



E-WASTE MANAGEMENT

POLICY ANALYSIS AND IMPLEMENTATION



ABOUT PPF

Policy Perspectives Foundation (PPF) was founded in 2005 as a non-profit apolitical think tank on matters of national interest and issues. The organization's activities focus on complex and inter-connected challenges to internal peace, stability and development in India. It promotes debates and dialogues with scholars, development practitioners, civil society, government organizations and other stakeholders, and implements training, research and advocacy programs on issues of national interest. Our activities broadly fall under three categories namely spreading awareness, building capacity and promoting resilience.

Policy Perspective Foundation

L1/19A, Kaushalya Park
Hauz Khas Enclave
New Delhi- 110016



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Manika Malhotra

The PPF – Centre for Cohesive Society Studies

Policy Perspectives Foundaton

L1/19A, Kaushalya Park, Hauz Khas Enclave, New Delhi-110016

FOREWORD

E-waste is a burgeoning problem globally. According to a UN Report (2018), approximately 48.5 million tonnes of e-waste was generated worldwide. India generates around 2 million tonnes of e-waste and already figures amongst the top five countries generating e-waste. It is predicted that India's 'production' of e-waste may go up to an estimated 5.2 million tonnes per annum by 2020 with annual growth rate (CAGR) of about 30 per cent. There are several international initiatives that are addressing global e-waste management as well as issues relating to environmental pollution due to e-waste. All segments of our society are exposed in varying degrees to the danger. Children are particularly vulnerable to the health risks from e-waste exposure and, therefore, would need to be specially protected. A 2013 study by Lancet, the British medical journal, had pointed towards change of thyroid function, changes in cellular expression and function, adverse neonatal outcomes, changes in temperament and behavior, and decreased lung function as amongst possible outcomes of exposure to e-waste.

With greater digitalisation this challenge will increase further as electronic gadgets multiply in our lives. For example, frequent launch of mobiles models and their variants is a stark example of prolific growth of gadgets. Internet of things whose numbers are globally expected to reach 25 billion is another worrying trend. Rapid generation of e-waste is a huge challenge to cope with. Both Government and other stakeholders need to realize the seriousness of this challenge in terms of all its dimensions. While rules have been framed to keep a check on e-waste management, there are real deficits in their implementation on the ground. This is a serious concern and needs concerted efforts and appropriate measure from both Government and other stakeholders for addressing e-waste and other facets of its management. The study 'E-waste management: Policy analysis and implementation' brought out by the PPF – Centre for Cohesive Society Studies is very timely. E-waste is the toxic companion of digital era. One cannot escape it in the present gadget loving age.

I am sure this monograph will convince many of this generation that merely demanding better legislation and their passage is not enough but collective action is required to protect human life and environment from hazards of e-waste. Even though small civil groups are raising awareness and undertaking self- help to manage e-waste at local levels but these are not commensurate with the magnitude and severity of the problem. Such initiatives are laudable but there is also a need for effective implementation of perfectly logical and sensible legislations in this regard. The author through this study has brought to the fore the deficits in implementation of the existing policies and suggested measures that will strengthen the management of e-waste and mitigation of hazards from irresponsible practices on the ground.

I am happy to present this monograph to a wider readership. The reason is not only that the subject is of critical importance to us all-which it indeed is- but also because Ms Manika, the author – all of 25 years and fresh out of University – brings a reassurance that our next generation is committed and would persist their efforts to 'right' some of the 'wrongs' that endanger the future of earth. I hope she would continue her commitment to the environmental causes. I wish her good luck and a bright future!

PC Haldar

President PPF, New Delhi, January 2020

ACKNOWLEDGMENTS

The revolutionary shift in information and communication sector has brought about enormous changes in the way we organize our lives, economies, industries and institutions. At the same time, it has also resulted in manifold challenges. One of the challenges, which the above process has given rise to, is the massive amount of end of life electronic products or 'e-waste'. Explosive growth of electronic gadgets poses a serious and potent challenge of e-waste management and disposal. Therefore, handling it is a looming challenge. India is witnessing a positive shift in its policy perspectives towards managing e-waste. While the policy intends to suggest practices which ensure maximum recovery and minimum unsafe disposal, the ground level realities indicate dominance of informal processing and material recovery.

It was during the master's program at TERI school of Advanced Studies, my alma mater, I developed curiosity to know and explore the post-usage journey of our broken, obsolete and outdated electronics and I quantitatively assessed Willingness To Pay (WTP) of consumers for getting their e-waste recycled. My interest in the subject prompted me to delve into the e-waste management legislation and procedural systems in India. The study titled 'E-Waste Management: Policy Analysis and Implementation' is therefore a descriptive study which provides useful insights on e-waste policy, processes and its implementation on ground in Delhi/NCR.

A project of this kind is difficult to accomplish without the support and encouragement of a number of people and institutions.

I would specially like to thank Policy Perspectives Foundation (PPF) for taking interest in the subject and understanding the magnitude of the issue. Sincere gratitude to PPF core committee members, their views and suggestions enriched the report. Moreover, I would like to thank all the respondents, stakeholders and experts who took out their valuable time to share insightful views and comments to strengthen the report. I gratefully acknowledge their timely contribution in helping us understand the varied challenges and complexities involved in 'E-waste Management'. I owe a debt of gratitude to: Mr. Bharat Bhushan Nagar, Waste Management Consultant- IPE Global Limited; Mr. Kamlesh Pathak, Green Works Consulting; Mr. Pranshu Singhal, Founder Karo Sambhav; Mr. Rahul Mallik, Associate Director, Waste Management Advisory, Pwc; Dr. Sanchita Jindal, Former advisor to Ministry of Environment and Forest (MoEF); Mr. Satish Sinha, Associate Director Toxics Link; Mr. Shekhar Sharma, Director Hindustan E-waste and Mr. Ulhas Parlikar, Former Director Geocycle India.

Finally, I would like to extend my deepest thanks to my colleagues and friends at Policy Perspectives Foundation for their contributions in successful completion of the report. Special thanks to Dr. Anil Kumar Das and Dr. Swati Srivastava for their concerted efforts in review and finalization of the document.

We hope the findings of this study will prove to be helpful to students, practitioners, program implementers and policy makers in the area of e-waste management.

Manika Malhotra
New Delhi, January 2020

LIST OF ABBREVIATIONS

ARF	Advance Recycling Fee
CFC	Chlorofluorocarbons
CPCB	Central Pollution Control Board
CRT	Cathode Ray Tubes
DPCC	Delhi Pollution Control Committee
DTH	Direct-to-home
EDMC	East District Municipal Corporation
EEE	Electrical and Electronic waste
EPR	Extended Producer Responsibility
EWM	E-Waste Management
ICT	Information and Communication Technology
MoEF	Ministry of Environment and Forestry
NCR	National Capital Region
NDMC	North Delhi Municipal Corporation
PBDE	Polybrominated diphenyl ethers
PRO	Producer Responsibility Organization
WEEE	Waste Electrical and Electronic Equipment
TSDF	Treatment, Storage and Disposal Facility
SDMC	South Delhi Municipal Corporation
SPCB	State Pollution Control Boar

EXECUTIVE SUMMARY

End of life electronics, also known as e-waste, is one of the growing waste streams globally. Waste Management has been an area of focus since years; however the perceived agency of individuals in terms of categorizing the constituents of 'waste' seems to be limited. The need for 'e-waste' management arises along with its generation. The consumer is the purchaser of electronics as well as the generator of e-waste. However, inadequate awareness and knowledge on the subject tends to determine their recycling behavior. India, which is the fifth largest producer of e-waste, formulated its first e-waste policy in 2011. The present study focuses on Delhi as it holds a critical position because e-waste continues to be illegally processed in various informal units in Delhi/NCR. A large amount of e-waste from other cities also lands up in the capital for further processing because many areas in Delhi/NCR act as 'e-waste processing hubs'. E-waste poses an imminent threat to the environment and to human health, especially to those individuals who are physically associated in handling the same. Therefore, it is important to address the management and disposal of e-waste in a safe and efficient manner through collaborative efforts of government and civil society. It is equally crucial to protect the livelihood of the informal sector workers. Towards creating a sustainable environment, the need of the hour is therefore to reinforce effective collection & recycling system for e-waste and make it responsive to the pressing needs of dealing with hazardous waste.

Objectives and Focus

In the light of emerging e-waste crisis in India, this study intends to ascertain the position of Delhi vis-à-vis other major Indian cities with regard to generation and management of e-waste, identify effects of e-waste on human health and environment and measure the extent of people's awareness of these harmful effects. The study also intends to critically examine the policies and programs being implemented in Delhi/NCR to locate specific initiatives and identify the challenges to effective management and disposal of e-waste.

Methodology

This is a descriptive research that seeks to understand the magnitude of e-waste generation and its effects; factors that contribute to e-waste generation; challenges associated with its management; and roles of different stakeholders. The study employed primary and secondary sources of data. The research team conducted a comprehensive review of available literature on the topic. To collect primary data, interactions with multiple stakeholders were conducted including primary end users, recyclers, producer responsibility organizations among others. The inputs gathered from different sources were both qualitative and quantitative in nature. The data from different sources enabled triangulation of findings and contributed to quality of analyses.

Salient Findings

The study brings to the fore following key issues and findings:

1. Lack of 'circularity' in designing electronics: planned obsolescence

Electronic products nowadays are 'designed to use and throw' and are not meant to be repaired. There is little regard of environmental safety and the real intent is to make profits for which the producers 'create' this obsolescence. These companies are promoting purchase of new electronics by introducing newer versions at small and frequent intervals. They do not offer economical alternative to extend life span of products along with warranty thereby taking away consumers' basic 'right to repair'. A consumer is then indirectly 'forced' to dispose their dysfunctional electronics and purchase new ones.

2. Inadequate consumer awareness

Inadequate awareness amongst respondents is one of the major reasons for adopting 'informal collection services'. Consumers though willing, lack adequate information to channelize their e-waste to appropriate waste management set up. They are not aware about the existing collection services offered for the purpose. Findings also reveal that respondents perceive the role of educational institutions and government authorities to be most critical in generating awareness on the issue.

3. Reverse logistics: informal sector dominance

The informal sector plays a pivotal role in e-waste sector as it has an edge in terms of reaching out to the end use consumers. On the other hand, law is silent on recognizing their presence because of its 'illegality' as the material flows for e-waste cannot be traced once it reaches in the hands of the informal sector. Due to their low operating cost and better pricing mechanism, they manage to collect e-waste from consumers and further selling it to informal dismantlers. Thus, informal cycle of e-waste continues to thrive.

4. Ambiguity in the system

The real irony is that on one hand the 'e-waste' policy doesn't consider the activities of the informal sector as 'legal'; on the other hand, supply of e-waste attracts 5 per cent GST rate¹. This has indirectly allowed various informal sector players to trade in e-waste by moving it from one city to another by simply paying the GST to ensure legal compliance. For instance, by paying 5 per cent GST an informal trader can transport e-waste from other cities to Delhi in a legally compliant manner.

5. Gaps in infrastructure and technological constraints

There is a deficiency in the existing infrastructure for e-waste management with huge gap between present collection & recycling facilities vis-à-vis quantum of e-waste being generated. There is lack of legitimate and cost-effective collection mechanisms to channelize waste from consumers into the formal segment. Also the formal sector further lacks cost-effective technology to recycle various metals present in e-waste. In India,

¹ Press Information Bureau, Government of India, Ministry of Finance, 10-November-2017 <https://pib.gov.in/newsite/PrintRelease.aspx?relid=173406>, accessed on 16th June 2019



the technologies available at present are meant mainly for recovering and recycling components like glass etc. but not metals from e-waste. Absence of advanced and cost effective technology to recycle e-waste and ban on its export may actually increase informal processing.

6. Financial constraints

Recycling facilities are facing difficulties to sustain their business due to high operational & technology costs incurred in recycling e-waste. Many companies are carrying out their operations under debt and some have also shut down. Besides existing firms, startup companies also find it difficult to acquire loan from banks under MSME and other schemes as there is no separate schematic provision for 'e-waste' or for 'waste management' which may streamline the process.

7. Data gaps and weak monitoring system

Data gaps at several points in the e-waste value chain complicate the task of estimating and managing these obsolete electronics. There is lack of disaggregated data available on volume of e-waste generated by commercial users and households, e-waste collected in a particular year and entering into recycling/re use facility. In order to ensure structured disposal of e-waste, strong monitoring is required. However, at present, a number of unauthorized repair facilities are operating in the localities of Delhi/NCR. Besides e-waste collected and sold by the informal collectors/kabadiwalas, many authorized dismantlers/recyclers are also selling waste to the informal sector, in complete violation of the law thus making monitoring of e-waste management challenging.

Recommendations

The study findings establish that e-waste accumulation and its proper disposal is a serious problem particularly in urban India. To address this problem, the study posits following recommendations.

1. Mainstreaming the problem of 'e-waste disposal'

- Initiating dialogue between the concerned ministries and stakeholders for collectively discussing strategies and solution for effective e-waste management such as costs of setting up waste treatment facilities, providing capital subsidy to companies to introduce adequate technology to recycle e-waste in India etc.
- Ensuring stringent implementation of the existing EPR mechanism, if necessary, by levying a small user charge on the consumer at the time of purchase. This would enable the producers to strengthen the collection and recycling activities of existing notified companies through an appropriate procedural framework.
- Standardizing e-waste value chain through a common 'digital system' to ensure greater transparency.
- Mainstreaming 'informal sector' to prevent illegal, hazardous and unauthorized e-waste disposal practices by providing them with appropriate incentives. Thus, integrating them in the hierarchy of collectors and in the logistics system. Stimulating capacity building of informal workers through financial assistance or training subsidy.
- Introducing special skill development programs on safe handling and processing for various stakeholders in the e-waste value chain.



2. Strengthening reverse logistics chain

- Introducing Reverse Supply Chain Management to facilitate better collection by assigning 'drop off locations' at shopping malls and universities.
- Designing mobile applications which provide consumers an option to track the entire 'journey' of their e-waste and notifying them when it reaches the concerned collection center/recycling facility or warehouse.
- Expanding the role of 'Urban Local bodies' in collection of e-waste in order to reach end use consumers.
- Ensuring effective recovery of e-waste by setting 'recovery targets' to ensure both efficiency and transparency.
- Adopting standardized technology to meet the set environmental standards and ensure safe disposal of hazardous materials which are a byproduct of the recovery process.
- Strengthening monitoring of EPR plans for collection processes adopted by producers such as e-waste exchange, collection centers etc.

3. Improving infrastructure

- Providing assistance to authorized manufacturers and recyclers in procuring land in industrial spaces in NCR to set up warehouses for proper storage of e-waste.
- Providing subsidy or incentives to compliant stakeholders for procuring technology and equipment for recycling of e-waste.
- Creating appropriate infrastructure system to promote segregation and recycling of complex and hazardous e-waste constituents such as 'CFL lamps' and 'tube lights'.

4. Awareness generation

- Generating greater awareness amongst consumers to ensure efficient channelization of e-waste. The role of RWA needs to be emphasized to encourage and sensitize people at the community level.
- Using public media to enhance awareness on the issue. Repeated advertisements in newspapers as well as electronic mediums in the form of jingles and short story type ads and revealing images of e-waste processing sites.
- Including dangers and toxicity from e-waste in academic curriculum in the form of compulsory chapters and projects in schools.
- Designing special academic modules on e-waste management as a crucial component in professional and vocational courses such as material management, Electronics, IT and Environmental engineering.
- Sensitizing students undergoing short-term vocational courses such as mobile/electronic repair about the relevant aspects of e-waste management legislation.

5. Ensuring circularity' in e-waste sector

- Promoting product redesigning, rationalization of input control and adherence to green procurement practices.
- Assessing feasibility of introducing carbon 'reduction' targets in e-waste recycling based on identified standard methodology of calculation.

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I INTRODUCTION

Electronic waste (e-waste) or Waste Electrical and Electronic Equipment (WEEE), a recent addition to the hazardous waste stream, is drawing attention across the globe as the quantum of such waste is rising rapidly. Electrical and Electronic Equipment (EEE) covers a broad spectrum of products used by businesses and other consumers. Such equipment, on completion of its useful life, contributes to the e-waste stream. It consists of many hazardous substances like lead, cadmium and mercury etc., which are dangerous to both humans and environment. Therefore, a proper recycling mechanism ensuring conscious channelization and efficient disposal of e-waste not just ensures sustainability of environment but also induces various economic benefits.

Digitization has played a major role in transforming activities in various sectors like education, healthcare, entertainment and the entire production and market system, while facilitating trade on global front. With technological developments, dependence of people on electronic products has increased. They have become indispensable part of daily living. Despite offering tremendous advantages and opening up new avenues for innovations and opportunities, they have resulted in accumulation of massive amount of hazardous and other wastes generated from electronic products. Thus, it is time to 'reset' the current consumption and disposal system of electronic products to break the vicious cycle of 'Consume-Collect-Recover-Dispose' model resulting in unbridled accumulation of e-waste in the environment.

Given this context, Policy Perspectives Foundation conducted a study on e-waste Management: Policy Analysis and Implementation. The following sections describe the need, objectives, methodology and methods of data collection.

Objectives

The key objectives of the study are to:

- Ascertain the position of Delhi/NCR vis-à-vis other major Indian cities with regard to generation and management of e-waste
- Identify the plausible sources that generate e-waste
- Understand effects of e-waste on human health and environment
- Measure the extent of people's awareness on the harmful effects of e-waste
- Critically examine the policies and programs being implemented for management of e-waste
- Identify the challenges to effective management of e-waste

Methodology

This is a descriptive research that seeks to understand the magnitude of e-waste generation and its effects; factors that contribute to e-waste generation; challenges associated with its management; and roles of different stakeholders. The study employed primary and secondary sources of data. The research team conducted a comprehensive review of available literature on the topic. To collect primary data, interactions with multiple stakeholders were conducted including end users, recyclers, producer responsibility organizations among others. The inputs gathered from different sources were both qualitative and quantitative in nature. The data from different sources enabled triangulation of findings and contributed to quality of analyses. Key methods of data collection and analysis are elaborated below.

Methods for Data Collection

- Desk research
- Interviews of people including bulk and end use consumers
- Key informant interviews (KIIs) covering experts in the area of waste management
- KIIs covering stakeholders engaged in e-waste management
- Field observation

Desk research: A comprehensive desk research was conducted to collect secondary information available in the public domain on generation, processing and management of e-waste. Various sources were consulted for secondary review including news reports, study reports, articles, and other publications on the topic. Information and data was collected on volume of e-waste generated by different cities, sources of e-waste, its effects, existing policies and programs. The desk research guided the development and fine-tuning of tools for primary data collection.

Interviews of end use consumers: Interviews were conducted with end use consumers to assess their awareness on the issue of e-waste. A sample of 100 respondents was randomly selected for these interviews. A structured online interview schedule was administered to collect data from these respondents.

Key informant interviews (KIIs) with experts in the area of waste management:

The purpose of conducting these interviews was to, inter alia, understand the level of implementation of existing laws, policies and programs on e-waste in terms of technological, economical and regulatory aspects. Semi-structured interviews were conducted with purposively selected respondents via email and telephonically.

KIIs with stakeholders engaged in e-waste management: To understand the efficacy of e-waste management on the ground and the role played by various stakeholders in this process, KIIs were conducted. Employing a semi-structured interview schedule comprising open and close-ended questions, face to face interviews were conducted with randomly selected respondents involved in e-waste value chain.

