>; accessed on 5th March 2019

4 ASSOCHAM & NEC study, 'Electricals & electronics manufacturing in India' [https://in.nec.com/en\\_IN/pdf/ElectricalsandElectronicsManufacturinginIndia2018.pdf](https://in.nec.com/en_IN/pdf/ElectricalsandElectronicsManufacturinginIndia2018.pdf); accessed on 5th March 2019

# E-Waste Generators (state-wise) 2018



Source: ASSOCHAM-NEC Study

■ Percentage

# NATIONAL POLICY & LEGISLATIONS IN INDIA

The Environment Act 1986<sup>5</sup> was one of the earliest legislations that enacted to provide for the protection and improvement of the environment in India. It broadly covered all aspects of protection, improvement and enforcement of environment-friendly operations. However, this Act does not have any specific mention of E-waste but several provisions were covered in the Act under the hazardous waste category, including processing, storage, usage, disposal and destruction. This Act became the umbrella legislation and guideline for other Acts and legislations.

The first time electronic waste or e-waste in India was defined as “Waste Electrical and Electronic Equipment, including all components, sub-assemblies and

5 The Environment Act 1986; <http://envfor.nic.in/legis/env/env1.html>

their fractions except batteries falling under Schedule 3 of Hazardous Wastes (Management and Handling) Amendment Rules, 2003<sup>6</sup>.” Moreover, the waste was classified by ‘process of waste generation’ in 44 categories, comprising of 148 waste streams in Schedule 1 and 79 waste types in Schedule-2. The Schedule was by large focused on recycling and disposal of electronic waste. Prior to this, electronic waste in India was considered as part of solid waste management under the guideline of Municipal Solid Wastes (Management & Handling) Rules, 2000. These rules specifically regulated the disposal of solid waste and hazardous in an environmentally manner, but

6 Schedule 3 of Hazardous Wastes (Management and Handling) Amendment Rules, 2003; <http://envfor.nic.in/legis/hsm/so593e.htm>; accessed on 19<sup>th</sup> Feb 2019

the rule did not mention about the disposal of E-waste. At the same time, the Information Technology Act 2000 under the mandate of Ministry of Communications & Information Technology did not recognise how to address instances if ICTs impacting on environmental and climate factors or how to address environmental issues occurred due to the collection of large amount of E-waste.

The issue of disposal and recycling of electrical and electronic waste was first time noticed in Rajya Sabha by Shri Vijay J. Darda, Honourable Member from Maharashtra on 23 December 2005 as a Private Member's Bill on 'The Electronic Waste (Handling and Disposal) Bill, 2005. The bill had recognised there was proper law or guideline on the handling of electronic waste disposal in India. The bill criticised the improper way of disposing electronic waste and called for regulation for electronic waste disposal. The bill lapsed in 2010 with the expiry of tenure of

honourable Rajya Sabha Member.

The Hazardous Material (Management, Handling and Transboundary Movement) Rules, 2007, drafted by the Central Government envisioning the Basel Convention<sup>7</sup>, to which India is also a signatory<sup>8</sup>, on 24 September 2008, these rules were notified as the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules 2008 by the Ministry of Environment and Forests. Later on, the Ministry constituted a committee to oversee the implementation of the Hazardous Wastes 2008<sup>9</sup>. The assessment of managing and handling -waste by the Central

7 Basel Convention; <http://www.basel.int/TheConvention/Overview/tabid/1271/Default.aspx>

8 M.P. Ram Mohan, Iti Garg and Gayatri Kumar, 'Regulating e-waste: a review of the international and national legal framework on e-waste, ' in Rakesh Johri, E-waste: Implications, Regulations and Management in India and Current Global Best Practices, TERI, The Energy and Resources Institute, 2008, p.170-71.

9 'Trade of Hazardous waste', Rajya Sabha Starred Question No. 119, dated 2.8.2010.

Pollution Control Board (CPCB) resulted the formation of Guidelines for Environmentally Sound Management of E-waste in March 2008. The guideline emphasised on using the Western countries disposal practices, Extended Producer Responsibility (EPR)<sup>10</sup> strategically giving responsibility to the producer for the entire life cycle of the product, especially for taking back, recycling and final disposal of the product. This way, producer's responsibility extended to the post-consumer stage of product life cycle.

In the public interest to enable the recovery and/or reuse of useful material from E-waste, and thereby reducing the hazardous waste, the Government of India introduced the E-waste (Management and Handling) Rules, 2010<sup>11</sup> enabling MSMEs to engage in process of E-waste. First time, global framework of E-waste management

was adopted by incorporating extended producer responsibility and also the need for Restriction of Hazardous Substances (RoHS) compliance that would follow international standards for the use of restricted hazardous substances in electronic manufacturing. These Rules were further recognised by the Ministry of Environment & Forest (MoEF) as E-waste (Management & Handling) Rules, 2011<sup>12</sup>. These Rules came into effect from 1st May 2012. The major highlight of Rule 2011 was that it enlisted detailed responsibility of various stakeholders involved in the supply-chain of E-waste management, ranging from consumer, producer, distributor, refurbisher, collection centres, dismantlers and recyclers. Defining the responsibilities of each stakeholder, the Rule 2011 also emphasised on setting up of the E-waste collection centre for end-of-life products in alignment with principle of EPR to refurbished or dismantled or recycle the E-waste

10 'Disposal of e-waste', Rajya Sabha Unstarred Question No. 1887, dated 21.2.2019

11 PIB Press Release, 'Hazardous Waste Management Rules', Ministry of Environment and Forests, 26 Feb 2019. <http://pib.nic.in/release.asp?relid=44081>

12 E-waste (Management and Handling) Rules; [http://www.moef.nic.in/sites/default/files/1035e\\_eng.pdf](http://www.moef.nic.in/sites/default/files/1035e_eng.pdf)

in a channelised manner. EPRs were responsible to create a system and finance it to meet the costs involved in the environmentally sound management of E-waste generated from the end-to-life of its own products and historical waste<sup>13</sup>. Whereas, producers need to share the contact details of dealers and authorized collection centres to consumers to facilitate return of E-waste.