Field observation: During visits to stakeholders like manufacturers, recyclers and informal processing sites, the researcher observed their work environment, safety measures in



place, potential or real signs of adverse effects of e-waste and other components of functioning.

Methods for Data Analysis

The completed interview schedules and research notes were cleaned and scrutinized to iron out and rectify inconsistencies. Following this, data cleaning, data entry and analysis were done with the help of MS Excel. Data analysis was conducted using frequency and pivot tables for data aggregations. Qualitative inputs and responses were analyzed through thematic clustering. Based on the research objectives, the responses were clustered under key themes, wherever feasible, data have been presented in tables, charts and text boxes.

Justification and Relevance

This study aims to understand and analyze the supply chain and reverse logistics for e-waste in India. It intends to ascertain the ground realities in terms of implementation of the present E-Waste Policy 2016 (amended in 2018) based on the interactions with range of stakeholders who play a crucial role in ensuring efficient e-waste management. The study presents views of the stakeholders in order to trace specific constraints to their functioning and to ensure convergence of their respective responsibilities as per the e-waste legislation in India. The existing publications in this field, some of which are presented below, provide valuable insights on 'e-waste' magnitude and management.

Toxics link (2003). Scrapping the hi-tech myth: Computer waste in India. New Delhi

The study highlights the grievous situation of dumping of 'computer waste' in India by other countries. It was published before introduction of e-waste legislation in India and thus, highlighted the need to have specific laws to deal with the concerned issue and specially 'imports of e-waste' as it comes in mixed with other categories of computers, including second hand computers as donations which makes it difficult to check and monitor its entry into the country. **TERI (2008) E-waste: Implications, regulations, and management in India and current global best practice.** New Delhi. The book focuses on discussing some of the critical issues in the context of 'e-waste management' and also covers international best practices and regulations on e-waste. It discusses various recycling technologies for e-waste and is a comprehensive handbook for professionals, PC manufacturing companies, IT companies, ministries, corporates, policymakers, researchers, engineering colleges, schools, NGOs and recyclers of old materials.

Bandyopadhyay Amitava (2008), A regulatory approach for e-waste management:

A cross-national review of current practice and policy with an assessment and policy recommendation for the Indian perspective. This paper attempts to make an assessment of the Indian perspective on handling e-waste through a cross-national review of current practices and policies. It also addresses policy and legislations on e-waste in transition economies. **Rajya Sabha (2011). E-waste in India.** The report comprehensively discusses the crucial components of 'e-waste' generation in India and associated environmental and health concerns. It highlights the e-waste recycling economy in the thriving informal and the nascent formal sectors and also looks at the global trade in e-waste and the international experiences in the area.



TERI (2014). Understanding public knowledge and awareness on e-waste in an urban setting in India a case study for Delhi New Delhi. The study intended to understand people's perception about the genesis of e-waste and designing customized awareness programs for addressing its management effectively. **Centre for science and environment (2015) Recommendations to address the issues of Informal Sector Involved in E-waste Handling.** The study traces the journey of Printed Circuit Boards (PCBs) to Moradabad and the role of Delhi in processing the same. It also highlights the metal recovery process adopted by informal recyclers and the extent of the problem of 'e-waste' in Moradabad. **Toxics Link (2019) Informal E-waste Recycling In Delhi.** This recent study by Toxics Link makes an effort to evaluate the scenario of informal e-waste processing hotspots in Delhi/NCR. The findings of the study validate existence of nearly 15 major e-waste processing hotspots in Delhi which also serve as the source of livelihood to more than 50,000 informal workers. The study highlights the prevalent dominance of informal recycling in Delhi/NCR post two years of introduction E-Waste rules 2016.

Given this context, the present study intends to identify the complexities involved in e-waste management and challenges in effective implementation of the legislation. It suggests recommendations to address these challenges in order to ensure safe and efficient recycling and disposal framework for e-waste. It also aims to fill the gaps arising in the life cycle process of e-waste, from the production of electronics to generation of e-waste and finally looking into the status of reverse logistics in this sector.



BACKGROUND

Although the world is battling with a wide range of environmental and ecological adversities, the hazards of electronic waste, or e-waste, is one of the minimally discussed issues. It is rapidly turning into a worldwide emergency. In order to subdue the negative impacts of e-waste in our general surroundings, it is essential to critically analyze and comprehend the 'actual' problem, the factors that are propelling it and the means by which we can eliminate the challenges and improve the situation.

The overall demand and utilization of "Information and Communication Technology (ICT)" equipment and various other electronic appliances is immensely growing worldwide. An increasing number of such appliances and equipment are discarded because of their short life span, a major reason behind e-waste becoming one of the enormously growing components of waste stream. In 2018, approximately 48.5 MT of e-waste was generated worldwide and India generates about 2 MT of e-waste annually. The amount of e-waste is expected to reach 52.2 MT in 2021, with an annual growth rate of 3 to 4 per cent².

Need for e-waste management

The wellbeing of residents of Delhi and the National Capital Region (NCR) is already an area of concern because of the alarming levels of air pollution in Delhi. Strong linkages have been established between factors like crop burning, vehicular and industrial pollution which deteriorate air quality in the region. The effects of unmanaged waste on the pollution levels and environment, in general, cannot be ignored. A study by Sharma and Dikshit (2016) reported that the incineration and poor waste management practices account for nearly 20–30 per cent emissions causing pollution in the capital. Despite this, landfill fires, incineration and open dumping continue to be the prevalent waste management practices in Delhi³. The problem becomes more acute when the e-waste is burnt and openly dumped. Due to the hazardous components present in the electronic goods, the emissions from burning such waste can be highly detrimental.

² Baldé, Cornelis P., et al. *The global e-waste monitor 2017: Quantities, flows and resources*. United Nations University, International Telecommunication Union, and International Solid Waste Association, 2017 https://collections.unu.edu/eserv/UNU:6341/Global-E-waste_Monitor_2017_-_electronic_single_pages_.pdf

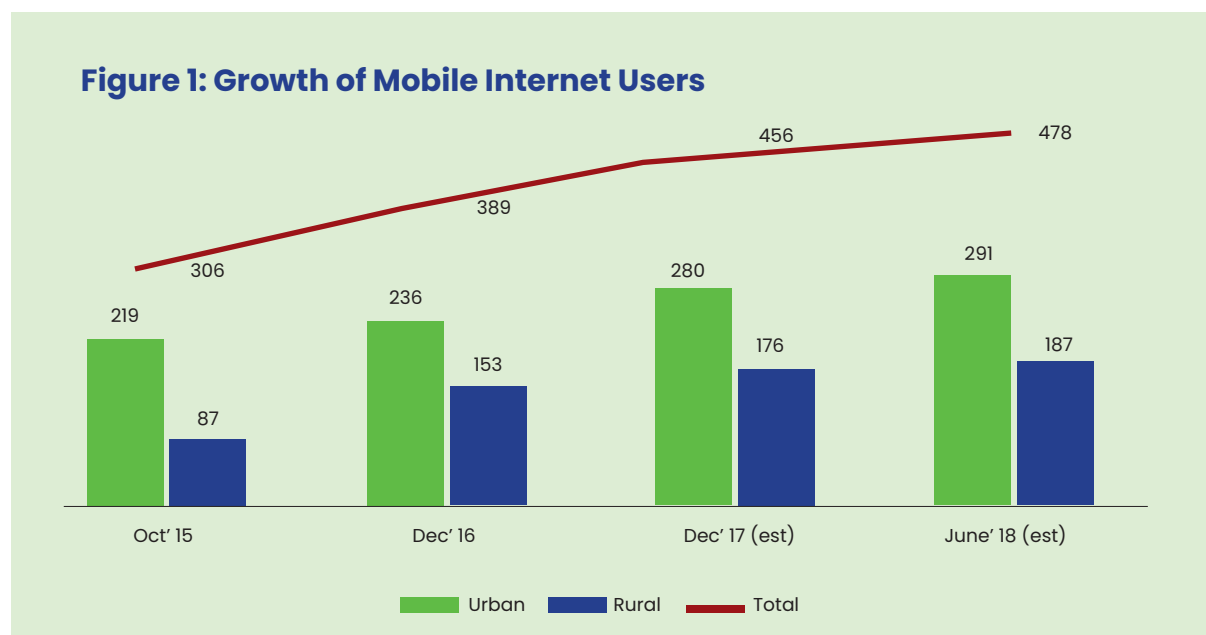
³ Sharma, Mukesh, and Onkar Dikshit. "Comprehensive study on air pollution and green house gases (GHGs) in Delhi." A report submitted to Government of NCT Delhi and DPCC Delhi (2016): 1-334, http://www.indiaenvironmentportal.org.in/files/file/Final_Report.pdf



A World Health Organisation (WHO) Report on air pollution and health revealed that nearly 60,000 children under five years of age in India died because of their exposure to PM 2.5. India witnessed the highest number of such deaths in 2016⁴.

Deteriorating air quality in Delhi is emerging as one of the critical concerns for the residents. The city hardly experiences any 'good' or 'moderate' days as per the Air Quality Index. While there are various immediate health impacts of being exposed to city's pollution, such as fatigue, headache, breathing issues, the additional long term impacts on health of an individual often go unnoticed. Thus, diminishing air quality in Delhi has become one of the major reasons behind 'brain drain' where many qualified professional move out of the city for better quality of living. Keeping other factors constant, residents of Delhi/NCR especially students and working individuals desire to access overseas opportunities for either work or studies because of the deteriorating levels of air quality in the region. E-waste today equally contributes towards deterioration of environment as all other forms of pollution and poor management of e-waste may only add to the present adversities.

Moreover, as the benefits of 'digitization' and digital goods grow, the problem of e-waste has certainly magnified in the past decade. In order to minimize paper trail, various platforms are digitizing their processes. Although half of the country's population is online, as is evident in the increasing rise of internet users, the offline management of their discarded equipment lacks attention.



(Source: IAMAI 2017⁵)

⁴ DeySushmi, TNN, India tops in under-5 deaths due to toxic air (2018) <https://timesofindia.indiatimes.com/india/india-tops-in-under-5-deaths-due-to-toxic-air-60000-killed-in-2016-who/articleshow/66422048.cms>, accessed on November 30, 2018

⁵ Mobile Internet Report, Internet and Mobile Association of India (2013). <https://cms.iamai.in/Content/ResearchPapers/2b08cce4-e571-4cfe-9f8b-86435a12ed17.pdf>



India's digital evolution over the years has been a phase of momentous changes. The government over the last few years has launched several e-government projects such as Bhoomi, CARD, Gyandoot, e-Seva and other lesser known projects. The motivation behind introducing these projects is to utilize Information Communication Technology (ICT) for development of the nation, poverty reduction and improved access to government services. These initiatives are an attempt to bridge the digital divide between the urban and rural population. However, it is imperative to decode the associated challenges posed by digitization. The residual of these initiatives, irrevocable, is the issue of 'e-waste'.

According to a marketing research firm report, 70 per cent DTH subscribers belong to rural areas and towns having a population under a million⁶. Hence, we may no longer consider digitization as an 'urban' phenomenon. This makes it crucial to disseminate the necessary information to the rural sections of the population while making these gadgets readily available to them. It is important to equip them with the methods, which they find easy to comprehend in order to deal with their obsolete electronics.

On the other hand, India is getting ready to upgrade to the next generation of 5G services, envisaged to be deployed in India by 2020. But the magnitude of this transition is huge, the massive increase in the quantum of e-waste generated post 5G, will be unmanageable. There will be millions of electronic gadgets like cell phones, modems which may become outdated and obsolete due to their incompatibility with the 5G technology. It is therefore, a matter of serious concern which demands not only prudence but also preparedness to deal with any byproducts of 5G. Is our country also getting ready to contain such an externality?

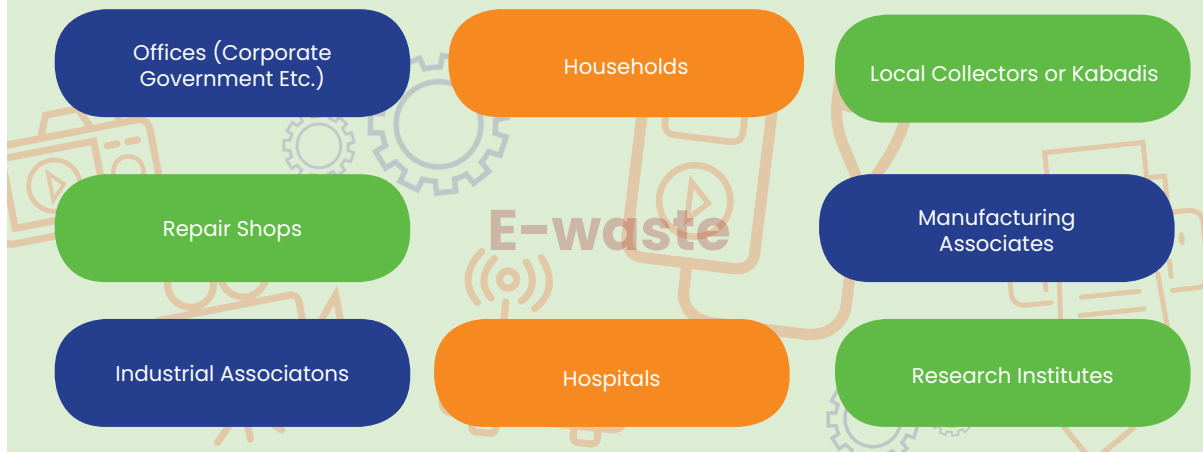
Sources Of E-Waste

E-waste originates from multiple sources mainly corporate, government agencies, commercial establishments, institutions of different types, manufacturers, and individuals. The general practice of e-waste disposal followed by users is to hand it over to the highest bidder, which could be a formal recycler or informal recycler or any local 'Kabadiwalas' (rag pickers). The quantity of e-waste generated may vary depending upon the demography and types of (Electrical and Electronic Equipments) EEEs installations of the establishment. However, main stakeholder as per the Indian scenario is the Kabadiwalas who undertake door to door collection of e-waste. The Government along with industrial sectors of the public and private partners are amongst the main contributors of e-waste.

⁶ Rural, small town India has 70 per cent DTH users, January 20 (2013) https://www.business-standard.com/article/companies/rural-small-town-india-has-70-dth-users-109090700091_1.html, accessed on 6th February 2019



Figure 2: Sources of E-waste Generation



The e-waste received from different sources predominantly comprises of televisions, desktops, servers and mobile phones. Other appliances like refrigerator, air conditioner, music system, recorder, ovens etc. also contribute towards e-waste generation but less in quantity as their life is more and their use is limited in the society.

Understanding the E-waste Management Value chain in India

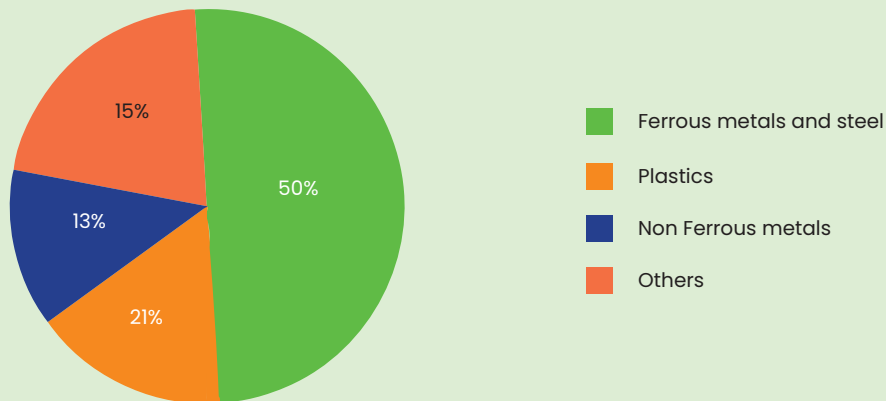
The traditional e-waste value chain in India is based on 'Consume-Collect-Recover-Dispose' model.

Introduction of new electrical and electronic items in the market: This stage concerns the developments in the ICT sector. New electronic goods are either manufactured by producers in the country or are imported from the other countries. There are a limited number of stakeholders involved up to this stage, that is, in the generation and production of 'new' electronic equipment.

Generation of electronic (and electrical) waste: A range of other stakeholders add up in the second stage of the e-waste value chain, i.e. generation of 'waste' electronics and electrical equipment. Any electronic item at the end of its life directly falls under the category of e-waste. At this stage, an important role is played by consumers, who could be either domestic or commercial.

Processing of waste electronics and electrical items: Majority of actors involved in this stage belong to the unorganized sector including scrap merchants/dealers, also called "kabadiwala", who may buy electronics from households along with other types of waste such as old newspapers, plastics etc. Despite few formalized interventions in this field, more than 90 per cent of the e-waste still finds its way to the informal sector. The 'kabadiwalas' may sell such waste to the dismantlers or informal recyclers who extract materials which could be reused like copper, gold etc. and the leftover waste is either disposed of in an incinerator or in a landfill without taking any precautions.

Figure 3: Resource Potential in E-waste



Source: Chatterjee (2015)⁷

Resource Potential in E-Waste and its Flipside

E-Waste comprises of many valuable subcomponents such as vital metals like copper, gold etc. Thus, for waste industry it holds a lot of resource potential. This is the primary reason informal sector is engaged in illegitimate e-waste handling and processing to generate higher revenues. The framework of practices adopted by informal sector, lack any precautionary measures to control negative consequences of 'recovery process' both on environment and human health.

⁷ Chatterjee.S., Sustainable recycling technology for E-Waste: Deity's Initiatives (2015).
<http://toxicslink.org/docs/e-waste-Deity.pdf>

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EFFECTS ON HEALTH AND ENVIRONMENT

E-waste has significant hidden consequences in terms of adverse environmental and health impacts. These challenges are serious yet distinct from those arising from managing other waste streams because of the substances it comprises. Majority of the e-waste generated in India is handled by the informal sector. The key concern in this regard is the adoption and utilization of primitive methods that causes dual imperilment in the form of health and environmental hazards.

Effects on Health

Release of toxic byproducts from e-waste adversely affects human health. Human body may get exposed to such hazardous substances either through occupational exposure or toxicants polluting the air and food chain etc. Adverse effects of e-waste on health may manifest during the life cycle of an individual or even pass on across generations.

The workers employed in the e-waste sector are highly exposed to toxic and unsafe chemicals and gases. Incineration of e-waste discharges lethal gases in the atmosphere causing respiratory problems and exposure to some of the metals could also result in injuries and death. In numerous nations, women and children represent at least 30 per cent of the workforce in the informal sector and therefore, are vulnerable to severe health problems. The laborers working on the site and their families are amongst the most affected groups. Even the individuals particularly infants, pregnant ladies, elderly, who come in contact with e-waste, are vulnerable to these hazards⁸.

There are potential risks associated with handling certain metals, for example, lead, cadmium, copper, zinc, and chromium which are discharged during e-waste recycling. Lead and Cadmium Sulphide are potential carcinogenic (cancer causing) agents. They can impair the organs and cause serious health issue⁹. Carcinogenic toxic metals are found in the blood stream of informal workers. Table 1 shows some of the hazardous substances in e-waste, their sources and their **impacts on human health**.

A study by Grant et al. (2013) found that the average height of children near the informal recycling sites was considerably short in comparison to those at the control sites (sites free from such practices).

⁸ Grant, Kristen, P. D., Brune et al. "Health consequences of exposure to e-waste: a systematic review." *The Lancet Global Health* 1.6 (2013): e350–e361. <https://www.sciencedirect.com/science/article/pii/S2214109X13701013>

⁹ Zheng, Jing, et al. "Heavy metals in food, house dust, and water from an e-waste recycling area in South China and the potential risk to human health." *Ecotoxicology and environmental safety* 96 (2013): 205–212 <https://www.sciencedirect.com/science/article/abs/pii/S0147651313002595?via%3Dihub>



Exposure to these chemicals has irreversible negative effects on neuro-developmental and neuro-behavioral aspects in infants. In addition, exposure to hazardous substances like PBDE (Poly Brominated Diphenyl ethers), lead and cadmium result in significant neuro-developmental disabilities and infirmities and diminished IQ. It also adversely influences reproductive development and fertility among women⁸.

Table 1: Environmental and Health Consequences due to E-waste Handling

Substance	Occurrence in e-waste	Environmental and Health Relevance
Halogenated Compounds		
PCB (polychlorinated biphenyls)	Condensers, transformers	Cause cancer, effects on the immune system, reproductive system, nervous system, endocrine system and other health effects, persistent and bio accumulatable
TBBA (tetrabromo-bisphenol- A)	Fire retardants for plastics (thermoplastic components, cable insulation) TBBA is presently the most widely used flame retardant in printing wiring boards and covers for components	Can cause long term period injuries to health, acutely poisonous when burnt
Chlorofluorocarbon (CFC)	Cooling unit, insulation foam	Combustion of halogenated substances may cause toxic emissions
PVC (Polyvinyl chloride)	Cable insulation	High temperature processing of cables may release chlorine which is converted into diocins and furans
Heavy metals and other metals		
Arsenic	Small quantities in the form of gallium arsenide within light emitting diodes	Acutely poisonous and on a long term perspective injurious to health.
Barium	Getters in CRT	May develop explosive gases (hydrogen) if wetted
Beryllium	Power supply boxes which contain silicon controlled rectifiers, beamline components	Harmful if inhaled
Cadmium	Rechargeable NiCd- batteries, fluorescent layer (CRT screens) printer inks and toners, photocopying machines (photo drums)	Acutely poisonous and injurious to health on a long term perspective.



Substance	Occurrence in e-waste	Environmental and Health Relevance
Chromium VI	Data tapes, floppy disks	Acutely poisonous and injurious to health and causes allergic reactions.
Gallium arsenide	Light emitting Diode (LED)	Injurious to health
Lead	CRT screens, batteries, printed wiring boards	Causes damage to nervous system, circulatory system, kidneys, causes learning disabilities in children
Lithium	Li- batteries	May develop explosive gases (hydrogen) if wetted
Mercury	Is found in the fluorescent lamps that provide backlighting in LCDs, in some alkaline batteries and mercury wetted switches	Acutely poisonous and injurious to health on a long term perspective
Nickel	Rechargeable NiCd- batteries or NiMH- batteries, electron gun in CRT.	May cause allergic reactions
Rare earth elements (Yttrium, Europium)	Fluorescent layer (CRT-screen)	Irritates skin and eyes
Selenium	Older photocopying machines (photo drums)	Exposure to high levels may cause adverse health effects.
Zinc sulphide	Is used on the interior of a CRT screen, mixed with rare earth metals.	Toxic when inhaled
Others		
Toxic organic substances	Condensers, liquid crystal display	
Toner Dust	Toner cartridges for laser printers/ copiers	Health risk when dust is inhaled along with risk of explosion.
Radioactive substances Americium	Medical equipment, fire detectors, active sensing element in smoke detectors	May cause cancer when inhaled

(Source: Report on Assessment of Electronic Wastes in Mumbai-Pune Area- MPCB, March 2007¹⁰, 88)

¹⁰ Maharashtra Pollution Control Board, Report on Assessment of Electronic Wastes in Mumbai-Pune Area- MPCB, March (2007), http://mahenvs.nic.in/pdf/Databank/issues_ewaste.pdf



Effects on Environment

The **environmental concerns** are equally appalling, as there is an enormous risk associated with dumping such items into landfills or incinerators allowing them to enter atmosphere as well as water streams. Most of which appertain to the alarming amount of lead that is dispersed into groundwater via landfills. CRTs when burnt, it emanates dangerous fumes into the air. Cadmium in land fill sites causes substantial contamination with unavoidable medium and long term impacts on the soil. Developing nations lead in terms of utilizing primitive recycling techniques causing adverse effects to the environment. For instance, in many regions of Africa, open smoldering of hazardous substances, incineration and landfilling are common practices. In towns, situated along the waterways where heaps of e-waste are dumped and blazed, individuals unaware of the consequences end up utilizing the stream water for drinking, preparing meals and for washing purpose¹¹.

In the Indian context, an assessment of Mandoli and Krishna Nagar Area in East Delhi revealed the magnitude of heavy metal contamination of soil and groundwater. The leachate created by unauthorized recycling units contained a huge amount of heavy metals like lead, copper and cadmium which pollute the groundwater and soil in the area. It was found that drinking water was 28 times lower than threshold safety limits making it highly unsafe for drinking¹². The unauthorized recycling of e-waste though banned in Delhi is still widespread in specific places of the city on a huge scale.

'E-Waste Hubs' In Delhi



(Courtesy: Manika, PPF)

¹¹ Frazzoli, Chiara, et al. "Diagnostic health risk assessment of electronic waste on the general population in developing countries' scenarios." *Environmental Impact Assessment Review* 30.6 (2010): 388-399 <https://www.sciencedirect.com/science/article/abs/pii/S0195925509001486?via%3Dihub>

¹² Panwar, Rashmi Makkar, and Sirajuddin Ahmed. "Assessment of contamination of soil and groundwater due to e-waste handling." *CURRENT SCIENCE* 114.1 (2018): 166. <http://www.indiaenvironmentportal.org.in/files/file/groundwater%20pollution%20e%20waste%20Delhi.pdf>

This section provides a brief description of the dismal state of work environment in which 95 per cent of the recycling activities in Delhi are carried out as less than 5 per cent of e-waste finds its way to the formal sector. In view of the complex composition of electronics, it therefore, becomes essential to track its reverse logistics to understand where these items land up, once they are labeled as 'waste'.

One such markets, also colloquially known as the "world's dumping yard" is Seelampur, located in East Delhi. This place is surrounded by stacks of motherboards, CRT screens, hard drives and all sorts of segregated and desegregated electronics and electrical items. The sight of utilizing primitive techniques and unauthorized practices to recycle this waste is prevalent in every nook and corner of this place. The workers involved in this informal process are themselves not formally trained individuals or specialists. They are slum residents whose ancestors have passed on the traditional occupation to handle these discarded items which works as an imaginary green card for them to engage in these practices as soon as they reach a permissible age. This age bar is usually not defined as per the cognitive ability or physical strength of an individual to be able to deal with harmful chemicals and complex recycling practices but may actually be enforced upon the child as soon as he is able to reciprocate to the surrounding. A major portion of dismantling and recycling activities are undertaken by women and children who are not equipped with any safety or protective gear. Workers though aware of the hazards are not really concerned about their long term health as they struggle earning a livelihood. For them, monetary benefit outweighs the additional costs in terms of diminishing health and productivity. Workers also have an instilled belief that the amount of money they manage to earn from this business sitting at their homes is better than what they would earn in any formal setup. Surprisingly, the authorities claim to be unaware of any such practices taking place in Seelampur or other areas like Turkman Gate, Shastri Nagar etc.

Like Seelampur, livelihood of thousands of men, women and children depends upon the India's unorganized e-waste recycling sector. Thus, their choice of adopting such practices to recycle e-waste is not contingent upon the magnitude of hazards associated with it, but on the monetary benefits they expect to receive.

Owing to these environmental and health costs, there is a dire need to safely recycle and process e-waste while ensuring integration of informal actors.



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LEGISLATIVE AND REGULATORY FRAMEWORK FOR E-WASTE

In the 21st Century, waste management is a cross cutting challenge that affects different aspects of an economy.

Global Overview

On the global front, strong linkages of e-waste with a range of issues including environment, health and climate change etc. have been recognized. Resultantly, more than 67 nations have introduced legislations to tackle e-waste. However, there are some countries that still do not have any e-waste legislations. In some regions of Africa, Latin America and South-East Asia, electronic waste is not yet addressed as an issue of critical concern, and is less emphasized in the formal agendas¹³.

The framework which regulates the trans-boundary movements of e-waste is the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, 1989 which has been ratified by 187 countries. One of the major objectives of Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes. The Convention places restriction on trans-boundary movement of hazardous wastes such as e-waste. There are similar regional conventions as well. However, illegal movement of e-waste to developing countries continues to be a major global challenge. To avoid detection by authorities, various illegitimate practices are adopted to export e-waste to other countries. It was reported, that nearly 1.3 million tons of obsolete electronics are annually shipped from Europe in an illicit manner¹⁴.

There have been several legislative developments by many nations in the past decade. China, a developing economy outperforming Japan, European Union and USA in terms of introducing new technologies, generates nearly “1.1million tons” of e-waste every year. The Chinese government has introduced various measures such as restriction on imports of discarded electronics, implementation of the “Technical Policy on Pollution Prevention and Control of Waste Electric and Electronic products (2006) and Administrative Measures (2007)”. China has also presented a licensing plan for ensuring legitimate e-waste recycling by those firms which are unapproved and not registered. Besides the legislative requirements, the municipalities in China have also made independent efforts to increase e-waste collection at the community level. A brief review of the collection system in Dalian, China is presented at the end of this section.

¹³ World Economic Forum, *A New Circular Vision for Electronics Time for a Global Reboot* (2019) <https://static1.squarespace.com/static/5c3f456fa2772cd16721224a/t/5c48930b0e2e728dfff44df3/1548260175610/New+Vision+for+Electronics-+Final.pdf>

¹⁴ Pariatamby, Agamuthu and Dennis Victor. “Policy trends of e-waste management in Asia.” *Journal of Material Cycles and Waste Management* 15.4 (2013): 411-419 <https://link.springer.com/article/10.1007/s10163-013-0136-7>

Switzerland has accomplished an efficient policy framework to control the management of the waste electronics. The collection of e-waste in Switzerland follows a mechanism of secured financing through method of 'Advance Recycling Fee'. This takes the form of user charge which is applicable on every electronic item; the funds are then utilized to pay for the transportation and recycling facilities¹⁵.

Government of Bangladesh is planning to introduce a cash-back policy for consumers to provide them with incentive to return their obsolete electronics to the manufacturers and distributors.

Pakistan currently has no inventory or exact data on e-waste generation, but they have made provisions to prohibit imports. However, many such items are still being imported to Pakistan as second-hand items. On the other hand, some nations are showcasing immense enthusiasm and interest to locate solutions to tackle the challenge. There is effective coordination within these nations along with support from private businesses. For instance a facility in UAE is being set up as the largest center of expertise for e-waste Management in the Middle East.¹⁶

The regulatory framework for e-waste in Europe is governed by WEEE Directive. The directive includes provisions for collection and processing system for e-waste. Many European countries have started enacting an 'all actors report' model which requires various stakeholders like recyclers, refurbishers, dealers, besides those involved in the producer compliance programs to individually register the quantum of e-waste collected.¹⁷

The USA provides a number of options to its residents to drop their e-waste to some permanent collection points, conducts special drop of events and so on¹⁸. Likewise, Government agencies in Japan in coordination with several enterprises, have set up nearly 380 collection points and 38 e-waste treatment plants. The residents have a choice to either drop their electronics at these points or hand over to the retailers¹⁹.

¹⁵ Sinha-Khetriwal, Deepali, Philipp Kraeuchi and Markus Schwaninger. "A comparison of electronic waste recycling in Switzerland and in India" *Environmental Impact Assessment Review* 25.5 (2005): 492-504. https://s3.amazonaws.com/academia.edu.documents/46748191/A_comparison_of_electronic_waste_recycling_in_Switzerland_and_in_India.pdf?response-content-disposition=inline%3B%20filename%3DA_comparison_of_electronic_waste_recycli.pdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAIWOWYYGZ2Y53UL3A%2F20200116%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Date=20200116T162304Z&X-Amz-Expires=3600&X-Amz-SignedHeaders=host&X-Amz-Signature=06fddb103b6de6e82ce93e1fbb4c0ca4707b593ab4d4e2d492a70e259c03e105

¹⁶ Global-e-waste Monitor Report, *Regional e-waste Status and Trends* (2017) <https://www.itu.int/en/ITU-D/Climate-Change/Documents/GEM%202017/Global-E-waste%20Monitor%202017%20-%20Chapter%2010.pdf>

¹⁷ World Economic Forum, *A New Circular Vision for Electronics Time for a Global Reboot* (2019) <https://static1.squarespace.com/static/5c3f456fa2772cd16721224a/t/5c48930b0e2e728dfff44df3/1548260175610/New+Vision+for+Electronics+-+Final.pdf>

¹⁸ Kang, H., Schoenung, J., 2005. *Electronic waste recycling: a review of U.S. infrastructure and technology options. Resources, Conservation and Recycling* 45 (4), 368e400 https://edisciplinas.usp.br/pluginfile.php/336462/mod_resource/content/3/Electronic%20Waste%20Recycling.pdf

¹⁹ Sakai, S., Ikematsu, T., Hirai, Y., Yoshida, H., 2008. Unit-charging programs for municipal solid waste in Japan. *Waste Management* 28 (12), 2815e2825. <https://www.semanticscholar.org/paper/Unit-charging-programs-for-municipal-solid-waste-in-Sakai-Ikematsu/2207df7d7d061b7a74348d4c6e674311af45fef4>

Box 1: Brief Review of Collection System in Dalian China²⁰

The Dalian Municipal Government took two major initiatives which brought changes in their e-waste collection system. The First Program, called the “Governmental Green Procurement”, was designed for engaging with the public institutions that plan to discard their existing obsolete devices such as desktops, printers or wish to replace them with new ones. Under this initiative, the municipal government allowed a specialized e-waste treatment company (Dongtai) to sign contracts with several public institutions, universities, hospitals etc. for e-waste treatment. Eventually, a number of state owned companies also tied up with Dongtai to protect their green image.

Similarly, to initiate e-waste collection from households, the Dalian Municipal Government introduced another program in 2008, called as the “Green Communities” program to encourage public participation and collective action at community level. Various types of collection exercises were purposely organized on weekends to ensure higher public participation rates in the ‘logistical and operational activities’. To incentivize and motivate the residents, the municipal government provided them with mini rewards such as towels and portable radios etc. Twenty e-waste collection points were set up whereas, 57 ‘green community committees’ were formed during this program. These have been operating effectively since then. The collected waste under this program was also sent to Dongtai for further processing.

Another noteworthy initiative of Chinese Central Government is the “buy a new one with a used one” program, initiated in 2009. The program compensated the buyers by providing them with heavy discounts if they brought an old home appliance at the time of new purchase. The program ran for around 3 years.

Given the large population of countries like India and China (both of which have national e-waste regulations in place), official policies and legislation currently cover around 4.8 billion people, which is 66 per cent of the world population as opposed to 44 per cent in 2014²¹.

However, the mere existence of policies or legislation may not directly correlate with its successful enforcement or operation of sufficient e-waste management systems.

²⁰ Qu, Ying, et al. “A review of developing an e-wastes collection system in Dalian, China.” *Journal of Cleaner Production* 52 (2013): 176–184. https://s3.amazonaws.com/academia.edu.documents/39678055/A_review_of_developing_an_e-wastes_colle20151104-22646-y7bjm8.pdf?response-content-disposition=inline%3B%20filename%3DA_review_of_developing_an_e-wastes_colle.pdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAIWOWYYGZ2Y53UL3A%2F20200116%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Date=20200116T162930Z&X-Amz-Expires=3600&X-Amz-SignedHeaders=host&X-Amz-Signature=ccc5bf51f6cff82bd7e770dc6e84797f42bbbe13e15d370318601a04ecff5c40

²¹ See footnote ref. 2



Evolution Of E-Waste Legislation In India

Prior to 2010, e-waste Management in India was covered under Hazardous Wastes (Management and Handling) Rules, 1989 (amendments made in 2003 and 2008). First set of E-Waste Rules were drafted in India in 2010 that came into effect in 2012. The Rules identified the critical stakeholders in the e-waste value chain and enlisted the authorization and registration requirements for stakeholders such as producers, recyclers and dismantlers. Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB) were designated as the monitoring agencies for the implementation of the concerned Rules. An important component of the 2011 Rules was the introduction of Extended Producer responsibility (EPR)²², a global strategy, based on the concept of 'polluter pays' principle, wherein the producer is responsible for disposal of its products once consumers discard them²³.

The second set of Rules was released in 2016, which were amended in 2018. E-Waste Rules 2016 are more comprehensive and broadly explain the procedure to seek authorization by specific stakeholders. Most of the missing aspects were covered in the new E-Waste rules (2016), which have introduced new dimensions, along with promoting 'product stewardship'. Additions have been made to the list of (discarded) electrical & and electronic equipments which are to be considered as waste e.g. CFL etc. Various other stakeholders have been covered and have a special mention in the new rules. These include Manufacturers, Dealers, Refurbishers and Producer Responsibility Organizations (PROs). More flexibility has been provided for setting up PROs or adopting a Deposit Refund Scheme to ensure effective implementation of EPR. The rules have introduced a collection based approach and have stipulated phase-wise collection targets²⁴ for producers either in number or weight. The Rules also prescribe penalty to manufacturers and producers in case of non-compliance, providing much broader scope for effective management.

The producers are now required to frame and submit EPR Plan to CPCB at the time of authorization. The Plan must include details of schemes and mechanisms adopted by the producers for collection and channelization of e-waste. The producers have also been granted with an optional choice where they can charge an extra amount from consumers at the time of sale of electronics, but will have to refund the same at the time consumer returns for disposing the product. The concerned scheme is known as '**Deposit Refund Scheme**'. The option of adopting Deposit Refund scheme at state level was first introduced in 2011. However, not many producers have adopted this mechanism. The take back policy in India is adhered to by some technology giants such as Apple, Microsoft etc. at their production plants. Two brands stand out as having the best take back practice in India- HCL and WIPRO. Other brands that do relatively well are Nokia, Acer, Motorola and LG²⁵.

²² This concept was first described by Thomas Lindqvist for the Swedish Government in 1990.