Even though the E-waste (Management and Handling) Rules, 2011 initiated various policy discourses for safe disposal of E-waste materials but it was also criticised several grounds by environmental groups. One of the major drawbacks was that it did not identify the rehabilitation of those people who were involved in informal dismantling and its structure. These rules were restricted only for defining responsibilities of producers

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13 According to the draft 'E-waste (Management and Handling) Rules, 2010', 'historical waste' means all available e-waste in the market on the date from which these Rules come into force.

but it lacked in developing the common standards and framework that producer can adhere to. Moreover the rules did not focus on establishing any standard or framework for E-waste collection, evaluation and disposal.

It was surprising that Rule states that collecting and dismantling of E-waste is not hazardous. Moreover, it stated that informal sector is carrying out the dismantling E-waste material efficiently because most of the E-waste can be refurbished and used as second hand material. Only extraction of precious metals is hazardous which should be left for organized sector<sup>14</sup>. The rules failed to address some of the key concerns in relation to informal workers. While this might be touted as a welcome regulation given that most of waste is imported from the western countries, however, the ban does not take into account import

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14 Comments and Suggestions made by Ms. Sunita Narain, Director, Centre for Science and Environment, New Delhi by email, dated February 17, 2001 on the draft backgrounder titled 'E-waste in India' prepared by the Research Unit of Rajya Sabha Secretariat.

under the pretext of metal scrap and does not restrict the import of goods for recycling, which is contrary to Basel Convention. These rules did not talk any sustainable model that can help collectors while collecting E-waste from consumers. Lastly, the major drawback is that central and state pollution boards were largely responsible for supervision and monitoring of E-waste, but it was not so practical given the bureaucratic nature of the Indian political system.

On 1 October 2016, E-waste (Management) Rules 2016 replaced the existing E-waste (Management and Handling) Rules, 2011. The concept of EPR expanded to the producers of electrical and electronic equipment to register and specified targets to collect generated E-waste and ensure that it is recycled in channelised manner. A manufacturer, PRO (Producer Responsibility Organisation), dealer and refurbisher also brought under the ambit of these rules. Neither 2011 nor 2016 acknowledge the role of informal

sector in e-Waste recycling process, despite the pressure from civil society organisations and even Indian parliamentary briefing flagged that the law ‘ignores the unorganised and small and medium sectors where 90% of E-waste is generated’ (Rajya Sabha , 2011).

In contrast, the solid-waste legislation took a different perspective and recognised the existing informality and waste management in India by mandating municipalities and ‘other urban local bodies’ to facilitate activities of waste-pickers and informal companies through providing access to waste and storage facilities for sorting and recycling. It also engaged municipalities to organise waste collection for informal settlements. The penalty and punishment for non-compliance were the same as sections 15, 16 of the Environment (Protection) Act, 1986. These sections specify an imprisonment term that may extend to five years or a fine, which may extend to Rs. 100,000

as penalty for non-compliance. Ironically, Hazardous and Other Wastes (Management and Trans-boundary) Rules, 2016 banned the importing of E-waste for disposal<sup>15</sup>.

#### Further E-waste Management 2016

<sup>15</sup> Hazardous and Other Wastes (Management and Trans-boundary) Rules, 2016; <http://www.moef.gov.in/sites/default/files/Final%20HWM%20Rules%202016%20%28English%29.pdf>; accessed on 4th Feb 2019

Rules were amended on 22 March 2018 to facilitate and effectively implement the environmentally sound management of E-Waste in India. These Rules will include collection targets as well as requirements that producers implement a deposit-refund system (DRS). The E-waste Management Rules 2018 also defined the collection targets, given in Table 3.

#### E - Waste Collection Target (Weight)

S. No.	Year	Target
1	2017-2018	10% of the quantity of waste generation as indicated in EPR Plan.
2	2018-2019	20% of the quantity of waste generation as indicated in EPR Plan.
3	2019-2020	30% of the quantity of waste generation as indicated in EPR Plan.
4	2020-2021	40% of the quantity of waste generation as indicated in EPR Plan
5	2021-2022	50% of the quantity of waste generation as indicated in EPR Plan
6	2022-2023	60% of the quantity of waste generation as indicated in EPR Plan
7	2023 onwards	70% of the quantity of waste generation as indicated in EPR Plan.

The Rule 2018 also provided EPR targets for producers<sup>16</sup>, have also been given a collection target, which is lesser than targets for other

<sup>16</sup> Producers/Importers who have recently started their operations—whose number of years of operations is lesser than the average life of the product they are selling—have also been given a collection target which is lesser than the targets for other producers

producers. However, the Rules supported them by allowing them to set-off this collected amount at the time of fixation targets (Table 4). Moreover, E-waste collected by producers between October 2016 and Sept 2017 would be continued in their targets for FY 2017-18.

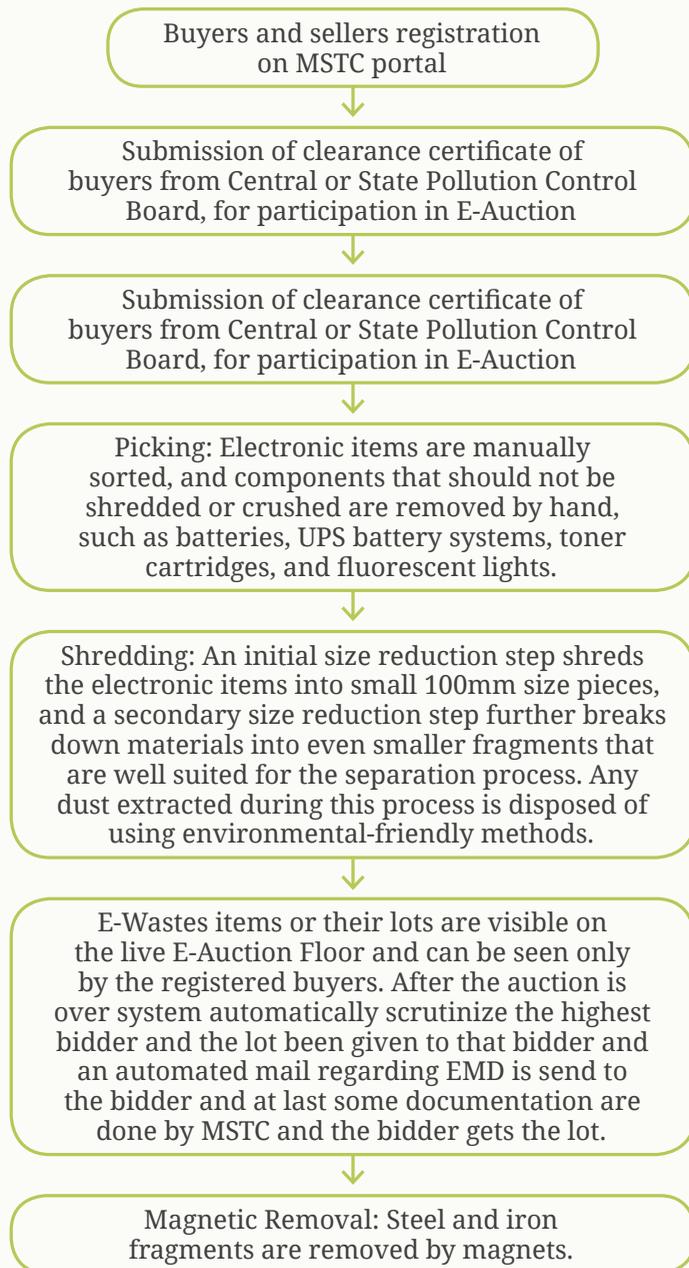
#### E-Waste Collection Target (Weight)

S.No.	Year	Target
1	2018-2019	5% of the sales figure of financial year 2016-17
2	2019-2020	5% of the sales figure of financial year 2017-18
3	2020-2021	10% of the sales figure of financial year 2018-19
4	2021-2022	10% of the sales figure of financial year 2019-20
5	2022-2023	15% of the sales figure of financial year 2020-21
6	2023-2024	15% of the sales figure of financial year 2021-22
7	2024-2025	20% of the sales figure of financial year 2022-23
8	2025 onwards	20% of the sales figure of the year preceding the previous year

## Auction Process of E-Waste

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As the concept of PRO is new in India and yet other stakeholders do not recognize their value proposition, thus, many recyclers objected at their existence into the market. Moreover, they see them as competition not as a conduit for business. Until May 2018, CPCB released guidelines for PRO to register with the government officially. Previously PROs were not government-authorized to bid for E-waste at recycling auctions. In fact, aggregator-traders who have already collected materials from bulk consumers. Since only registered recyclers were authorised to bid for E-waste materials, PROs needed to purchase E-waste on behalf of producers from the dismantlers and recyclers with whom they needed to negotiate recycling contracts. Even though the PRO guidelines define the expected functions of a PRO, but don't define core competencies of PRO. The auction process of E-waste and its after-process is given below.



## Key policy initiatives

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The Ministry of Environment and Forest has issued a number of notifications related to the safe disposal of hazardous waste, as follows:

1. Hazardous Wastes (Management and Handling) Rules, 1998/2000/2002/2003
2. MoEF guidelines for Management and Handling of Hazardous Wastes, 1991
3. Guidelines for Safe Road Transport of Hazardous Chemicals, 1995
4. The Public Liability Act, 1991
5. Batteries (Management and Handling) Rules, 2001
6. The National Environmental Tribunal Act, 1995
7. Bio-medical Wastes (Management and Handling) Rules, 1998
8. Municipal Solid Wastes (Management and Handling) Rules, 2000 and 2002
9. Guidelines for Environmentally Sound Management of E-Waste 2008
10. Draft E-Waste (Management and Handling) Rule 2009
11. E-waste (Management and Handling) Rules, 2011
12. E-waste (Management) Rules 2016
13. E-waste (Management) Rules 2018

# FINDINGS: INFORMAL E-WASTE SCENARIO IN INDIA

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The E-waste recycling in the informal sector essentially includes collection, segregation, dismantling and extraction of precious metals. These are generally small units exercise either minimal or no control over their activity and use highly polluting dismantling process without being aware of health risks associated with it.

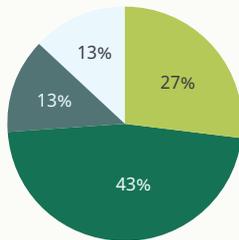
Seelampur gets E-waste from across North India. All scrapped computers that are auctioned in North region wind up in Seelampur. Another source is collecting E-waste from rag-pickers and household waste collectors, also known as 'kabadiwalas' (Manomaivibool, Lindhqvist, & Tojo, 2007). However, most of computers are either broken or imported second hand computers.

Auction News, a bi-weekly journal in Delhi, publishes advertisements on scrap that offices or government departments want to auction. When recyclers gather in the offices concerned, auctions are held.

In Seelampur, there are two types of scrap dealers, one who segregate plastic and metals and sell it to the respective dealers of metals such as copper, iron, aluminium and plastic<sup>17</sup>. Others are traders who buy scrap from dealers and sell to other dealers. Informal E-waste units in Seelampur generally follow the steps such as collection of E-waste from the rag pickers and door-to-door waste collectors, disassembling of the products for their reusable

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<sup>17</sup> In conversation with scrap dealers in Salempur (Delhi) by DEF research team.



### Share of E-waste import in India



parts and components. The rest of the material is chemically treated to recover precious metals causing leaching of hazardous substances to the air, soil and water. These recycling methods require low-efficiency and recovery is carried out for valuable metals like gold, silver, aluminium, and copper. While these dismantlers are unable to recover other metals like tantalum, cadmium, zinc, palladium, etc. Around 47% of scrap dealers in Salempur purchase the scraps from shops in the market and 27% purchase from rag pickers.