²³ Implementation of E-Waste Rules 2011, Guidelines, (2011). <https://cpcb.nic.in/displaypdf.php?id=aHdtZC9JbXBsaWllbnRhdGlvbktVtV2FzdGUucGRm>

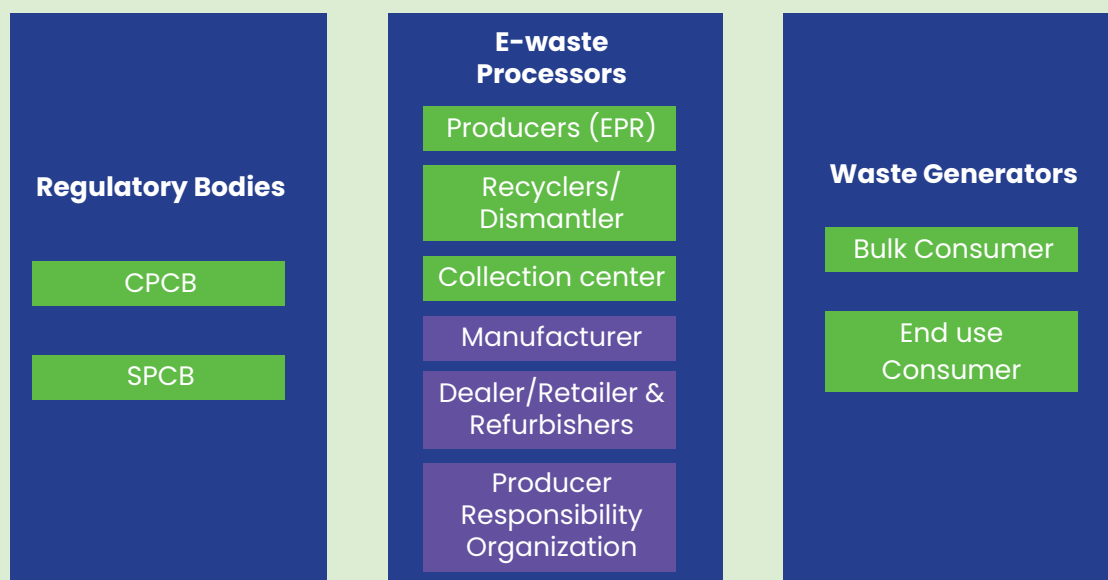
²⁴ 30 percent for the first two years, progressively going up to 70 per cent in the seventh year of the rule.

²⁵ Begum, K. J. "Electronic waste (e-waste) management in India: A review" *IOSR Journal of Humanities and Social Science (IOSR-JHSS)* 10.4 (2013): 46-57. <https://pdfs.semanticscholar.org/8cda/238ee8d21bce26473728308a6ce7e6db186f.pdf>

Figure 4: Stakeholders as per E-Waste Rules 2011



Figure 5: Stakeholders as per E-Waste Rules 2016



The responsibility for e-waste management falls under the purview of different stakeholders including the State Government and the Urban Local Bodies (ULBs). More broadly, Department of Industry in the state (or any other government authorized agency) has to ensure earmarking or allocation of industrial space or shed for e-waste dismantling and recycling in the existing and upcoming industrial park, estate and clusters. Further, Department of Labour (or any other government authorized agency) has to ascertain recognition and registration of workers involved in dismantling and recycling, provide assistance in the formation of groups of workers involved in dismantling and recycling, undertake annual monitoring and ensure safety & health of workers.

Further, State Government is also required to prepare an integrated plan of these provisions and submit an annual report to the Ministry of Environment, Forest and Climate Change. Apart from this, each state is mandated to prepare its e-waste inventory which would assist SPCB to monitor & regulate e-waste Management as per E-Waste Rules.

Responsibilities for SPCB²⁶ include:

- Inventorisation of e-waste
- Grant authorization to e-waste manufacturers, dismantlers, recyclers and refurbishers.
- Monitoring compliance of EPR and take action against violation of rules
- Conducting random inspection of dismantler or recyclers or refurbishers

On similar lines, CPCB is required to further coordinate with the State PCBs and ensure implementation. The ULBs on the other hand have been assigned the duty to collect and channelize orphan products to authorized dismantlers or recyclers.

Policy and Systemic Deficiencies

Government in India has put a ban on imports of e-waste in the country as per the Hazardous and Other Waste Rules, 2018²⁷. However, there are many loopholes in the legislation because of which exporters from other nations, pave their way through. India's Exim Policy doesn't provide any Exim code for trading in "second hand computers" for either donating or re sale. This allows clubbing of new computers with the used ones under the same code allowing scope for developed nations to channelize and dump their e-waste in India.

Similarly, there is prohibition on the import of hazardous waste or other wastes. However, the description of the toxicity or hazardous nature of a product is ambiguous, as a developing country, India is not yet equipped with a structured mechanism to test and monitor the same. The E-Waste Rules though comprehensive have serious concerns in terms of implementation.

According to Ministry of Environment and Forestry (MoEF), e-waste is getting generated at a 10 percent annual growth rate which is one of the highest in the world. India's environment, therefore, faces a serious threat. Following the Supreme Court directions, states built a number of hazardous waste laws and hazardous waste disposal facilities in the last few years. However, a CAG report of 2008, found that over 75 percent of state bodies were not implementing these laws²⁸. Another CAG Report of 2015²⁹ indicated weak coordination of CPCB with the SPCBs on various aspects. Further, it noted that out of 34 state bodies, not more than 18 SPCBs were submitting their yearly reports to Central Board.

Due to these constraints, some of which are still prevalent even after eight years of release of E-Waste Rules 2011 & three years of E-Waste Rules 2016, the country struggles to manage its e-waste.

²⁶ E-Waste Management Rules (2016). <http://greene.gov.in/wp-content/uploads/2018/01/EWM-Rules-2016-english-23.03.2016.pdf>

²⁷ The Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016 released on 04th April, 2016 regulate the import and export of wastes in the country. As per these rules no import of hazardous and other wastes from any country to India for disposal is permitted. Import of e-waste into the country is prohibited under these Rules.

²⁸ Rajya Sabha Report (2011). https://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf

²⁹ Chapter 7, Ministry of Environment and Forests, Compliance Scientific department report (2015). https://cag.gov.in/sites/default/files/audit_report_files/Union_Compliance_Scientific_Departmen_Report_30_2015_chap_7.pdf

Indian Policy Trends: State-wise Analysis

The national legislations have established an overarching framework for e-waste management in India. However, considering the great geographical extent of India, the role of the state(s) cannot be neglected in effective recycling of e-waste in different parts of the country.

Sixty-five cities in India contribute more than 60 per cent and 10 states generate 70 per cent of the total WEEE in the country. Maharashtra ranks first followed by Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab in the list of WEEE/e-waste generating states in India. Among top ten cities generating WEEE/e-waste, Mumbai ranks first followed by Delhi, Bangalore, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat and Nagpur.

Table 2: Top 10 E-waste Generating States

S. No	State	WEEE (Tonnes)	Percentage
1.	Maharashtra	20270.59	18.49
2.	Tamil Nadu	13486.24	12.30
3.	Andhra Pradesh	12780.33	11.66
4.	Uttar Pradesh	10381.11	9.47
5.	West Bengal	10059.36	9.18
6.	Delhi	9729.15	8.87
7.	Karnataka	9118.74	8.32
8.	Gujarat	8994.33	8.20
9.	Madhya Pradesh	7800.62	7.11
10.	Punjab	6958.46	6.35

(Source: Begum 2013³⁰, 5)

While northern India is not a leading generator, it happens to be a leading processor of e-waste. Surprisingly, southern and western India together accounts not more than 0.02 per cent of the total recycling rate in the country.

³⁰ See footnote ref. 25



Table 3: Top 10 E-waste Generating Cities

S. No.	Cities	WEEE (Tones)	Percentage
1.	Mumbai	11017.1	24.0
2.	Delhi	9730.3	21.21
3.	Bangalore	4648.4	10.13
4.	Chennai	4132.2	9.00
5.	Kolkata	4025.3	8.77
6.	Ahmedabad	3287.5	7.16
7.	Hyderabad	2833.5	6.17
8.	Pune	2584.2	5.63
9.	Surat	1836.5	4.00
10.	Nagpur	1768.9	3.85

(Source: Begum 2013³¹, 6)

Delhi is not just the second largest generator, but also a major dumping ground for e-waste. Not just (international) trans-boundary e-waste enters Delhi, other major states also dump their e-waste in the capital. The NCR is the “preferred recycling destination” for other major cities like Mumbai³².

Not many states have drafted a separate state level policy for e-waste. Telangana launched a comprehensive set of policies in 2017 for managing its e-waste. The Policy was framed in consultation with the Telangana State Pollution Control Board and laid emphasis on creating awareness and nurturing a culture of reusing and recycling. The vision of these policies is to assist transition of unsafe ‘informal’ sector into ‘organized’ sector through several initiatives. The policy creates a level playing field for the stakeholders in this sector by proposing various incentivization schemes. The salient aspects of the policy have been discussed in text Box 2.

³¹ See footnote ref. 25

³² Toxic Link, WEEE: other side of the digital revolution (2007). http://toxicslink.org/docs/06184_ewaste.pdf, accessed on 9th June 2019

Box 2: Telangana-E-Waste Management Policy 2017³³

Some of the salient aspects proposed in the state's e-waste policy:

- Promotion of refurbished goods
- Records of e-waste generated by bulk consumers
- Mobile and web application to be set up for consumers
- Collection centers to be set up in coordination with SPCB and Greater Hyderabad Municipal Corporation (GHMC) in residential areas, commercial complexes, retail outlets and educational institutes etc.
- Conversion of unorganized sector to organized sector by introducing vocational training programs to skill the current informal sector workers

Various incentives proposed for recyclers, dismantlers and collection centers:

- 'Capital intensive subsidy' shall be provided (under certain terms and conditions) to the first five recyclers, refurbishers, collection centers and dismantlers
- 'Subsidy on lease rentals' (25 per cent) shall be applicable for each company, the first three years of operations with maximum subsidy fixed at INR 5 lakh
- 'Training subsidy' of INR 1000/month shall be provided for a maximum of 1000 people
- 'Subsidy on purchase of refurbished products' (10 per cent of total expenditure incurred on purchase of refurbished goods) to be provided to bulk consumers subject to a minimum of 100 units procured and maximum subsidy of INR 2 lakh

Tamil Nadu also proposed an E-Waste policy in 2009-10, even before the first set of E-Waste Rules were released, the Government entrusted the tasks of managing e-waste to Electronics Corporation of Tamil Nadu Limited (ELCOT). On comparing the Tamil Nadu policy with the E-Waste Rules, 2011, the former covered some of the aspects more extensively. However, in practice, the recycling rate of Tamil Nadu in the present day is severely low which reveals that not much has been done in terms of executing the policy. The Tamil Nadu Pollution Control Board (TNPCB) has proposed to prepare an inventory of e-waste generated in the State, which they believe would allow them to target the issue in an efficient manner. Tamil Nadu has also recently rolled out a state wide policy for solid waste management in July 2018. The Municipal Administration of the state has been very active in ensuring its effective implementation, which demands special attention. The salient features of the Tamil Nadu Policy for Solid Waste have been summarized in Box 3.

³³ Telangana E-Waste Management Policy (2017). <https://www.telangana.gov.in/PDFDocuments/Telangana-e-Waste-Management-Policy-2017.pdf>



Box 3: Takeaways From (Solid Waste Scenario Of) Tamil Nadu

Door to door collection of unmixed waste is a useful practice adopted in Tamil Nadu. The households are required to separate their dry and wet waste and also ensure that they only provide their wet waste on a regular basis as dry waste is only to be given once a week. Initially there were a large number of defaulters, but the state took proactive steps to address non-compliance. Over 3000 communicators have been appointed, under different supervisors who are responsible to locate the defaulters, contact them and explain to them, the importance and procedure of waste segregation and ensure that they do not appear in the defaulter's list again. Students, majority of female volunteers, just out of school are appointed and assigned the task of visiting different households once a week and are also provided monthly remuneration for conducting weekly assessments. The waste generators also pay user charges of approximately 20 INR, which is added to their property tax, every six months.

The key takeaway for e-waste management from Tamil Nadu experience is waste segregation. Given the complex composition of e-waste, it is extremely crucial what all the states must place special emphasis on segregation of Solid Waste including e-waste. There should be adequate communication of municipalities with the households through campaigns, appointing personnel who telephonically communicate with the residents or pay occasional visits to localities to ensure that no e-waste gets mixed with their day to day waste. Along with promoting segregation, it is important to initiate collection of e-waste from Households

The state has also proposed to estimate the inventory for e-waste in three phases, targeting eight districts in its first phase. Towards the end of which, TNPCB wishes to identify different types of e-waste and prepare a "quantitative database" of its component³⁴. Creation of an enabling environment and behavior change intervention of Tamil Nadu's Municipal Administration offer lessons for other states. These state level good practices when expanded can bring about a nationwide transformation in the waste management scenario.

Some states have not designed specific policy but have taken steps in the desired direction: In Andhra Pradesh, the GVMC (The Greater Municipal Corporation of Vishakhapatnam) arranged e-waste bins all-round the city.

The West Bengal Pollution Control Board conducted an assessment and provided policy recommendations in the domain of e-waste in 2008³⁵. The findings of the study revealed that the computers coming into the recycling market in India were much older

³⁴ Chaitanya SV Krishna, To crackdown on e-waste, Tamil Nadu Pollution Control Board proposes a mega inventory, Indian Express [26th January 2019]. <http://www.newindianexpress.com/states/tamil-nadu/2019/jan/26/to-crackdown-on-e-waste-menace-tnpcb-proposes-a-mega-inventory-1930126.html>, accessed on 7th March 2019

³⁵ Bandyopadhyay, Amitava. "A regulatory approach for e-waste management: a cross-national review of current practice and policy with an assessment and policy recommendation for the Indian perspective." *International Journal of Environment and Waste Management* 2.1-2 (2008): 139-186. https://s3.amazonaws.com/academia.edu.documents/6394294/unpan037142.pdf?response-content-disposition=inline%3B%20filename%3DA_regulatory_approach_for_e-waste_manage.pdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAIWOWYYGZ2Y53UL3A%2F20200121%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Date=20200121T175719Z&X-Amz-Expires=3600&X-Amz-SignedHeaders=host&X-Amz-Signature=25360861c2c13b584f79cfd7ace3ba5038fd9c53ef14c0be0d9a112803e7456b

versions in comparison to the bulk waste (discarded computers) received for recycling in a developed nation like Switzerland. This observation established that useful life of computers is much more in India. People either use products beyond their estimated life span or they donate products which in turn extend the life span or they tend to store their obsolete electronics. The study provided useful insights for e-waste management in the state. To create awareness at the grassroots level, the West Bengal Pollution Control Board (WBPCB) is aimed at translating E-Waste Management Rules 2016 into Bengali.

To effectively ensure adoption of Extended Producer Responsibility the Government of Odisha has directed the producers of electronics to collect/take back the discarded products whilst implementing the Deposit Refund Scheme. The Scheme provides for charging an additional fee to be paid during the purchase of the item which is compensated (with interest), when they return their obsolete electronics.

Kerala is one of the states with no independent recycling facility for e-waste. Since a long time, e-waste collected from Kerala is sent to the plants in Andhra Pradesh and Tamil Nadu for recycling. Clean Kerala Company, a recycling enterprise, formed under the local self-Government Department, Government of Kerala has now taken a step to set up an e-waste dismantling and recycling unit along with an integrated plastic management facility. The recycling unit is proposed to set up at Kuttipuram and Malappuram, whereas four places have been identified to set up collection centers³⁶.

The discussion above shows that some states are ahead of others in taking steps to tackle e-waste. Several initiatives have been taken but they are fragmented in piecemeal. This results in lack of uniformity in state-wide practices and responses for e-waste management. To address this problem, state-specific initiatives to strengthen the implementation of the national e-waste policy are required.

³⁶ Rajagopa Shyama, *Clean Kerala plans e-waste processing centre at Kuttipuram*, *The Hindu* [July 03, 2019] <https://www.thehindu.com/news/national/kerala/clean-kerala-plans-e-waste-processing-centre-at-kuttipuram/article28276707.ece>



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ASSESSMENT OF CONSUMER AWARENESS

Consumers play a very important and dual role in the life cycle of electronics. Firstly, they are the purchasers of electronics and secondly, they are generators of e-waste. It is, therefore, imperative to disseminate proper information to consumers about components of e-waste, dos and don'ts in its handling as well as their role in ensuring its organized disposal. Lack of awareness and the 'value' that consumers in India attach to their obsolete electronics are the major factors which influence their recycling behavior.

In order to assess consumer awareness on policy, hazards of e-waste and other issues, the research team gathered inputs from 100 people of different age groups and occupations ranging from students, academicians, retired professionals to self-employed individuals and private sector employees. The key themes related to consumer awareness probed during the study and the subsequent responses have been presented below.

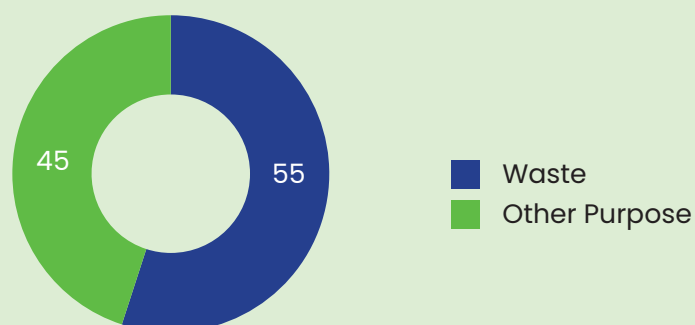
Obsolete Electronics: Waste Or Not?

The responses revealed that nearly 90 per cent of consumers replace their mobile phones or purchase a new one every 4 to 6 years. However, 55 per cent of them consider their obsolete electronics as waste while remaining were in favor of using discarded electronics for some 'other purpose'.

Box 4: Some of the common responses from consumers included:

- How can Electronics be waste, we could sell them and fetch money
- The phones could be re used or donated.
- I haven't sold any discarded piece of electronic items in the last 15 years.
- It can be stored as a backup phone or stand by phone.
- If it is completely scrap, spare parts could be used or it may be sold to scrap dealer.

Figure 6: Obsolete Electronics: Waste or Not?



Amongst those who consider their electronics as waste, only a few of them mentioned about following any structured/proper method of disposing them. Details on methods adopted for disposal have been presented in subsequent sections.

Awareness On Regulatory Environmental Laws For E-Waste

As shown in the figure 7 below, around 51 per cent of the respondents were not aware about existing policy for e-waste, whereas 21 per cent claimed to be somewhat aware in this regard.

Awareness of laws and rules has immense bearing on e-waste management. The Rules deal with responsibilities not only for them, as consumers, but also all the stakeholders who are a part of the e-waste value chain. It works as a manual for any consumer to understand whom do they reach out to hand over their electronics. However, it can be rightly perceived that there has been serious lag in disseminating the required information among the consumers.