Dismantlers in Seelampur for their job are involved in breaking computers into their basic parts and selling motherboards to traders in Moradabad. The remaining metals and plastics do not reach there, but

stay in Seelampur<sup>18</sup>. Most of the workers in Seelampur work 8-10 hours per day without any apparent regard of their own well-being. The income of these workers are linked on the quantity of metals they dismantle and the quality of what is extracted. In Seelampur, workers were reluctant to discuss about the pollution problems as they have fear that could result in police raid. Moreover, the workers in Seelampur denied that burning of E-waste happens in the locality, however, during visit, it has been observed that metal burning stoves were present in the household. Locals were reluctant to share any details in a fear that their trading will be shutdown during one of the regular police patrols in an

<sup>18</sup> In an interview with dismantlers in Saleempur (Delhi)

attempt to curb Delhi's critical air and water problems. As a result of this fear, E-waste burning and acid washing are often hidden from views in the outskirts and reaching to neighbouring states such as Uttar Pradesh where the chances of police raid are minimal. However, there are nearby places like Mandoli, where burning of waste takes place. This location was filled with swirling clouds of thick acid smoke and women and children both were engaged in process of dismantling metals by burning electrical cables over a coal fire to extract copper and other metals.

In discussion with local women-- they were aware about health risks and implications on environment in relation to their work-- it has been found that deaths due to respiratory problems are common in the locality.

In Saki Naka (Mumbai), most of them are aggregators and use it for dumping their E-waste and do minimal dismantling and segregation work. Once the E-waste

is collected here, it is transported to Mumbra, suburb located in outskirts of Mumbai for further transporting to Seelampur, Delhi<sup>19</sup>. This way, the same E-waste is transported twice, so that it can reach to Seelampur, so that it can be segregated and transported further to Moradabad for dismantling. There are more than 100 shops located in Teen Number Khadi of Saki Naka. These shops aggregate E-waste from this region and trade it to Saleempur. Dealers here in Saki Naka keep constant watch on illegal imports, auction and tenders to source the material.

The E-waste in Moradabad comes from all the metro cities, majorly from New Delhi (Shastri Park, Seelampur, Mundka and Mandoli), Mumbai, Kolkata, Bangalore and Chennai. E-waste recycling has become a home business in the city, with most members in a family involved in processes right from dismantling to metal recovery. The aim has been to gain

<sup>19</sup> In conversation with aggregators in Saki Naka (Mumbai)

information about their practices, processes and health hazard they face while dealing with E-waste.

In all three locations, scrap dealers, aggregators and dismantlers deal with all kind of E-waste, including computer, laptop, smartphone, feature phone, pager, tablet, photocopy machines, pen drive, cables, telephones, chargers, earphones, mouse, fridge, TV, transformer, compressor and others<sup>20</sup>.

Whether it is Seelampur or Moradabad, mostly workers use their hands and minimal equipment such as gas stove or spirit lamp to dismantle the metals from E-waste. They are also not bothered to protect their hands and mouth while dismantling E-waste. Residents in Seelampur and Moradabad are immune to smoke, the noise and the smell of hazardous gas. Average per day income of traders in Seelampur is Rs. 711. The workers employed in Moradabad earn around Rs. 150 to

20 In conversation with workers in Seelampur, Sakinaka & Moradabad

200 per day for dismantling E-waste. Whereas women and children get only Rs 70 to 100 per day for 10 hours of work. Over 5000 people in Moradabad are directly or indirectly engaged with dismantling. About 80% population in Moradabad is involved in dismantling E-waste and segregating precious metals, while only 8-10% population is involved in metal recovery process<sup>21</sup>. Mostly these workers are working in over-congested environment. It is mostly done in small houses, in narrow streets creating noise beyond the decibel counts permissible for the human ear. Metallic dust, chemical fumes and smoke emanate from various processes and affect the respiratory systems of workers.

In a day, around four-five trucks carrying 9 tonnes of E-waste per truck come to Moradabad. Moreover, small tempos<sup>22</sup> run by small traders also transport E-waste daily from Delhi to Moradabad.

21 In an interview with dismantlers in Moradabad, Uttar Pradesh

22 Tempos is four-wheeler small vehicle

These vehicles comprise of 80% TV remote/radio, 8-10% motherboards, 4-5% mobile boards and the remaining are circuits of CFL lights and keyboards. Workers engaged in extraction of metals, do not get enough gold and silver from PCB. They mainly extract copper, which is further routed through brass industry. However, the presence of acids in some houses proves that some of the workers are also engaged in gold extraction<sup>23</sup>. According to the study by (Chatterjee & Kumar, 2009), metals that can be recovered from 1000 kg of PCB are as follows:

Recovered metal	Weight
Gold	279.93 g
Precious metals (Pt, Pd, In)	93.31 g
Copper	190.512 kg
Aluminium	145.152 kg
Lead and tin (Pb/Sn)	30.844 kg
Silver	450 g

The methods followed by these workers are rudimentary and lead to a loss of significant quantities of metal. They extract only 60-70% of metals and the rest goes to waste.

The understanding of regulations amongst workers of informal sector was found to be minimal. 86% of respondents were not aware about E-waste guidelines. They were however aware about new Goods & Services Tax (GST) imposed by the government in July 2017. The rag pickers and waste collectors interviewed were severely impacted and saw no economic benefit in it. Most of the items in E-waste were recyclable, so its low value put a stop on the informal recycling industry. From July to October 2017, the income of the waste collectors came down by 40%-50%.

<sup>23</sup> Observational method during the data collection



# FORMAL VS INFORMAL E-WASTE RECYCLING

The E-waste in India is produced through different sources, thus various stakeholders are involved in the process of recycling as well. Yet, there are primarily two sources in the E-waste supply chain – 1) bulk consumers and 2) individual consumers. **As per the E-waste rules, both types of consumers are required to channelise the waste generated by them to authorized collection centres, dismantlers or recyclers or return to the take back services to brand companies. However, bulk consumers need to make the records of their E-waste, but some of them find it their way to informal sector.**

Another major source is E-waste in India, apart from bulk and household consumers, is illegal import of E-waste from developed countries where it is expensive to recycle the discarded electronics (Dwivedy & Mittal, 2012). The primary reason is that that the waste traders in USA and Europe spend close to USD 20 for recycling a

computer safely in their respective countries while it takes half the cost via informal waste traders in developing countries like India (E-Waste in India, 2011). The US dumps 42% of their E-waste in India, whereas China and EU dumps 30% and 18% respectively (as shown in the figure below).

Despite the fact that India is signatory of the Basel Convention for Transboundary Movement of Hazardous Substances, there has been lack of proper import regulations, which further resulted in import of illegal E-waste.

In India, there are 177 formal recyclers as of December 2016, according to Central Pollution Control Board<sup>24</sup>. Karnataka and Maharashtra have the largest number of recyclers in the country with 57 and 32 respectively. The table 5 shows the state-wise number of recyclers with their capacity as of December 2016:

<sup>24</sup> Annual Report 2015-2016; Central Pollution Control Board

States	No. of Units	Number of capacity
Karnataka	57	44,620.50
Maharashtra	32	47,810.00
Uttar Pradesh	22	86,130.00
Haryana	16	49,981.00
Tamil Nadu	14	52,427.00
Gujarat	12	37,262.12
Rajasthan	10	68,670.00
Telangana	4	11,800.00
Uttarakhand	3	28,000.00
Madhya Pradesh	3	8,985.00
Chhattisgarh	2	1650.00
Punjab	1	150.00
West Bengal	1	600.00
<b>Total</b>	<b>177</b>	<b>438,085.62</b>

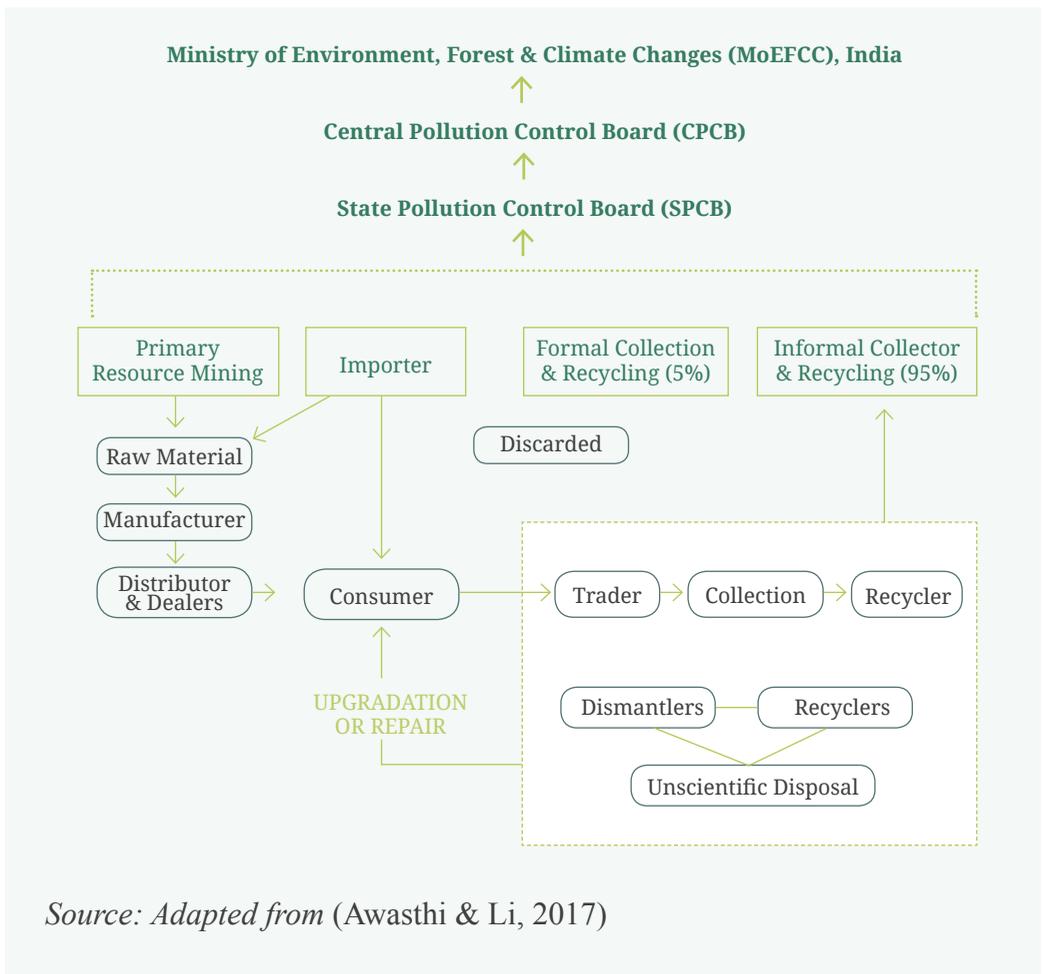
According to the E-waste rules, the producer has responsibility of managing the life of equipment till the end after it is discarded by consumers. Under EPR, the producer is responsible for finance and organising the system to meet with the cost involved in complying with EPR.

EPR cost of producer = Awareness Cost + Collection Cost + Logistics Cost + Recycling Costs.

Based on the abovementioned costs, the formal sector requires heavy investment in terms of machinery as compared to informal sector. The formal sector has proper

facilities and standards for handling E-waste but it lacks outreach down to the household level like informal sector (Xinwen, Porte, Wang, & Reuter, 2011). About 5-10% of E-waste is recycled formally,

whereas 90-95% of the same goes to the informal sector. The E-waste management system flows in the following manner (see figure 3).