Figure 7: Awareness on E-waste Legislation in India

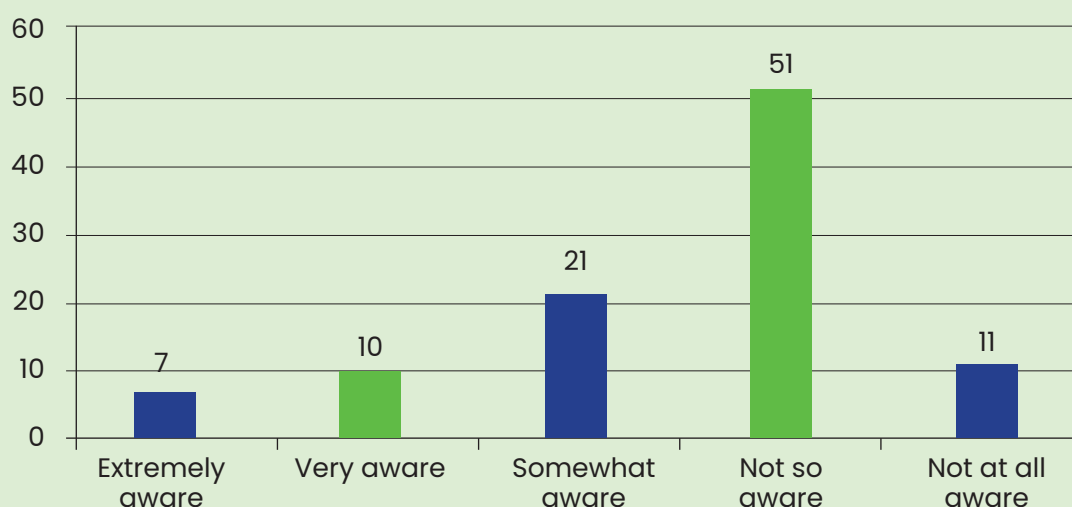
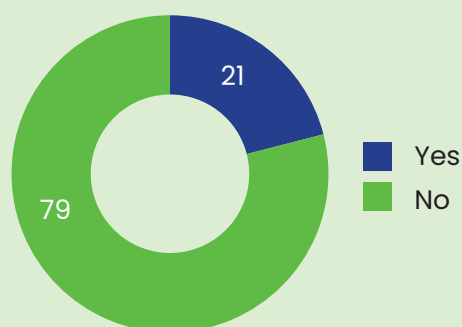


Figure 8: Awareness on Government Initiatives



Have you come across any initiative from government's end which enhanced your awareness on this issue?

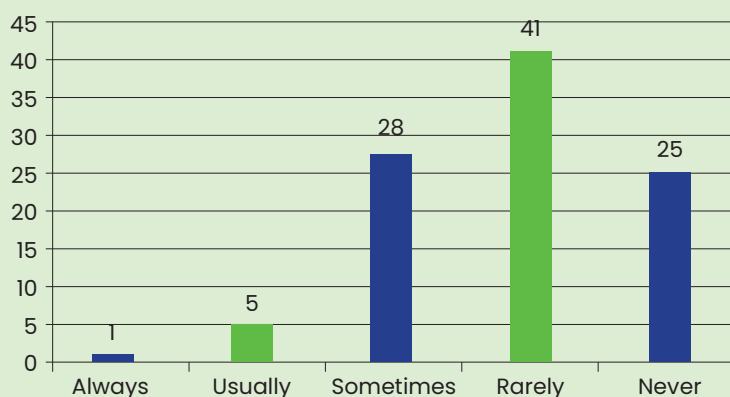
(Source: e-waste Management consumer survey 2019)

Respondents were also asked about the sources of information on e-waste they came across or consulted. The question was asked to understand the popular sources of information which could be used to create awareness on the issue among consumers.

The study found that 79 per cent respondents did not come across any advertisements, campaigns or any other related initiatives of the Government on e-waste disposal. However, few respondents knew about 'solid waste segregation and disposal' through television advertisements and awareness generation activities of municipalities.

According to 41 per cent respondents, they had rarely come across advertisements by any manufacturing or producer entity, whereas 28 per cent noted that they had seen some advertisements on the concerned issue. Interestingly, few of them in their comments tried to relate the take back policies by various companies as a method to channelize e-waste. Given the percentage of such responses being less than 50, it could be ascertained that initiatives by the manufacturers and producers have not reached the consumers, at large.

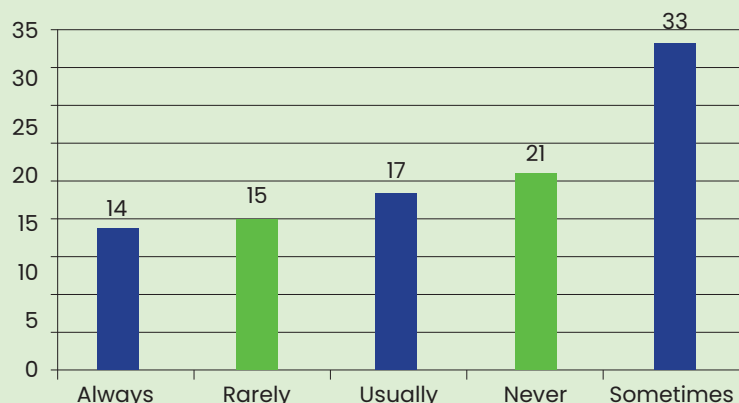
Figure 9: Awareness on Manufacturers' Initiatives



Have you ever come across any print or electronic (TV etc.) advertisement by any manufacturing company on the issue of e-waste?

(Source: E-waste Management consumer survey 2019)

Figure 10: Seeking Services from Informal Collectors



Do you seek services of any informal collection mechanism (Kabadis/garbage collector) for collecting your e-waste?

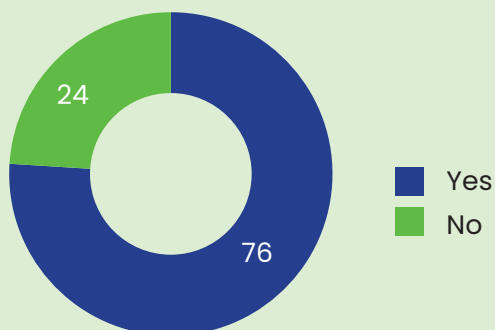
(Source: E-waste Management consumer survey 2019)

While 33 per cent of the respondents revealed that they sometimes resort to selling their electronics to scrap collectors also known as 'Kabadiwala', 21 per cent said that they do not sell their electronics through such means.

The study further looked into the possibility of people selling their obsolete electronic items to formal recyclers.

Three-fourth of the total respondents expressed their willingness to deal with formal recyclers provided they were paid for it. An optional question was asked to find out if they would stick to their decision of selling e-waste to formal recyclers when the amount of compensation varied. Interestingly, amongst the 74 responses received, 56 were willing to sell their electronics for a slightly lesser amount. In other words, 75.6 per cent respondents were willing to trade off the extra amount they may receive from the informal sector and revealed their preference for an environment friendly mechanism to dispose of their e-waste.

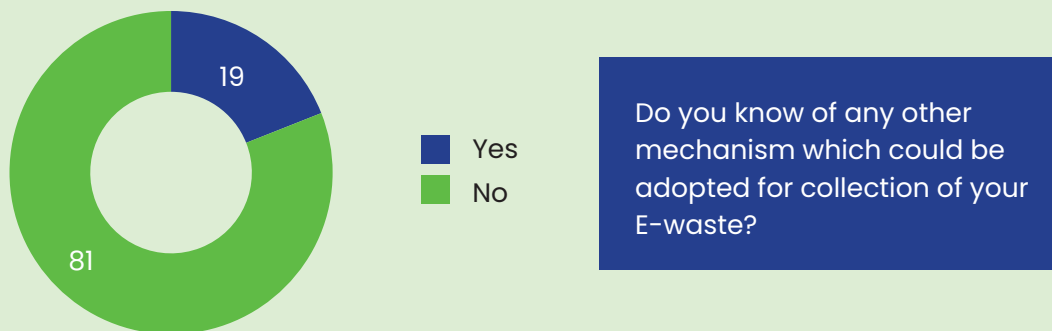
Figure 11: Consumer Willingness to Adopt Formal Collection Services



Will you give your obsolete electronics to formal recycling companies if they pay you?

(Source: E-waste Management consumer survey 2019)

Figure 12: Consumer Awareness on Available Collection Mechanisms



(Source: E-waste Management consumer survey 2019)

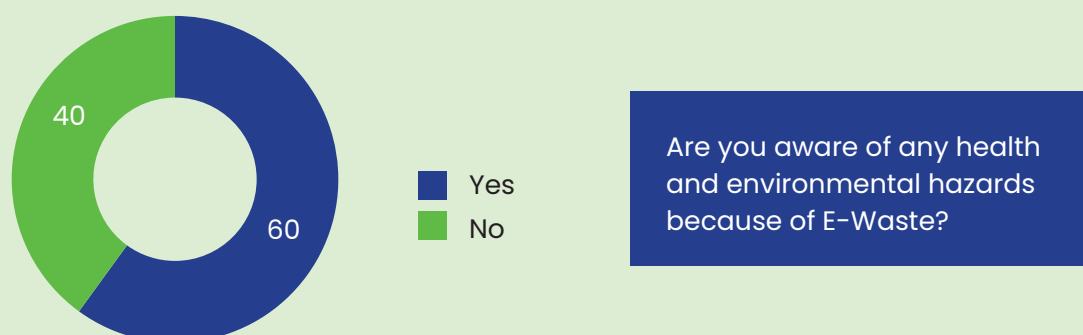
In view of the willingness of the consumers to choose a structured way of disposal despite lower compensation, the respondents were asked if they knew of any other mechanism to hand over their e-waste, besides selling it to Kabadiwalas. It was found that majority (81.63 per cent) of them did not know of any other collection mechanism for the purpose. Further, the respondents were asked to suggest convenient ways which could be adopted to ensure efficient collection. (See Box 5)

Box 5: Some of the prominent suggestions by the respondents:

- Recycling vending machines in localities or metro stations
- Need for collection centers/points which provide some type of monetary benefit like coupons
- Online services and applications
- Handing over to retailers in localities

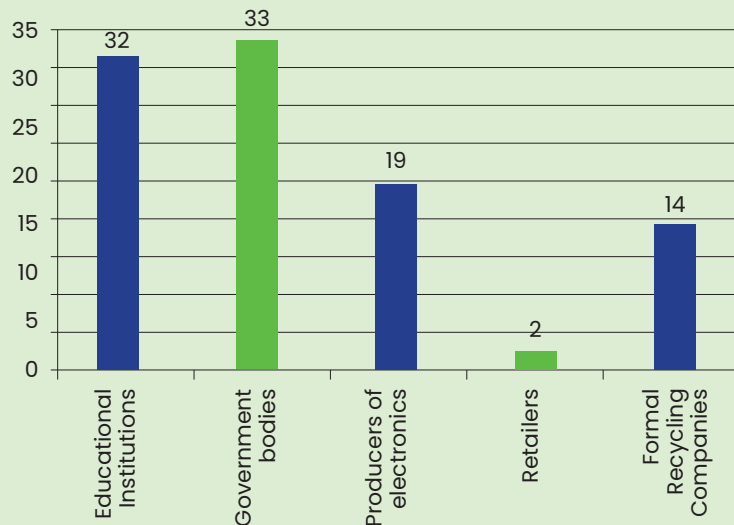
The responses of consumers point towards 'lack of information' on formal collection services rather than 'lack of willingness' as a barrier to safe waste disposal

Figure 13: Awareness on Environmental and Health consequences of E-Waste



(Source: E-waste Management consumer survey 2019)

Figure 14: Potential of Stakeholders in Awareness Generation



Who do you think possesses the maximum ability to impart knowledge and create awareness on the issue of E-waste?

(Source: E-waste Management consumer survey 2019)

Although 60 per cent respondents were aware of some environmental and health hazards of e-waste, they lacked a detailed understanding on the nature of these. Health and environmental hazards of e-waste also determined respondents' choice of disposal. In an optional question, 44 people out of 61 said that their choice of disposal methods was driven by environmental and health safety. Thus, apart from monetary incentive, the consumers preferred to choose environment friendly ways of disposal, if available.

The study also sought views of people on the potential stakeholders who possess the maximum ability to impart knowledge and create awareness on the issue.

As the responses indicate, the role of government bodies and educational institutions in awareness creation is of paramount importance. Producers and manufacturers also play an important role in designing and disseminating information through posters and visual/digital messages, to inform the consumers at the time of purchasing electronics. Formal recycling companies, were also identified by 14 per cent respondents as a potential stakeholder for awareness generation on e-waste.

CIRCULAR FRAMEWORK FOR ELECTRONICS

With increasing use of technology, digitization, rapid urbanization and affordable electronics, generation of e-waste has increased substantially. Recycling of e-waste has thus emerged as an environmental concern around the world. The global recycling rates for electronics still do not meet the desired level. To contend with the challenge of e-waste, India should focus on efficient resource utilization and waste management by adopting a 'Circular Economy Framework'. Facilitating the design for reuse, remanufacture and recycle through innovation towards waste minimization lies at the core of this framework.

The need for a Circular Framework

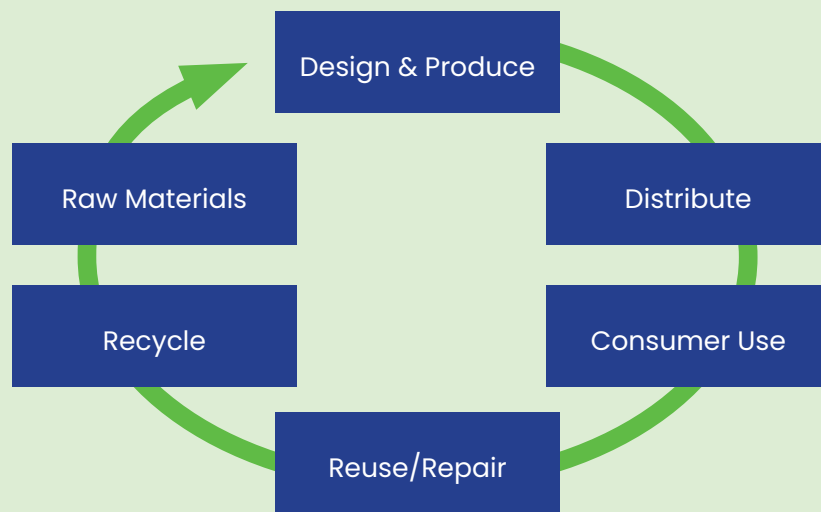
It has recently been declared by scientists that a number of vital elements out of the 90 natural occurring elements have been categorized as 'endangered'³⁷. At least 30-52 out of these 90 elements are utilized to make mobile phones and televisions. Despite the limited supplies and their location in conflict zones, the utilization of these metals continue to be largely uncurbed. The low recycling rate and the consumer practices to frequently change their smart phones may contribute to scarcity of these finite resources.

In order to preserve the virgin resources and minimize their utilization, it is imperative to have a global movement towards increasing the recycling rates. There is a need to close the loop in the life cycle of electronics by switching to a circular economy which would ensure that the metals recovered out of the obsolete electronics are utilized as raw materials in the future production.

While recycling is one of the solutions, it's equally important to decode the root cause of the 'actual' problem. India is the second largest producer of electronics only next to China and is the fastest growing telecom market in the world. Thus, need for embracing circular framework for electronics in the country is more than ever. To this end, circularity should be adopted not only at the recycling stage but right at the design and input stage. Efforts are firstly required to keep electronics out of the landfills and also to reduce their quantum reaching the landfills and recycling stage by extending their lives. Emphasis should be on 'reduce' and 'reuse' before recycle. An explicit realization 'to produce less in order to pollute less' among all the relevant stakeholders is a must. A circular concept for electronics aims to reduce e-waste at each step in the life cycle of electronics.

³⁷ Gabbatiss Josh, why you shouldn't be in a hurry to change phones, Times of India [29 January 2019] <https://www.pressreader.com/india/the-times-of-india-new-delhi.../282243781792266>. Accessed on 29 January 2019

Figure 15: Circular Framework for Electronics



It challenges the status quo, that is, the take, make and dispose model. With current disposal practices, there is a loss of energy as well as resources. Introducing a circular framework may directly strengthen the reverse logistics and enhance employment opportunities whilst retaining resource balance.

The material extracted from e-waste alone is worth more than three times the annual output of the world's silver mines and more than the Gross Domestic Product (GDP) of several nations. Amount of gold extracted from one tonne of mobile phones is much more than one tonne of iron ore³⁸. Utilizing the extracted metals from used electronics as raw materials produces fewer emissions than mining an ore. In such a scenario, the circular vision highlights the need to envision more progressive methods through which resources are re-utilized and valued and not just blindly extracted.

Design Stage

Electronic items nowadays are designed for shorter lifespans and single time use. A mobile phone despite its brand and monetary value stops functioning well within two-three years of its purchase. The cell phones are now designed in a way that there inbuilt batteries are glued which makes it difficult to dismantle and repair them, also various exotic metals are now being used to design electronics to give them a compact and sleeker look and extracting these metals from the electronics for reuse, becomes a challenge.

³⁸ World Economic Forum, *The world's e-waste is a huge problem. It's also a golden opportunity (2019)* <https://www.weforum.org/agenda/2019/01/how-a-circular-approach-can-turn-e-waste-into-a-golden-opportunity/>

Sustainable designing and production of electronics is a preliminary step towards reducing wastage. Besides preserving the virgin 'raw materials', a longer life cycle of an electronic spreads out its 'carbon footprint' over considerable period of time (of its usage). Producing a mobile phone accounts for 85–95 percent of its yearly carbon footprint because the mining of metals utilized for manufactory is an 'energy intensive' process.

A study revealed that cell phone emissions will go up from 17 to 125 megatons of carbon dioxide between 2010 and 2020. This is equivalent to a jump from 4 percent to 11 percent of total global ICT emissions³⁹. Therefore, to contain climate change, ICT sector has a huge potential in reducing carbon emissions globally. Keeping this in mind, it is essential to at least ensure that new electronic products are designed:

- In a way that increases durability in terms of its total life
- To be easily reused and refurbished
- With minimal utilization of hazardous materials at the time of production

Global organizations incorporating, Acer, Apple, Samsung, LG, Lenovo, Dell and HP committed (2009/2010) to eliminate Polyvinyl Chloride (PVC) and Brominated Flame Retardant (BFR) from the produced items. However, as per a study published in 2017 just Apple and Google have ensured their items to be free of BFR and PVC⁴⁰. Chapter 5 of the E-waste Rules 2016 places critical emphasis on the reduction in the use of hazardous substances (RoHS) by the manufacture of electronics. There is a need to strengthen implementation of RoHS by ensuring time bound phasing of the targeted hazardous materials and promote 'product redesigning' with longer life span and functional life of electronics.

Reuse and Recycling Stage

There are both challenges and opportunities in the electronics and electrical equipment industry. One of the opportunities is recovery of valuable sub-component but the challenge is how to do it. Efficiency of activities in the recovery and recycling sector depends upon the strength of the reverse logistics in the formal system. Recycling of e-waste ensures environmental safety and reduces carbon footprint. Besides ensuring environment safety, availability of low cost technology to domestically recycle the e-waste may also bring in economic benefits to an economy. It will enhance employment by increasing the number of jobs in the recycling sector and *material* recovery would bring immediate benefits to the economy. Role of consumers is equally crucial to hold on to their electronics as long as they are in good functioning condition and to ensure that they at least give it for safe refurbishing or recycling at the time of purchasing a new item. However, informal handling of 'e-waste' releases greenhouse gases which pollutes the environment and increases the carbon footprint.