The E-waste Management Rules 2016 places responsibility on electronic goods manufacturing companies and bulk consumers to collect and channel E-waste from consumers to authorized re-processing units. However, firms are yet required to set their yearly collections target linked to their production numbers. Moreover, the same rule also limits their use of hazardous heavy metals such as mercury, lead, cadmium. The government had hoped that by 2018, the producers will be able to understand new Rules and outline their targets as well as measure collected E-waste, it however failed to take any practical shape.

In conversation with owner of recycle unit in Mumbai, invested about heavily to set up the re-processing plant and have 25 workers in the plant. Despite the new Rules, he stated ‘there is hardly any increase in orders as yet electronic companies do not seem to have taken these Rules very seriously’. According to Central Pollution Control

Board (CPCB), more than 200 companies that manufacture electronic goods from smartphones to laptops are not complying with E-waste procurement.

In the case of informal sector, workers use minimal equipment(s) to recycle the E-waste. The informal sector is well networked, organised and has huge network of waste collectors, traders and dismantlers, but it is unregulated. This sector makes financial gain through re-use refurbishment and recycling and operates on low-infrastructure without formal equipment(s). The primary research conducted by Digital Empowerment Foundation (DEF) identifies that in this value chain, each player makes at least 10 per cent profit. This means that there is enough incentive already built in the system, which kills the formal collection process due to less profitable revenue model as compared to the informal sector.

Interestingly, the informal waste recycling centres and dismantlers are functioning right in the outskirts

of metro cities such as Delhi, Mumbai, Bangalore, Chennai and Kolkata. These informal collectors usually pay fair amount for the waste collecting the waste as compared to formal collectors (Gunsilius, 2010). Moreover, waste collectors offer door-to-door pick up service, which is more convenient for consumers who don't have to engage in any formal paperwork. Similarly, other stakeholders in this value chain process, aggregators are able to sell it to dismantlers without any paperwork (Li, Park, & Demirbilek, 2012). Most of people working in the informal sector are migrant and unskilled workers from backward states such as Uttar Pradesh, Bihar, and West Bengal, as per the DEF research finding. Another study by (Sinha, Mahesh, & Donders, 2011) too corroborates the fact that migrant workers mostly come from the mentioned states or are Bangladeshi migrants.

A Study by (Turaga & Bhaskar, 2017) lists eight pointer identifying the prevalence of informal workforce

in India: 1) reluctance to pay for disposal by customers for their E-waste; 2) illegal import of large quantity of second E-waste from developed countries; 3) lack of awareness amongst informal sector of the potential hazards of E-waste; 4) lack of proper management of E-waste; 6) absence of effective take back programs for end-of-life electronics; 7) lack of incentives in E-waste management and 8) improper implementation of E-waste policy.

## Health and Environmental Hazards Due to Informal E-Waste Recycling

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Since the E-waste is blend of plastic, chemical and metals, the improper handling of E-waste is detrimental not only to the environment but also to human life. It poses serious threats to health of workers working informally in these sectors. Often these hazards arise due to improper recycling and disposal processes that are in practice in developing countries like India and

Bangladesh. Various studies have shown E-waste are dismantled using crude techniques mentioned below:

1. Physical dismantling using tools such as hammers, chisels, screw drivers and bare hands to separate different materials;
2. Removing components from printed circuit boards by heating over coal-fired grills;
3. Stripping of metals in open-pit acid baths to recover gold and other metals;
4. Burning plastic cables to recover metals such as copper and further burning unwanted materials in the open air;
5. Disposing unsalvageable materials in fields and riverbanks.

Disposed E-waste as landfills produces contaminated leachates, which eventually pollute the groundwater. Burning of metals and chemical extraction are reasons of atmospheric pollution, while melting computer chips, if acids and sludge are disposed on the

ground causes acidification of soil. Dissolving chemical extraction and disposing recycling waste in rivers contaminates the water, which in result leads to shortage of drinking water. One of the most dangerous consequence is caused by plastics burnt in the open-air to recover copper and other metals. It does not only affect the local environment but also broader global air currents.

Various studies have shown adverse effect of E-waste on workers' health. Any E-waste consists of 26% plastic element that generates organic pollutants once burnt in open air. Lead, one of the most commonly used heavy metal used in computer and television screens, can cause vomiting, diarrhea, coma or even death, affecting brain, kidney and nervous system even through a short-term exposure. It is much more dangerous for children as it impacts intellectual development, behaviour, size and hearing skills. Moreover, lead can cause severe damage in case of pregnancy, it can cross the placenta and affect the

unborn child (Wong, et al., 2007). Studies have shown that female worker in dismantling workshops, who are exposed to high levels of lead, suffer more miscarriages and give stillbirths (Huo, Peng, Xu, , Zheng, , & Qiu, 2007).

The study by (Wath, Vaidya , Chakrabarti, & Dutt, 2010) states that informal sector in India is labour intensive where most of recovery and recycling operations are carried out using outdated technologies and processes. This, as a result, leads to release of uncontrolled emission of pollutants.

## Regulating the Informal Sector

The integration of informal sector and formal sector is a challenge in developing countries. It is essential to recognise the role and contribution of the informal sector that will add substantial value to the economy. There is also a need to create awareness about environmental issues with them ( Gerdes & Gunsilius , 2010). More than 70% of workers

in Seelampur and Moradabad have not attended school<sup>25</sup>. In our society, waste workers are considered blue collar jobs that has a social stigma attached to it and are vulnerable to oppression. They are perceived as untrustworthy, irresponsible and street people, who still don't have social acceptance by other class of people (Snel, 1999). Thus, they are yet not completely accepted by the formal sector, including municipalities and private waste aggregators.