³⁹ Patel Prachi, *Smartphones are warming the planet far more than you*, *Anthropocene* [Apr 5, 2018]. <http://www.anthropocenemagazine.org/2018/04/the-energy-hogging-dark-side-of-smartphones/>, accessed on 7th July 2019

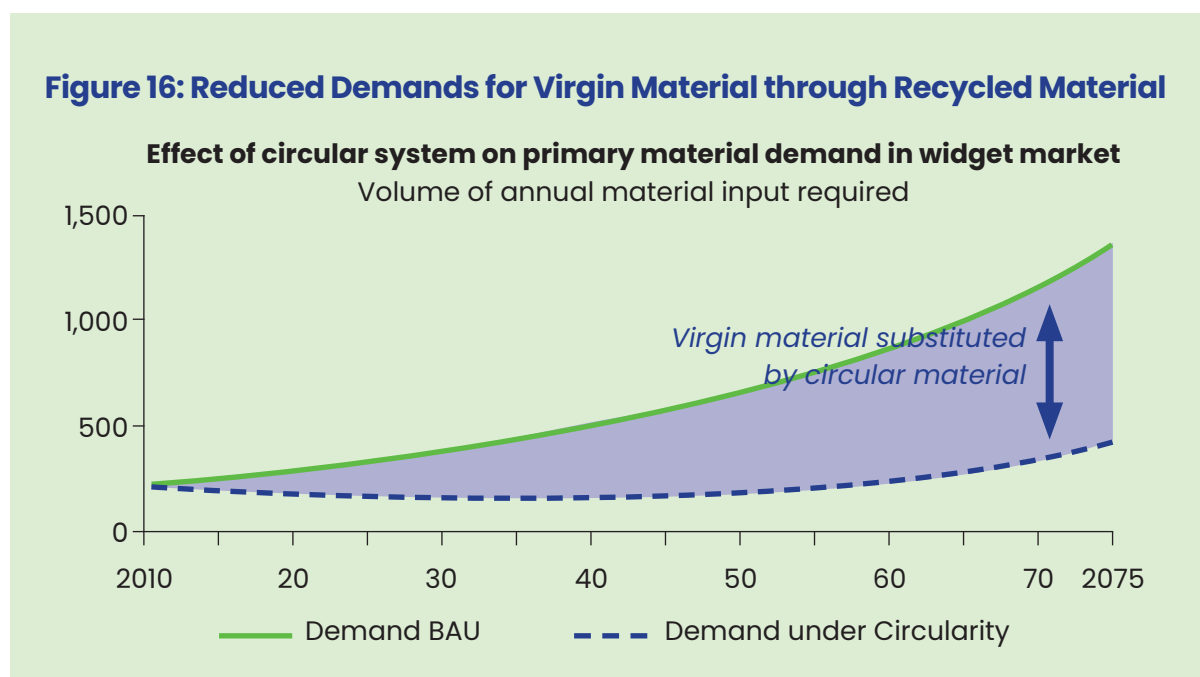
⁴⁰ Elizabeth, G. C. (2017). *Guide to greener electronics*. Washington D.C.: Green Peace. https://www.greenpeace.org/usa/wp-content/uploads/2017/10/GGE17_ReportCards.pdf



Input Stage – Substitution With Recycled Materials

In order to reduce pressure on virgin raw materials, there is a need to introduce 'product rationalization'. Some of the precious substances used as input materials for designing electronics are gold, silver, rare earth metals, plastics, platinum and copper. National Resource Efficiency Policy 2019 highlights India's 100 per cent import dependency for some of these elements. There is an urgent need to 'rationalize input control' in order to reduce resource dependency and maximize recovery. A World Economic Forum Report presents the effect of circular system on the demand of raw materials in the market, in view of these materials being replaced by the materials extracted from the electronics. Figure 16 depicts that virgin material input will reduce by 70 per cent by 2075 and also demonstrates the decrease in requirement of primary materials as the use of virgin material is substituted through more recycled materials.

Few manufacturers/producers have started aligning their practices with the circular system. Companies like Dell, Fairphone have started utilizing recycled materials in production to close the loop. But the progress has been very little in comparison to the size of the problem.



(Source: World Economic Forum, 2013⁴¹)

⁴¹ World Economic Forum, *From linear to circular—Accelerating a proven concept* (2013). <http://reports.weforum.org/toward-the-circular-economy-accelerating-the-scale-up-across-global-supply-chains/from-linear-to-circular-accelerating-a-proven-concept/>

Table 4: Stakeholder Involvement in Ensuring Circularity in E-waste

Circularity Indicator	Stakeholders involved
Making Supply Chain Circular	Suppliers
Product Life Extension	Customers, suppliers, dealers and distributors
Product as a service, asset sharing and use of sharing platforms	Suppliers, customers, insurers and government
Recovery and Recycling	Regulators, recycling facilities, landfill operators and haulers

(Source: TERI Report, 2018⁴²)

In order to promote circular framework for waste management, we need to adopt a city centric approach which prioritizes circular business models while reducing extraction from natural resources. There is a need for mass cooperation and joint commitment from all stakeholders, consumers to government, business and the community at large. Companies need to design electronics with circularity in mind and build components that can close the loops in production. City governments should especially take the lead in primarily starting from waste management, resource efficiency, and energy efficiency at the local levels. ULBs have a unique opportunity to map resources and collaborate with businesses, industries, societies and residents which can be achieved through interactive programs.

⁴² TERI Report, Circular Economy A Business Imperative for India (2018) https://www.teriin.org/sites/default/files/2018-03/TERI-YES_BANK_Circular_Economy_Report.pdf



This image shows a full page of primary-ruled paper. It features multiple sets of horizontal dashed lines spaced evenly down the page, providing a guide for handwriting practice. The background is white, and there are no margins or additional markings present.

EFFECTIVENESS OF CURRENT E-WASTE MANAGEMENT PRACTICES IN INDIA

The present e-waste management practices are largely incongruous and face numerous constraints such as absence of any specific model for inventorization, poor regulatory enforcement, lack of awareness amongst the consumers and stakeholders and poor working conditions in the informal sector. This chapter captures stakeholder perceptions to understand ground realities and challenges in current e-waste management practices.

Perceptions Of Experts In The Area Of Waste Management

Takeaways from the discussion with experts in the area of waste management have majorly been in terms of the challenges that are prevalent and need to be addressed:

- There is lack of awareness about the policy and guidelines amongst the stakeholders.
- Weak understanding and capacity of implementation agencies also results in non-compliance.
- Sensitization amongst people who are expected to comply and those who are required to ensure compliance is low.
- There is unwillingness amongst stakeholders to share disposal/recycling cost actually incurred on e-waste disposal and channelization.
- Absence of desired supply chain processes to get e-waste delivered to appropriate recycling facilities.
- Lack of adequate data on the e-waste generation to guide evidence-based action
- Recycling of some 'negative goods' such as CFL and Tube lights remain an acute problem. They end up in landfills because of the 'profit oriented' e-waste sector, no one is willing to bear the cost of recycling.

Various experts concurred that efficient 'procedures and protocols' to deal with e-waste were absent. Identification of too many stakeholders, without adequate monitoring mechanism has resulted in free riding, overlapping roles and lack of accountability thereby deteriorating the e-waste recycling economy.

Apart from implementation gaps, supply side challenges and constraints were shared by other stakeholders such as recyclers, producers and PROs.

Recyclers

Formal recyclers hold the most critical position in the e-waste value chain. They are the actors who are supposed to structurally dispose 'e-waste'. The relevance of ensuring effective e-waste management and disposal depends upon the 'degree of efficiency' attained at the recycling stage. It is thus, extremely crucial to ensure that these recycling facilities manage their activities in an effective and transparent manner. During the course of the study, representatives from six recycling companies were interviewed. The research team also interviewed an ex-employee of a well-known recycling facility which was recently shut down. These respondents threw light on the challenges faced by the recyclers.

Table 5: Perception of Recyclers towards Questions concerning E-waste (per cent)

Question	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Do you think E-waste Policy in India covers all the necessary aspects?	0	29	29	43	0
Do you think the implementation of the policy is as robust as it is on papers?	0	71	14	29	0
Are E-waste Rules 2016 an improvement over the rules laid down in 2011?	0	14	14	57	14
Do E-waste Rules place adequate emphasis towards addressing the informal sector dominance in e-waste processing?	57	29	29	14	0
Is Refurbishing a product a better practice, in terms of ensuring minimal wastage?	0	0	0	71	29

(Source: E-waste management survey for recyclers 2019)

While majority of the recyclers (43 per cent) felt that the current E-waste Policy covered almost all the necessary aspects falling under the purview of e-waste management, 29 per cent of them noted that policy lists stringent requirements for recyclers but is silent in context of 'costing' to recyclers for acquiring e-waste which provides flexibility to corporates and multinationals. About 71 per cent recyclers were of the view that E-Waste Rules 2016 are an improvement over the E-waste Rules 2011. The implementation of the



Rules was identified as a serious concern by majority (71 per cent) of respondents. Some of the challenges shared by the respondents are presented below.

Lack of Awareness on part of consumers: One of the challenges that recyclers face is inadequate awareness on the subject. Monetary incentive largely drives decisions of consumers to choose the preferred medium for disposal of e-waste. They lack appropriate knowledge about the hazards of e-waste and due to convenience they chose informal collect services. Thus, the demand for formal collection service is very low.

E-waste Rules 2016 and amendments in 2018: Recyclers feel that mandating EPR authorization for producers has not brought the required changes. A lot of producer companies after getting into an agreement with formal recycling companies on papers (which is a requirement in order to attain EPR authorization) still give their e-waste to the informal sector. The recyclers face huge difficulties to get in touch with the producers directly and are unable to seek clarity.

Limited no. of authorized refurbishers: 'It's not waste until it's wasted' – An end of life electronic could either be recycled or refurbished. Ideally, the refurbishment should be done by the producer of the electronics as this would ensure that the quality of product is retained. It was revealed during discussion that almost all recycling firms in India also have refurbishing units but very few amongst them have actually attained refurbishment 'certification' in order to operate these units. Apart from the recycling firms, various repair shops are operational in every locality that repair or 'refurbish' the product. However, these local shops usually do not attain refurbishment authorization and are therefore not adequately trained to utilize good quality spare parts and such repaired products usually end up in the e-waste stream after a couple of months.

Infrastructure constraints: As per EPR policy, the producers are responsible for ensuring structured disposal for e-waste and hence, they are supposed to develop appropriate infrastructure facilities for its management. However, their activities in this context are quite tangential. It is ultimately the PROs and the recyclers who have been making efforts for smooth channelization of e-waste to the formal sector. They do not receive adequate support from the producers towards strengthening the infrastructure.



Manufacturing and assembling of Printed Circuit Boards (PCBs)
(Courtesy: PPF, Manika)

Trans-boundary movement of Obsolete Electronics: Given the research and development limitations and technological constraints, a lot of components which constitute e-waste cannot be recycled in India. For instance, Indian recycling firms lack technology and machinery to recycle and dispose PCBs⁴³, a complex constituent of electronics. Resultantly, the predominant practice of recyclers for many years is to export PCBs to other nations like Belgium, where material recovery and e-waste disposal is undertaken in a structured manner. At the time of the interviews, the recyclers together were facing a critical challenge of recycling these constituents of e-waste as the government had banned any trans-boundary movement of obsolete electronics. Ban on import of e-waste shall prevent dumping of e-waste in the nation to some extent, but ban on 'exports' might increase adoption of alternate primitive techniques as country does not have advanced technology to recycle such complex components. It was noted that the government has recently permitted exports of PCBs to developed nations. However, for long term sustainability, there is an urgent need to establish effective and efficient methods for recycling the metals presented in the waste PCBs in India.

Producer Responsibility Organizations (PRO)

PRO gained recognition, as a registered legal entity in e-waste value chain only after the 2018 amendments in the E-waste Rules. These organizations serve as an intermediary between the producers and the recyclers. Representatives from four PROs were interviewed to capture their views on the issue. One representative each from a producer entity and a manufacturing firm were also interviewed.

Ambiguity in 'Targets': E-waste Amendments 2018 lay down stringent targets for the producers of electronics. However, these targets are merely collection targets. Complying with collection targets may not necessarily coincide with meeting the 'recovery targets', an important aspect which deserves attention. E-waste is a major source of recovery of precious metals that reduces the burden on utilization of virgin resources. Hence, it is crucial to establish targets which can measure the 'recovery tangent' of these precious metals from the obsolete electronics. This would not only ensure greater 'efficiency in collection' of e-waste but also commit to 'efficient recycling'.

Collection targets have definitely forced the producers to take 'some' action in this sphere, however, the real pressure is to overcome regulatory constraints such as 'enforcement at customs'. Further, the take back policy is mostly limited to the big tech firms and corporate sector, whereas small producers and manufacturers fail to reach out to the end use customer. The interviewees highlighted that in some situations, e-waste from the informal sector is purchased in order to meet the set targets.

Limited Collection Facilities: The 'collection facilities'⁴⁴ operating in Delhi are marginal in number. Despite the initiatives of some of the prominent brands, a lot of producer entities

⁴³ PCB is an integral component of almost every electronic equipment (TV, printers etc.), also synonymously known as 'mother board' in a computer.

⁴⁴ Collection Points majorly refer to the Collections Bins or any similar facility set up by the producer. Given that it is not necessary for a collection point and a collection center to be a distinct facility, these collection points may also be labeled as collection centers. However, the collection centers may operate only under EPR authorization and can be managed by the PRO or recycler who is in the agreement with the Producers. Given the absence of the collections bins, mobile vans and low adoption of Deposit Refund schemes, there seems to be huge gap that needs to be addressed.

have still not set up collection centers in Delhi. There are some brands which have labeled their head office (located at the outskirts of Delhi) as the 'only' collection Point for the Delhi/NCR citizens. Moreover, many collection centers are either non-existent or non-functional.



Doorstep collection offered by any recycler on the behalf of a producer may also be termed as an appropriate collection facility. However, it draws us back to our earlier recommendation that the preliminary step in this direction should begin with sharing the appropriate information with the consumers who lack awareness and information on existence of any such services. Further, as per the observations drawn by statements of various stakeholders, recyclers fail to provide door step collection to end use consumers when the quantum of the electronics isn't enough for them to meet their overhead expenses of transport etc.

Inadequate monitoring of various stakeholders: Despite several policies put in place and the clarity in terms of the responsibilities of various stakeholders, the discarded electronics continue to be informally processed and recycled. The e-waste from formal sector also gets channelized to the informal sector for recycling. One of the major observations has been in the context of the evolution of 'Paper Trading'⁴⁵, a practice evolving at a great pace in this sector. This 'false trail' has increased after the introduction of the targets in the recent Rules. Most of the authorized players lack adequate competence, infrastructure and are also burdened with huge overhead and operating costs. In order to address the loopholes in compliance and ensure transparency, there is a need to undertake steps towards standardizing the value chain and digitalization of the trail along with proper monitoring of the recyclers' activities.

Figure 17: Stages in E-waste Management and Recycling



⁴⁵ An example of which could be a producer or a recycler (in agreement with a producer or individually) being able to collect only 25 per cent of the desired quantum of waste and revealing 100 per cent collection on papers or weighting 'scrap' to meet the targets.



It is also believed that a lot of formal companies undertake activities up to the pre-processing stage or maximum till the segregation stage⁴⁶; and channelize the e-waste to the informal sector for further processing, which is in pure violation of law. This highlights the inadequacy in compliance. Further corroborating the findings of recyclers and PROs, infrastructural deficiencies and lack of available cost effective technologies for recycling e-waste are some of the reasons behind non-compliance.

Government- Delhi Scenario

E-Waste Rules lay down certain responsibilities for the identified stakeholders in the e-waste value chain. Hence, in view of the duties listed for SPCB and CPCB, several RTIs (Right to Information) were filed with the various concerned departments. Delhi Pollution Control Committee (DPCC), in response to an RTI (filed to collect information and data over certain aspects), stated that no inventorization activity has been carried out to estimate the quantum of e-waste for Delhi lately and also flagged unavailability of any recent data on this. Further, it failed to share an updated list of authorized manufacturers and recyclers in Delhi/NCR. It also didn't have any information pertaining to the producers who have violated the rules and were liable for penalty.

The RTI along with subsequent appeals were therefore filed with the CPCB to extract data on the EPR Plans registered with them and data concerning EPR plans of producers who failed to comply with the stated rules and responsibilities.

In mid-2018, North Delhi Municipal Corporation (NDMC) enunciated that it would soon offer door step collection of e-waste in Delhi to all the households and consumers and would also pay the consumers to incentivize them. However, any further update on this couldn't be traced and as per an inquiry with the stakeholders, it was confirmed that such facility had yet not (at the time of interview) been provided to Delhi residents by MCD. To collect more information, RTIs were filed between January to March 2019, with NDMC along with other Municipal Corporation Departments including East Delhi Municipal Corporations (EDMC) and South Delhi Municipal Corporation (SDMC). Despite several attempts, any response from NDMC was not received. Following this, rigorous attempts were made to extract more information. It was then revealed that NDMC had launched an online portal for e-waste collection on June 14, 2019. However, accessibility to the services and awareness about the initiative remains very low⁴⁷.

Despite several attempts, reliable estimates on inventory of e-waste or the data on different schemes adopted by producers (such as Deposit Refund Scheme) could not be sourced. The RTIs were filed majorly in accordance to the duties and responsibilities stated

⁴⁶ Segregation is a process which allows us to extract the important metals out of the electronics preceding the most complex and crucial step of disposing the left over toxic metals in an environmental friendly manner and ensuring protection and preventive measures for the workers involved in the entire process. Some of these processes are: Shredding/Crushing; Pyro, Hydro & Electro Metallurgical Operations, Plasma processing, chemical leaching, molding operations for metals and plastics.

⁴⁷ There is only one vendor registered with NDMC at present. An attempt was made to give e-waste through this platform, however, despite two attempts and telephonic conversations with the vendor, e-waste was not picked up from the mentioned location.



in the E-Waste Rules 2016 and E-Waste Guidelines 2016 along with few additional points⁴⁸. However, different authorities transferred RTIs among department and authorities, but responses were received from a number of stakeholders.

The research indicated one Rajya Sabha official debate on the issue of e-waste Policy in the year 2019. However, considering the debates in the recent years, it was observed that Ministry does not maintain data on the quantum of e-waste generated in the country⁴⁹. The last estimates on e-waste were reported by CPCB in 2005 (1.47 lakh ton of e-waste generated in the country). It was also clarified in the 2019 debate that no expenditure was incurred by the Government for setting up of any recycling facilities and the same was entirely financed by the private sector. In addition to this, there was a mention about directions issued to DPCC in 2016 for immediate closure of all illegal and unauthorized e-waste recycling units operating in Mandoli and Seemapuri areas of Delhi. However, as per a 2018 study on assessment of ground water contamination due to e-waste in Mandoli and Krishna Nagar, the prevalence of such practices in the concerned areas is indicative of heavy metals in ground water beyond safe limits⁵⁰. Another recent study⁵¹ by Toxics Link in 2019 validated the presence of such units in the above mentioned places. Besides these, areas like Seelampur, Mustafabad, Bawana etc. are also amongst e-waste hubs where such primitive practices are extremely prevalent.

Given the complexities of e-waste, it is crucial to bring a paradigm shift in the manner in which this waste stream is not just 'handled' but 'recycled'. There is a need for strict enforcement by the SPCBs and other municipal authorities. Producers, aware of the weak enforcement, are only motivated to attain the EPR authorization, and lack the right intent to safely dispose e-waste. The loopholes and lack of transparency on part of any stakeholder may be addressed through systemic reforms, inducing legislative pressure and stringent monitoring by the authorities. There is also a need to introduce incentivization schemes for stakeholders to ensure better compliance. E-Waste Policy (2017) of Telangana (discussed in chapter 3) touches upon some of the crucial incentivization steps for e-waste recycling, which can be helpful in other settings as well.

Policy Analysis: Challenges and Observations

The respondents also noted gaps in crucial legislative and policy measures. Comparative and critical analyses of the existing policy measures, ground level implementation and associated challenges have been presented in the following table.