To regulate the informal sector, it is necessary to dovetail the activities of informal and formal sector for providing mutual benefits to each other. For integrating both the sectors, the process involved in E-waste management needs to be enhanced not only in terms of collecting waste and recyclable recovery rates, but it needs to reduce the overall management costs. For instance, if the material is recovered from waste collector at the household itself, there will be

<sup>25</sup> Based on the primary data collection by DEF

no cost of collection, transportation and disposal. The savings on transportation depends on the point at which material is removed from the waste stream for recycling. So, if the material is recovered at the disposal site, not only the transportation cost will be reduced but overall disposal cost will be reduced too. Thus, engaging informal sector in recycling activities in a more channelised manner, it will also create environmental benefits for municipalities and enable them to achieve their recycling targets. The move will also help in reducing landfills, which are occupied by the E-waste. Similarly, it will also reduce the extraction of raw materials and return secondary raw material to the production cycle resulting in less energy consumption for recycling processes as compared to production that entails raw materials. It has been proven that informal sector recovery scores are better than formal sector because it reduces the use of fossil energy as most of informal sector activities rely on manual or animal labour rather than on using machinery (Dhillon & Sandhu, 2017).

## Recommendations

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E-waste management is a serious global concern and informal sector plays vital role in the process. One of the major constraint is flawed implementation of E-waste Management Rules that has failed at engaging the informal sector. The study identifies that presently both the formal and informal sectors are working in isolation. Various environmental and health concerns are also raised due to unethical practices such as acid bathing, dismantling in an open area, using bare minimum devices to dismantle metals, etc., by the informal sector. However, considering informal sector reach, its strong network, high collection rates, the study lists out a set of recommendations that can lead to effective management of E-waste in the country:

1. E-Waste regulation should build on the existing practices and informal actors. Creating inclusive and formal-informal hybrid models that can add significant value and increase efficiency gains in models that integrate small-scale and informal enterprises. In order to create hybrid

model where recycled goods enter formal, it is required to clean channels, close the gap in price differences for E-waste between formal and informal sectors.

2. Simpler policies need to be designed that are practical in terms of implementation and takes in account realities of the existing E-waste markets and shapes them for better E-waste management. Proactive incentives will encourage E-waste markets to comply with well-intentioned environmental, health and safety principles. Incentives are particularly important, given the cost and logistical difficulty in punitive enforcement of regulations. Importing of E-waste from developed countries including US, Australia and European countries need to be stopped.
  3. Engage municipalities to support inclusive E-waste models and provide local resources while defining E-waste Management policies. Dismantling, storage and processing requires space and small vendors and informal waste collectors do not have that much space to store.
- This is one of the reasons that dismantling work is cluttered and haphazard because there is little room for segregation of metals and compartmentalising it in ways that could be more organised. Municipalities can also reduce weighty bureaucracy surrounding formalisation. Local authorities and municipalities should be proactive rather than reactive in driving this forward.
4. Public awareness and building educational programmes are required at every stage of the supply-chain till the consumers to make them understand the benefits of clean and safe disposal of E-waste. Educating children who are actively involved in E-waste processing creates E-experts for future generation who can handle the hazardous waste and turn them into valuable resources.
  5. The need to ensure that there is monitoring of health and environmental conditions of informal E-waste hubs in the country so that people who are employed there get compensation for ill-effects of waste disposal on their

health. There is also a need to ensure that producers of electronic material are held liable for environmental toxicity caused by the unethical practices.

6. There should be better cooperation and trust between key stakeholders-- manufacturers, regulators, policymakers and informal recyclers-- who are critical to make EPR-style systems work. Government, NGOs and E-waste businesses could encourage manufacturers to engage in developing pilot models that includes both the informal and formal sectors, ensuring E-waste is disposed via clean channels. To have an effective policy implementation, it is vital to work with leading manufacturers to explore the financial options for addressing the price differences between 'clean' versus 'dirty' channels.
7. There is an urgent need to ensure that a stringent monitoring and enforcement channel is at place to look after the provisions of the E-waste Rules 2018. It is essential to have transparency in the disposal and recycling process of E-waste.
8. Post-consumed recycling of electrical and electronic goods will not be enough to deal with the issue. Electrical and electronic companies need to repair the products they sell, something has to be mandated by law in some jurisdiction under its 'repair policy'. When a product is no longer used, we can apply 'reverse supply chain process'. In this process, the material needs to be collected and sent back to the producers unlike the forward supply chain. However, the movement and processing of materials are not subsidised by the value of a finished product laden with features. In fact, they must rely on the value of raw materials only and therefore demand that a reverse supply chain be developed, further ensuring safe and responsible disposal of materials.

# CONCLUSION

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The E-waste sector in India is categorised as a highly dynamic market with a high degree of fragmentation. Some of the issues are overlapped in the system and process of E-waste recycling, for example the existing policy framework is not uniform for all stakeholders. Similarly, it does not specify the role of different stakeholders, including dismantlers, waste aggregators and collectors from informal sector. Moreover, it does not define any mandatory requirements for the specific activities conducted by stakeholders. Most of these actions are also not justified because there is no reward or incentive for following compliances and government norms neither there is a punitive action against the erring units. These regulations are explicitly designed for infrastructure management of E-waste but there is no framework at place to verify whether these regulations are

implemented properly or not. It has been proven by various studies that implementation of regulations is vital for the success of any policy.

The mushrooming of E-waste businesses in small pockets of tier II and tier III cities reflect that metro cities like Delhi, Mumbai, Bangalore, etc. are only becoming hub of aggregating and trading of E-waste. The informal E-waste segment is not regulated and it is growing because of the lack of their engagement and acknowledgement in the overall E-waste management system. However, there is a strong linkage between formal and informal sector as 90% of E-waste collection and dismantling work are done by workers of informal sector.

It is, hence, responsibility of the government to turn away the flow of E-waste from informal sector to formal sector by developing efficient incentive-based system

for E-waste dismantlers and collectors. Developing a better understanding of informal recycling and supporting policies for the informal sector that will result to create job opportunities and safe environment for low-skilled workers. Further, there is need

to create a system framework for awareness and providing technical training to workers of informal sector to handle WEEE, so that they can obtain better environmental performance without sacrificing the economic and social benefits.