⁴⁸ Information sought from the RTIs has been presented in annexures.

⁴⁹ Rajya Sabha Official Debate (2016) Title: Funds for disposal and recycling of e-wastes, 8-Aug-2016 http://rsdebate.nic.in/bitstream/123456789/663402/2/PQ_240_08082016_U2336_p133_p135.pdf#search=E%20Waste

⁵⁰ Assessment of contamination of soil and groundwater due to e-waste handling Rashmi Makkar Panwar* and Sirajuddin Ahmed. <http://www.indiaenvironmentportal.org.in/files/file/groundwater%20pollution%20e%20waste%20Delhi.pdf>

⁵¹ Toxics Link, Informal E-Waste Recycling In Delhi (2019) <http://www.toxicslink.org/docs/Informal%20E-waste.pdf>



Table 6: Comparative analysis of policy and implementation

Aspect	E-Waste Rules 2016	Observations
Collection of e-waste	Collection Centers can be set up by producer or by any person or agency or association for the purpose of collecting e- waste. Separate authorization from SPCBs for setting up of such collection centers was necessary ⁵² .	This was majorly introduced to prevent leakage of e-waste to unauthorized players. However, involvement of various stakeholders in 'collection of e-waste' has increased the ambiguity in terms of responsibility and accountability of setting up the collection centers. Besides take back initiatives, there is lack of coherence in other collection processes. Absence of a simplified collection 'model' creates scope for involvement of the informal collectors or kabadiwalas.
Collection Targets	Collection and channelization of e-waste in Extended Producer Responsibility - Authorization shall be in line with the targets prescribed in Schedule III of the Rules. The phase wise Collection Target for e-waste, which can be either in number or Weight shall be 30 per cent of the quantity of waste generation as indicated in EPR Plan during first two year of implementation of rules followed by 40 per cent during the third and fourth years, 50 per cent during the fifth and sixth years and 70 per cent during seventh year onwards ⁵³ .	Target based approach for EPR has been adopted on the basis of existing international best practices which indicate higher success rate for implementation of EPR in countries such as Japan, UK, Netherlands etc. However, these countries do not just meet the collection rates but also the 'recovery' rates which ensure adequate and efficient recoveries of the useful components like 'rare earth metals'. Hence, focus being on the collection targets, the incentive may indirectly be just to increase 'weight' of waste collected and with less focus on recovery and recycling.
Responsibility of Urban Local Bodies	Urban Local Bodies (Municipal Committee/Council/Corporation) has been assigned the duty to collect and channelize the orphan products to authorized dismantler or recycler ⁵⁴ .	At present, ULBs hold a significant position in reaching out to the end use consumers but have minimal responsibility in collection of e-waste as per the Rules. Municipalities play an important role in collection, segregation and transportation of the waste, in general. In order to overcome the challenge of delays in effective collection, the role of ULBs should be enhanced in the overall coordination of waste management system.

⁵² (E-Waste Rule 5.1) 2016.

⁵³ (E-Waste Rule 5.1.a and 13.1.ii) 2016.

⁵⁴ (E-Waste Rule 24) 2016.



Aspect	E-Waste Rules 2016	Observations
Authorization of Refurbishers	Collect e-waste generated during the process of refurbishing and channelize the waste to authorized dismantler or recycler through its collection center and seek one time authorization from SPCB ⁵⁵	Huge amount of e-waste is generated while an electronic item is refurbished or repaired. The refurbishers are hence, required to efficiently dispose the generated e-waste by directing the same to organized recyclers. However, the annual report of DPCC, in records of CPCB revealed that only 5 refurbishers have sought authorization from CPCB in the particular year. Given the existence of various repair shops and recyclers-cum-refurbishers, ensuring their sensitization on the issue remains a challenge and may require strenuous efforts in terms of monitoring.
Economic Instrument	Deposit Refund Scheme has been introduced as an optional scheme wherein the producer charges an additional amount as a deposit at the time of sale of the electrical and electronic equipment and returns it to the consumer along with interest when the end-of-life electrical and electronic equipment is returned; ⁵⁶	As the concerned scheme is an optional scheme, there is no available data with CPCB and otherwise, to ascertain the number of companies who may choose to adopt which means there will be no data on implementation status making the monitoring difficult. For instance keeping a track of funds collected in case a company initially adopted this scheme but had to shut down for some reason after a couple of years. Since this scheme concerns every producer in isolation, ensuring 'accountability' of each individual enterprise becomes difficult.

Waste management sector in India, in particular, has certainly transformed in view of some crucial steps taken by the government in the past decade. Last few years have witnessed revolutionary movements in terms of the rigorous cleanliness drives which have definitely changed the Indian mindset regarding the importance of waste management. This momentum should therefore be utilized to address the gaps and to strengthen the implementation of e-waste Policy. This will help in stimulating not only e-waste 'management' but its efficient 'disposal' by planning well in advance rather than adopting a post-facto approach.

The need for 'waste' management arises along with its generation. It is very important to initiate state-wise inventorization of e-waste in order to ascertain the progress made by

⁵⁵ E-Waste Rule 8.1 and 8.2) 2016.

⁵⁶ (E-Waste Rule 5.2) 2016.



the country in e-waste management. As per the e-waste Rules, 2016 SPCBs are required to implement activities for management of e-waste. Although there have been initiatives by SPCBs in other states, data in regard to activities of SPCB of Delhi is not available.

Notwithstanding the rules on management of e-waste, leakage of e-waste to informal sector has only increased over the years. Formulation of a 'go-to' mechanism for the consumers, and clarity to proceed with selling their electronics is the need of the hour.

Although the role of informal sector is not discussed at length in our policy and programs, we cannot be oblivious to their dominant role in the entire e-waste Value Chain, both implicitly and explicitly. Eliminating them may not be feasible considering their long standing involvement and livelihood dependence on e-waste Value chain since decades. The e-waste policy is silent on identifying and defining 'traders' of e-waste or recovered materials. These individuals or mafia groups, also rainmakers, have significant financial control in the e-waste market and tend to exploit the cheap labor force available in this sector. There is a need to sensitize informal sector workers, provide incentives and create opportunities to absorb them in the formal system.



E-waste management has gained considerable attention over the years due to its imminent threat to human well-being and environment. The concrete policy and legal steps such as introduction of E-waste Rules and Guidelines (2011 and 2016) have also resulted in emotive concern among the policy makers and program implementers on tackling the e-waste. These instruments have laid a foundation for management of e-waste in the country. Although EPR is a crucial component of e-waste legislation in India, there is need for “sharing responsibility” between, central and state governments and the civil society to implement the laws and bring an improvement in the present scenario. E-waste Rules 2016 (and amendments in 2018) incorporates a range of important aspects that were missing in the earlier set of Rules (2011). The new Rules provide a direction in regard to listing of responsibilities of the manufacturers, dealers, refurbishers and other stakeholders. It has also brought clarity in definition and obligations of bulk consumers who are one of the largest generators of e-waste. However, the implementation of the policy remains an area of concern.

The challenges that hamper effective implementation of the act and efficient management of e-waste have been arrived at keeping in view the dynamics on the ground and the perspectives of different stakeholders who play a pivotal role in shaping a sound e-waste management and disposal system in the city.

Planned Obsolescence

Electronic products nowadays are ‘designed to throw’ and are not meant to repair. There is little regard for environmental safety and the real intent is to make profits for which the producers ‘create’ this obsolescence. A consumer is forced to dispose of their dysfunctional electronics. These companies are promoting purchase of new electronics not only by introducing newer versions at small intervals but also by taking away the basic ‘right to repair’ of a consumer by not providing them with an economical alternative to choose an extended life span and warranty on their existing products and delay purchasing a new one.

Consumer Awareness

Majority of the respondents noted that they do not have adequate awareness about existing policies and mechanisms for e-waste management and seek informal collection services to sell their e-waste. They expressed their willingness to give e-waste to formal collection services provided they are compensated for the same. Inadequate awareness amongst respondents is one of the major reasons for adopting ‘informal collection

services'. Consumers though willing, lack adequate information to give away their e-waste to appropriate waste management set up. They are not aware about the existing collection services offered for the purpose. Findings also reveal that respondents perceive the role of educational institutions and government authorities to be most critical in generating awareness on the issue.

Reverse Logistics: Informal Sector Dominance

The informal sector plays a pivotal role in e-waste sector as it has an edge in terms of reaching out to the end use consumers. On the other hand, law is silent on recognizing their presence because of its 'illegality' as the material flows for e-waste cannot be traced once it reaches in the hands of the informal sector. Due to their low operating cost and better pricing mechanism, they manage to collect e-waste from consumers and further selling it to informal dismantlers. In such a manner, illegal activities continue to operate in Delhi/NCR.

Ambiguity in the system

The real irony is that on one hand the 'e-waste' policy doesn't consider the activities of the informal sector as 'legal'; on the other hand, supply of e-waste attracts 5 per cent GST rate⁵⁷. This has indirectly allowed various informal sector players to trade in e-waste by moving it from one city to another and simply paying the GST to ensure 'legality' and thereby conforming to law.

Infrastructure

There is a deficiency in the existing infrastructure for e-waste management with a huge gap between present collection & recycling facilities vis-à-vis quantum of e-waste being generated. There is lack of legitimate and cost-effective collection mechanisms to channelize waste from consumers into the formal segment. The formal sector further lacks cost-effective technologies to recycle various metals present in e-waste. In India, the technologies available at present are meant for recovering and recycling components like glass etc. but not the metals from e-waste. Absence of advanced and cost effective technology to recycle e-waste and ban on its export may actually increase informal processing.

Financing

Recycling facilities are facing difficulties to sustain their business due to high operations & technology costs incurred in recycling e-waste. Many companies are carrying out their operations under debt and some have also shut down. Besides existing firms, start-ups also find it difficult to acquire loan from banks under MSME and other schemes as there is no separate provision for 'e-waste' or for 'waste management' which may streamline the process.

Data Gaps

Data gaps at several points in the e-waste value chain complicate the task of managing these obsolete electronics. Calculation of efficient 'reuse and recycling rate' requires

⁵⁷ Press Information Bureau, Government of India, Ministry of Finance, 10-November-2017. <https://pib.gov.in/newsite/PrintRelease.aspx?relid=173406>



data on volume of e-waste generated by commercial users and households, volume of e-waste collected in a particular year along with volume of e-waste entering into recycling/re use facility. However, there is no standard mechanism to monitor the same neither any state specific inventorization has been carried out for Delhi. Both academic institutions and industrial organizations highlight the need for quality data to address the challenges and concerns in this sector.

Technology

The formal recycling companies in India, except some, are only limited to pre-processing of the e-waste material, where the crushed e-waste with precious metals is sent to smelting refineries outside India- to Belgium, Singapore and other countries and hence, may actually be termed as 'dismantlers' of e-waste.

There are several available technologies in the US to turn e-waste into power with 'thermolyzer technology' which do not produce toxic fumes and are also used to generate synthetic gas, which can sustain the entire recycling operation⁵⁸. A technique invented by scientists at the IIT Madras in 2015 claims to utilize e-waste as a resource to treat waste water and to also generate electricity. This innovation was financially supported by the Ministry of Human Resource Development, Government of India and was also awarded at the Innovation Festival in 2015. However, this technique has not been adopted as the institution could not locate any taker for this technology⁵⁹.

On the other hand, Waste to Energy plants, which play a crucial role in Solid Waste Management have found to be defunct. It is stated that the inability of these plants to handle 'mixed waste' and the high cost of electricity has been the reason behind its stagnancy⁶⁰. In the first place, these plants are not required to process mixed waste. Because the waste processed in these plants is not adequately segregated, they release dangerous toxic fumes posing a threat to the environment. Even under normal working conditions, plants situated in the vicinity of residential areas are known to pose health concerns. Mixed waste along with hazardous waste may also end up being processed in these plants. These technologies are being phased out in the West and setting up of such plants near residential areas should at least be avoided⁶¹. There is not just a pressing requirement for new technologies to be put in place but also an urgent need for enhanced regulatory and monitoring capacity to ensure safe operations of the existing ones.

⁵⁸ E-materials recovery, turn e-waste into power and profits with thermolyzer technology, <http://www.e-materialsrecoveryllc.com/index.html>, accessed on 16th March 2019

⁵⁹ Turning e-waste to electricity: IIT Madras innovation waits for takers, *The Economic Times* [Feb 24, 2017] <https://economictimes.indiatimes.com/news/environment/pollution/iit-scientists-develop-a-technique-to-generate-electricity-from-e-waste-in-eco-friendly-manner/articleshow/57334316.cms>, accessed on 7th October 2019

⁶⁰ Koshy Jacob, Wasted effort: half of India's waste-to-energy plants defunct, *The Hindu* [FEBRUARY 14, 2019], <https://www.thehindu.com/news/national/wasted-effort-half-of-indias-waste-to-energy-plants-defunct/article26273068.ece>, accessed on 7th October 2019

⁶¹ Ahluwalia Isher and Patel Amrita <https://indianexpress.com/article/opinion/columns/toxic-plants-waste-to-energy-national-green-tribunal-waste-incineration-5560270/>, accessed on 8th October 2019



Weak Monitoring System

It is important to contemplate the domestic scenario, recognize various actors in e-waste sector like repair shops, informal collectors, informal recyclers etc. and then undertake necessary actions in view of the same. Inadequate monitoring framework along with limited understanding of the Indian waste management scenario has led to certain ambiguity. For Instance, the rules list seven distinct responsibilities of a refurbisher, one of which is to seek authorization from the SPCB. There are numerous repair facilities functioning in Delhi which certainly have not sought concerned authorization for their operations or fulfill other responsibilities. Besides e-waste collected and sold by the informal collectors/kabadiwalas, many authorized dismantlers/recyclers are also selling waste to the informal sector, in complete violation of the law thus making monitoring of e-waste management challenging.



RECOMMENDATIONS

Environment friendly disposal of e-waste requires participation of different stakeholders including the government, public and private entities, and the consumers in the process. The recommendations noted below have been made keeping in view the need for ensuring multi-stakeholder engagement and partnership to bring in a paradigm shift in e-waste management and disposal system in the country.

Mainstreaming informal sector

Since majority of e-waste in India is handled by unauthorized recyclers, there is a need to mainstream them by integrating in the formal sector in order to neutralize the hazards of e-waste disposal. It is therefore, extremely crucial to break the chain at the point where segregated e-waste is handed over to the informal recyclers and introduce formal practices at this crucial stage. However, in order to operationalize this integration at the state level it is important to curb the informal recycling practices prevailing at present. This could be done by providing incentives to informal recyclers to either formalize their activities or to shift their line of business from 'recycling' to 'collectors of e-waste. One possible way is to collaborate with the informal collectors and provide them with tax incentives⁶².

Reverse Logistics in the Electronics Sector

There is a need to escalate the process of 'Reverse' supply chain Management in the electronics industry. It is extremely crucial to intensify the efforts to ensure both economic stability and environmental sustainability. Despite optional schemes and take back policies, a huge quantum of e-waste still lands up in the common waste bins or is stored by the consumers.



The **collection** of WEEE is the primary stage in the Reverse Logistics Chain in Electronics sector and it is the weakest aspect in the entire reverse supply chain.

⁶² Karo Sambhav' is a Producer Responsibility Organization which has already aligned the organization's agenda with the desired practices, on this platform.

- Assigning '**drop off locations**' at places such as shopping malls and universities would not only assist in reaching out to huge masses of people but would also provide a platform for students to volunteer and disseminate the 'need' to be more aware of the consequences of mishandling of e-waste. This might slowly diminish the long standing emphasis that the Indian society places on seeking 'monetary refund' for their electronics.
- The '**retailers of electronics**' are one of the most accessible informers and collection points for the consumers. However, there seems to be lack of knowledge about e-waste and minimal awareness regarding the E-Waste Rules amongst them. There is a need to sensitize them. Every retail unit, irrespective of its scale of operation, can be made accountable to allocate a separate bin or any related facility for consumers who wish to drop their e-waste and this provision should be independent of the take back mechanism of producers.
- E-waste Rules specify minimal responsibility of the '**Urban Local Bodies**' in the collection of e-waste despite the fact that they have the utmost potential to reach out to the end use consumers. Therefore, the role of 'Urban Local bodies' needs to be expanded in collection of e-waste.
- Creation of '**digital platform**' to build trust and induce behavioral change amongst the consumers. Designing mobile applications which would allow the consumers to specify the quantity of WEEE they want to sell, suitable time for collection, option to track the entire journey of their WEEE and notifying them when it reaches the concerned collection center/recycling facility or warehouse could be some of the options in this regard.

Recovery: There is a need to emphasize on 'recovery' of the components which could further be utilized as raw materials in production of new electronics. Besides the collection targets, it is important to track the ratio of collected waste to material recovered to ensure 'efficient recycling' and establish 'recovery targets' for e-waste to ensure both higher efficiency and transparency.

Awareness

Although WEEE falls under the category of hazardous waste, the consumers are not yet aware of the adverse consequences. The government must promote use of public media to enhance awareness on this issue. Repeated advertisements in newspapers as well as televisions in the form of jingles and short story type ads which depict hazardous conditions of e-waste processing sites through images should be encouraged which would put the viewers in an invidious position. The role of **RWA** needs to be idealized to encourage and sensitize people at the community level.

Introducing subject of 'e-waste' in academic curriculum

There is a need to introduce:

- Compulsory chapters and projects in schools to highlight the 'toxicity in e-waste'. Special focus to be placed on elementary and primary level as this would encourage not only the students but ultimately their parents to adopt ideal practices to manage e-waste within their homes.



- Diploma and certificate courses in e-waste management
- Specially designed academic modules on e-waste management as a crucial component in courses such as material management, Electronics, IT and Environmental Engineering.

Capacity Building

Specific skill development programs in context of e-waste, should be introduced under National Skill Development Mission. There is a need to sensitize various players like recyclers, dismantlers and refurbishers who play a critical role in the e-waste value chain. Moreover, sensitization on the issue and e-waste legislation should also be incorporated in vocational courses (such as short term mobile/electronic repair courses and similar certificate courses) in an institutionalized way.

Improving Infrastructure

The lacunae in e-waste management primarily arise due to lack of adequate infrastructure to deal with the issue at each step. The entire responsibility to create necessary infrastructure is placed on producers. However, there is a need for creating an enabling environment for the stakeholders by:

- Supporting the administration in this area (waste collectors or recyclers) through affordable methods for transportation by offering subsidized credits and other assistance
- Providing support to authorized manufacturers and recyclers in procuring land to set up warehouses for enhancing storage conditions and/or other incentives which may underpin the efforts of various stakeholders.
- Stimulating the activities of informal sector through financial assistance and/or training subsidy.
- Initiating dialogue between the concerned ministries and stakeholders for collectively discussing strategies and solutions for effective e-waste management such as costs of setting up waste treatment facilities, providing capital subsidy to companies to introduce adequate technology to recycle e-waste in India etc.

Polluters Pay Principle

In many countries, EPR also has a monetary aspect attached to it. A **user charge** at the time of purchase of a new electronic subsidizes the collection and recycling activities. A similar pool of funds could strengthen the activities of existing firms by providing assistance for transportation (etc.) and an incentive for new firms venturing into this area, therefore, setting up a framework which not only overcomes the financial constraints but also enhances the responsibility and accountability of the formal recyclers.