# BIBLIOGRAPHY

---

Annamalai, J. (2015). Occupational health hazards related to informal recycling of Ewaste in India: An overview Jayapradha. Sathyabama University, Department of Chemical Engineering, Chennai.

---

Awasthi, A. K., & Li, J. (2017). Management of electrical and electronic waste: A comparative evaluation of China and India. *Renewable and Sustainable Energy Reviews*.

---

Baldé, C. P. (2015 a). E-waste statistics: Guidelines on classifications, reporting and indicators. Bonn, Germany, United Nations University, IAS - SCYCLE.

---

Borthakur, A., & Sinha, K. (n.d.). Electronic waste management in India: A stakeholder's perspective. *Electronic Green Journal* 1, 36.

---

Cahill, R., Grimes, S., & Wilson, D. (2011). Review article: Extended producer responsibility for

packaging wastes and WEEE – a comparison of implementation and the role of local authorities across Europe. *Waste Management & Research* , 29 (5), 455-479.

---

Chatterjee, S., & Kumar, K. (2009). Effective electronic waste management and recycling process involving formal and non-formal sectors. *International Journal of Physical Sciences*, 893-905.

---

Dhillon , J., & Sandhu , V. (2017). Integrating the Activities of Informal and Formal Sector in E-Waste Management: Potential Benefits and Challenges. *International Journal of Latest Technology in Engineering, Management & Applied Science* , VI (VII), 133-136.

---

Dwivedy, M., & Mittal, R. K. (2012). An investigation into e-waste flows in India. *Journal of Cleaner Production*.

---

E-Waste in India. (2011). Secretariat R.S. New Delhi: India Research Unit

(Larrdis): Rajya Sabha Secretariat.

---

Gerdes, P., & Gunsilius, E. (2010). The Waste Experts: Enabling Conditions for Informal Sector Integration in Solid Waste Management. Lessons Learned from Brazil, Egypt and India. GTZ.

---

Gunsilius, E. (2010). Role of the informal sector in solid waste management and enabling conditions for its integration experiences from GTZ.

---

Huo, X., Peng, L., Xu, X., Zheng, L., & Qiu, B. (2007). Elevated Blood Lead Levels of Children in Guiyu, an Electronic Waste Recycling Town in China. *Environ Health Perspect*, 115(7), 1113–1117.

---

Jain, A. (2008). 'Global e-waste growth' in Rakesh Johri, *E-waste: Implications, regulations and management in India and current global best practices*. TERI, New Delhi.

---

Khan, S. A. (2014). *Differentiating EEE products and Wastes*. United Nations University.

---

Li, X., Park, M., & Demirbilek, O. (2012). Comparison of Informal and Regulated WEEE Collection Methods in China. *International Conference on Environmental, Biomedical and Biotechnology*, 41. Singapore.

---

M., I., S., H., & Kim, J. (2017). E-waste flows, resource recovery and improvement of legal framework in Pakistan.

---

Manomaivibool, P., Lindhqvist, T., & Tojo, N. (2007). *Extended Producer Responsibility in a Non-OECD Context: The management of waste electrical and electronic equipment in India*. IEEE, Lund University.

---

Pathak, P., Srivastava, R., & Ojasvi. (2017). Assessment of legislation and practices for sustainable management of waste electric and electronic equipment in India. *Renewable & Sustainable Energy Reviews* 78, pp. 220-243.

---

Rajya Sabha. (2011). *E-waste in India. Briefing to members of Parliament*, Rajya Sabha Secretariat, New Delhi.

---

Resources, Conservation and Recycling . 125, 131-138.

---

Schedule 3 of Hazardous Waste (Management & Handling) Amendment Rules 2003.

---

Sinha, S., Mahesh, P., & Donders, E. (2011). Waste electrical and electronic equipment. The EU and India: sharing best practices.

---

Snel, M. (1999). Integration of the formal and informal sector — waste disposal in Hyderabad, India. *Waterlines*, 17 (3), 27-30.

---

Song, Q, Wang, Z., Li, Duan, H., Yu, D., & Zeng, X. (2017). Characterizing the transboundary movements of UEEE/WEEE: Is Macau a regional transfer center? *Journal of Cleaner Production*, 157, 243-253.

---

Turaga, R. M., & Bhaskar, K. (2017). India's E-Waste Rules and Their Impact on E-Waste Management Practices: A Case Study . *Journal of Industrial Ecology*.

---

Wath, S., Vaidya , A. N., Chakrabarti, T., & Dutt, P. S. (2010). A roadmap

for development of sustainable E-waste management system in India. *Science of The Total Environment*, 409 (1), 19-31.

---

Widmer, R., Oswald-Krapf, H., Sinha-Khetriwal, D., Schnellmann, M., & Böni, H. (2005). Global perspectives on e-waste', *Environmental Impact Assessment Review*. 25, 436–458.

---

Wong, M. H., Wu, S. C., Deng, W. J., Yu, X. Z., Luo, Q., Leung, A. O., et al. (2007). Export of toxic chemicals e A review of the case of uncontrolled electronic-waste recycling. *Environmental Pollution* , 149, 131-140.

---

Xinwen, C., Porte, M. S., Wang, M. Y., & Reuter, M. A. (2011). Informal Electronic Waste Recycling: A Sector Review with Special Focus on China. *Waste Management* , 31 (4), 731-42.

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India is the fifth largest producer of E-waste in the world. It currently generates 1.8 million metric tonnes of E-waste per annum which is expected to grow to 5.2 million metric tonnes by 2020. The volume of E-waste in India is growing at a compound annual growth rate of 30% with 95% of it recycled through the informal sector and only 5% recycled through formal recyclers. The Green Prakriya research and advocacy project aimed to identify the gaps between policy and social reality. It delved deep into the world of men, women, children and families who form a part of India's informal E-waste sector in Seelampur (New Delhi), Moradabad (Uttar Pradesh), and Saki Naka (Mumbai) to understand risks inherent in their precarious livelihoods and how these must be factored into policy-making processes for a inclusive, equitable, and sustainable future.