In order to circumvent the coordination issues between the recyclers/PROs and producers, a similar pool of funds could be generated by collecting membership fee (may differ as per product type) from the big tech producer firms. These funds as discussed, may allow the recyclers/PROs (registered as take back companies) to meet the collection rates and recovery rates



Digitalized Systems Approach

In order to ensure transparency, the e-waste value chain must be standardized through a common digital platform. Digitalization of the trail would ensure that every activity gets integrated into a common system. This will not only serve as a useful record of the routine activities, but will be an efficient way to monitor the activities of various stakeholders.

Carbon 'reduction' targets

The purchase of electronics increases our carbon footprint⁶³, but their eventual disposal increases it even more. Manual dismantling, primitive methods to handle e-waste and improper disposal of e-waste release greenhouse gases have detrimental effects on environment. On the other hand, e-waste recycling lowers the demand for metal mining and extraction, an environmentally destructive, greenhouse gas-emitting process. There are various calculators now available to calculate carbon footprint 'reduction' from recycling electronics for instance, Environmental Protection Agency (EPA) has introduced a calculator⁶⁴ to assess GHG emissions mitigated by recycling e-waste. There is a need to introduce carbon 'reduction' targets in context of e-waste recycling by identifying a standard methodology to calculate the same. Incentivizing the companies to use innovative solutions for recycling e-waste, invest in the future and set examples for others in this sector is important. This will also diminish scope for any 'informality' arising in the formal system.

'Reduce' and 'Reuse' before Recycle

The desired transition towards adopting a circular framework for electronics cannot be achieved by any single actor but needs collaborative efforts across the value chain, involving individuals, the private sector, different levels of government and civil society. In order to promote circular economy we need to:

Enhance product redesigning: Promotion of better design-based electronic and electrical equipment with increased life span with multiple uses similar to the concept of 'universal remote' which replaces the remotes for your TV, Blu-ray, streaming devices like Apple TV, soundbar, DVD, game consoles etc.

Rationalize input control: National Resource Efficiency Policy (NREP) 2019 states that India is 100 percent import dependent for accessing 'rare earth metals' utilized in designing of electronics. There is a need to achieve resource efficiency by defining these rare earth metals as 'critical elements'⁶⁵ to foster efficient use and recycling of these critical raw materials. There is also a need to map 'resource consumption' versus 'recycling potential' to recover resources from e-waste, in order to reduce the import dependency.

⁶³ Carbon Footprint is a term that is used to describe the overall carbon emissions for which a country, an organization or an individual is responsible, through the usage of fossil fuel based energy and the purchase and consumption of products.

⁶⁴ It uses the total weight of electronics recycled to determine the metric tons of mitigated GHG emissions

⁶⁵ European Commission has created a list of critical raw materials that are economically and strategically important for the European economy but have a high-risk associated with their supply



Adopt Green Procurement Practices: Both public and private sector must adopt green and sustainable purchasing practices. There is a need to promote 'purchase of refurbished products' over newer equipment especially amongst bulk consumers. This can be done either by providing subsidy for procuring such goods or mandate public schools, government institutions and private entities to buy a minimum percentage of refurbished products.



This image shows a full page of handwriting practice paper. It features multiple sets of horizontal dashed lines spaced evenly down the page, providing a guide for letter height and placement. The background is white, and the lines are light gray or blue. There is no text or other markings on the page.

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ANNEXURE

Table 7: Information sought through Right to Information (RTI)

Sr. No.	Department	Information Sought	Reply
1.	CPCB	1) Names, location in Delhi, capacity of business operation (operational outputs) on the authorized electronic manufacturers and dismantlers, recyclers and refurbishers. ⁶⁶	No information on authorized recyclers was received.
		2) List of producers who have opted for deposit refund scheme ⁶⁷	Under E-waste (Management) Rules, 2016 the Deposit Refund Scheme (DRS) is one of the optional scheme, compilation of such producers is not available in records
		3) List of producers who have e-waste collection centers set up in Delhi ⁶⁸	CPCB has so far issued EPR authorization to 1239 producers under E-Waste Management Rules, 2016. The list of the same was provided.
		4) No. of EPR (Extended Producer Responsibility) plans of producers ⁶⁹	CPCB revealed that they have EPR plans for all the 1239 registered producers.

⁶⁶ (E-Waste Rule 11.2) 2016

⁶⁷ (E-Waste Rule 5.1.d) 2016
(E-Waste Guidelines 2.1.3) 2016

⁶⁸ (E-Waste Guidelines 2.1.5) 2016

⁶⁹ E-Waste Guidelines 2.1) 2016

Sr. No.	Department	Information Sought	Reply
		4) List of producers against whom action has been taken for non compliance to EPR plans ⁷⁰	List of 10 producers against whom action have been taken for non-compliance to epr plans, was provided. There authorization has been suspended with effect from 04-04-2019.
		5) Recent annual report submitted by DPCC to central pollution control board (CPCB) with regards to the implementation of E-Waste Rules (preferably for year 2017-2018) ⁷¹	Report not attached
		6) Recent annual report submitted by DPCC to Ministry of Environment, Forest and Climate Change (MOEFCC)	There is no record available in CPCB for the annual report submitted by DPCC to Ministry of Environment, Forest and Climate Change (MOEFCC)
		7) List of collection centers for e-waste in delhi as per the EPR (Extended Producer Responsibility) plans of different producers ⁷²	List of collection centres for e-waste in Delhi as per the EPR plans of different producers are not available in the records of CPCB. However, producers on their website maintain the list of collection centers
2.	DPCC	1. Recent data regarding the inventorisation of e-waste in Delhi, carried out by DPCC. ⁷³	No inventorisation has been carried out by DPCC in Delhi
		2. Names, location in Delhi, capacity of business operation (operational outputs) on the authorized electronic manufacturers and dismantlers, recyclers and refurbishers. ⁷⁴	No information available. Maybe transferred to CPCB

⁷⁰ (E-Waste Schedule 4.1.6) Rules 2016

⁷¹ (E-Waste Rule 18.1) 2016

⁷² (E-Waste Form-1 6.1) Rules 2016

⁷³ (E-Waste Schedule 4.2.1) Rules 2016

⁷⁴ (E-Waste Rule 11.2.2) 2016

Sr. No.	Department	Information Sought	Reply
		3. Recent data (preferably for year 2017-18) on the producers who have failed to meet the epr targets or were held responsible for non-compliance of E-Waste Rules. ⁷⁵	No information available. Maybe transferred to CPCB
		4. List of TSDF's (hazardous waste treatment, storage, and disposal facilities) that are presently operating in Delhi.	Does not pertain to WMC-1/iii May be transferred to hazardous waste cell, DPCC
		5. Operational details of units identified for generating hazardous wastes or e-waste in Delhi.	No information available.
		6. Recent annual report submitted by DPCC to Central Pollution Control Board (CPCB) with regards to the implementation of E-Waste Rules (preferably for year 2017-2018) ⁷⁶	No reply
		7. Recent annual report submitted by dpcc to Ministry of Environment, Forest and Climate Change (MOEFCC) with regard to implementation of the provisions in e-waste rules. ⁷⁷	Pertains to CPCB
		8. List of collection centers for e-waste in delhi as per the EPR (Extended Producer Responsibility) plans of different producers.	Pertains to CPCB
3.	EDMC ⁷⁸	1. Initiatives undertaken towards ensuring collection of e-waste in Delhi	No separate collection facility for e-waste in municipal department of Shahdara, EDMC.

⁷⁵ (E-Waste Rule 14.1) 2016
(E-Waste Schedule 4.2) Rules 2016

⁷⁶ (E-Waste Rule 18.1) 2016

⁷⁷ (E-Waste Rule 12.3) 2016

⁷⁸ (E-Waste Schedule 4.3) Rules 2016.



Sr. No.	Department	Information Sought	Reply
		2. Areas/localities in Delhi where MCD has already initiated door step collection of e-waste	As above
		3. Collection centers identified by mcd for dropping off e-waste by society	SWM Rules 2016 require all the e-waste retail units to collect e-waste and channelize it to the producer entities.
		4. Recent data on the quantity of e-waste generated every month	No data available with EDMC, Shahdara
		5. List of recyclers appointed by MCD for e-waste recycling	As above
	SDMC ⁷⁹	1. Initiatives undertaken towards ensuring collection of e-waste in Delhi	Collection and disposal of e-waste comes under the jurisdiction of DPCC Delhi Govt. However, e-waste generated in household and collected from the household with garbage by sdmc is segregated and disposed of separately. Further, the case to engage a consultant for advice regarding scientific disposal of e-waste is in process
		2. Areas/localities in delhi where MCD has already initiated door step collection of e-waste	As above
		3. Collection centers identified by MCD for dropping off e-waste by society	As above
		4. Recent data on the quantity of e-waste generated every month	As above
		5. List of recyclers appointed by MCD for e-waste recycling	As above
	NDMC ⁸⁰	1. Initiatives undertaken towards ensuring collection of e-waste in Delhi	No reply

⁷⁹ See footnote ref. 78

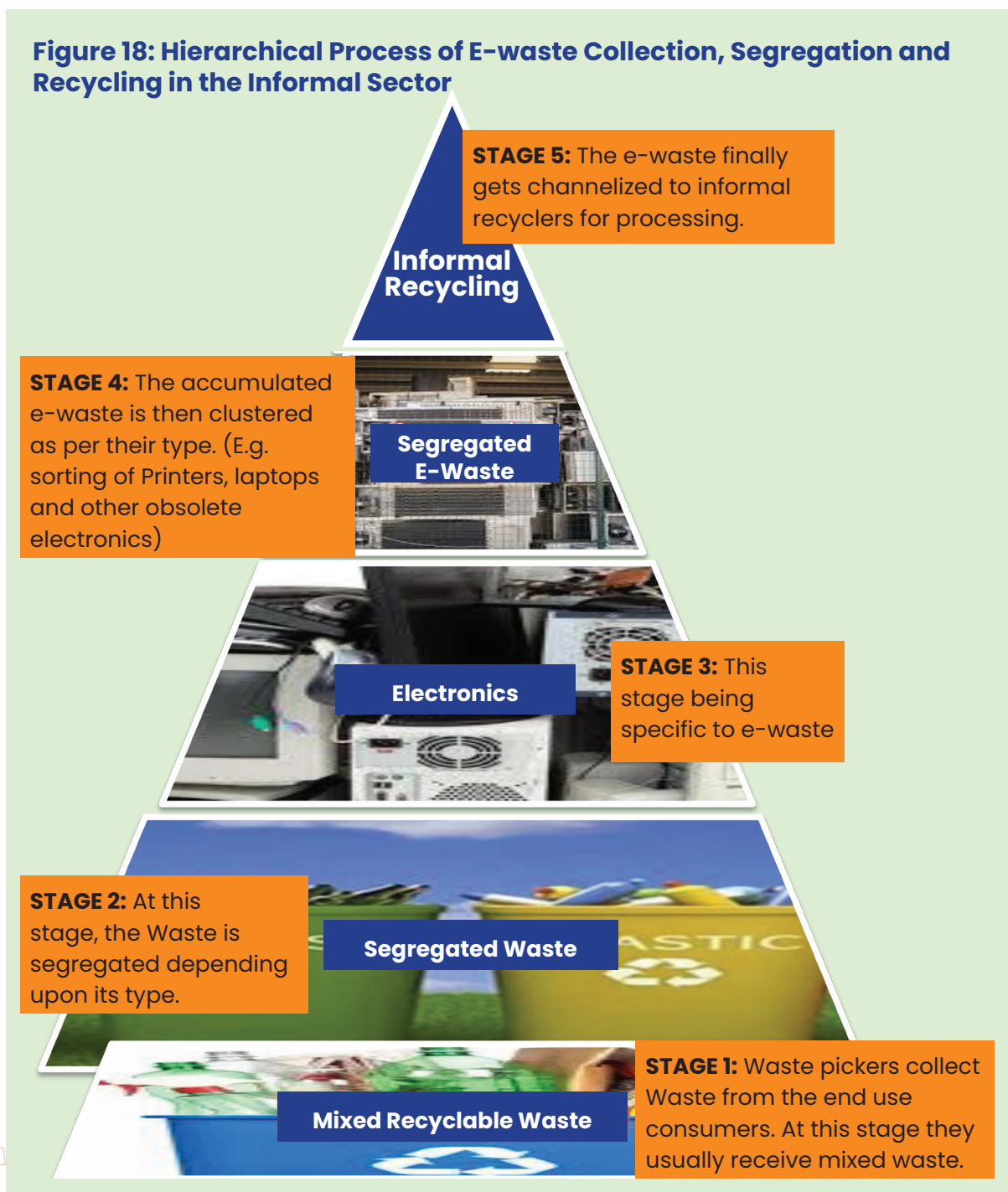
⁸⁰ See footnote ref. 78

Sr. No.	Department	Information Sought	Reply
		2. Areas/localities in Delhi where MCD has already initiated door step collection of e-waste	No reply
		3. Collection centers identified by MCD for dropping off e-waste by society	No reply
		4. Recent data on the quantity of e-waste generated every month	No reply



Figure 18 highlights the hierarchical process of e-waste collection, segregation and recycling in the Informal Sector. Waste pickers collect mixed waste from the end use consumers and channelize it further. It is the stage 5 which poses major concern, where the e-waste is handed over to the 'informal' recyclers. Stages 1-4 do not pose concern as it does not involve hazardous practices and hence, may remain intact in a manner that the segregated e-waste is handed over to the formal companies.

Figure 18: Hierarchical Process of E-waste Collection, Segregation and Recycling in the Informal Sector





ANNEXURE

Interview Schedules of stakeholders

Consumers

Q 1. Do you change your electronics, namely cell phones every 4-6 years?

- i. Yes
- ii. No

Q 2. Do you consider your discarded electronics as waste?

- i. Yes
- ii. No, Other Purposes

If no, please state the additional purpose

Q 3. Are you aware of regulatory environmental laws for e-waste in the country?

- i. Extremely aware
- ii. Very aware
- iii. Somewhat aware
- iv. Somewhat aware
- v. Not so aware
- vi. Not at all aware

Q 4. Have you come across any initiative from government's end which enhanced your awareness on this issue?

- i. Yes
- ii. No

Q 5. How often do you come across any print or electronic (TV etc) advertisement by any manufacturing company on the issue of e waste?

- i. Always
- ii. Usually
- iii. Sometimes
- iv. Rarely
- v. Never

Q 6. Do you seek services of any informal collection mechanism (Kabadis/garbage collector) for collecting your e-waste?

- i. Always
- ii. Usually
- iii. Sometimes
- iv. Rarely
- v. Never

Q 7. Will you give your obsolete electronics to formal recycling companies if they pay you?

- i. Yes
- ii. No



Q 8. Will you be willing to give your electronics to formal companies even in cases when they pay you little less than the kabaddis for the same Item?

- i. Yes
- ii. No

Q 9. Do you know of any other mechanism which could be adopted for collection of your e waste?

- i. Yes
- ii. No

If yes, what other mechanism do you think could be adopted to collect your e-waste?

Q 10. Are you aware of the health and environmental hazards because of e-waste?

- i. Yes
- ii. No

Q. 11 Which factor strongly drive your decision of selling your discarded electronics?

- i. Monetary incentives
- ii. Safety of Health & Environment

Q 12. Who do you think possesses the maximum ability to impart knowledge and create awareness on the issue of e waste?

- i. Educational Institutions
- ii. Government Bodies
- iii. Producers of electronics
- iv. Retailers of electronics
- v. Formal Recycling companies

Recyclers

This survey is being carried out by Policy Perspectives Foundation as a part of a Research Project. We assure you that all the information collected for this survey is required for research purpose only and no part of this information would be used for any other purpose. Kindly give us some time and allow us to capture your views on the subject issue.

1. What are the sources from which you receive e-waste?
2. What services does your company offer to its customers?
3. Do you think the E-Waste Policy in India covers all the necessary aspects?

1	2	3	4	5
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree

4. Do you think the implementation of the policy is as robust as it is on papers?

1 Strongly Disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
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5. Has E- Waste Rules 2016, an improvement over the earlier set of E-Waste Rules (2011)?

1 Strongly Disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
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6. Do E-Waste Rules place adequate emphasis towards addressing the informal sector dominance in e-waste processing?

1 Strongly Disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
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7. Is refurbishing a better practice, in terms of ensuring minimal wastage?

1 Strongly Disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
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8. What do think acts as an incentive for producers to manage their e-waste? Please comment

9. Is the issue of environmental hazards and health hazards (because of e waste) taken care of while undertaking operations? Please comment

10. Does your company face any constraints to capture the domestically generated e-waste? Please comment

11. Does your company face any challenges while coordinating with other stakeholders? Please comment

12. Please suggest measures, in general, to address the mentioned challenges and ensure efficient management of e-waste in the country

PRO

This survey is being carried out by Policy Perspectives Foundation as a part of a Research Project. We assure you that all the information collected for this survey is required for research purpose only and no part of this Information would be used for any other purpose. Kindly give us some time and allow us to capture your views on the subject.

1. What are the sources from which you receive e-waste?

2. What services does your company offer to its customers?

3. Are E- Waste Rules 2016 (and amendments 2018), an improvement over the earlier set of E-Waste Rules (2011)? Please comment



4. Have producers, in general, been able to a) create awareness on e-waste b) set up collection centres c) offer take back policies? Please comment
5. Is there any specific interest factor for producers to transfer the task of managing their e-waste to a PRO? Please comment
6. Does your company also offer recycling services for e-waste?
7. Does your company face any constraints in functioning and ensuring efficient management of e-waste
8. Please share challenges, in general, which hinder efficient recycling and disposal of e-waste in the country.
9. Please suggest measures, in general, to address the mentioned challenges and ensure efficient management and disposal of e-waste in the country.

Producers/manufacturers

- Q 1. Please write your name & the company's name (*this information would be kept anonymous*)
- Q 2. Are you aware of the regulatory environmental laws or policies for managing e-waste in the country? (Yes/No)
- Q 4. Does your company offer buyback policy (Yes/No)
- Q 5. Is there any separate policy of the company for e-waste management? (Yes/No)
- Q 6. Has your company transferred the task of managing the e waste to any PRO? (Yes/No)
- Q 7. How many collection centers does your company have in Delhi?
- Q 8. Do you think adopting the optional 'Deposit Refund Scheme' could assist in efficient e-waste management? (Yes/No)



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Notes

This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



About the Author

Manika Malhotra holds a Master's degree in Economics from TERI School of Advanced Studies, New Delhi. She completed her Bachelors in Economics from Delhi University, New Delhi. Her Master's dissertation titled '*E-Waste Management: A micro perspective*' in which she quantitatively assessed stakeholder preferences towards adopting the preferred mechanism of disposing e-waste, with a special focus on economic (costs and incentives) and social attributes and calculated Marginal Willingness to Pay (MWTP) of Consumers to get their e-waste recycled.

Ms. Malhotra is a young researcher with Policy Perspectives Foundation, New Delhi currently working on a research study on Implementation of Protection of Children Against Sexual Offences (POCSO) Act 2012 in association with Delhi Commission for Protection of Child Rights (DCPCR). She has also published 2 articles in PPF's monthly newsletter 'PRISM' on the subjects concerning emerging e-waste crisis and crumbling state of women's safety in India. She was earlier an intern Consultant with Department of Administrative Reforms and Public Grievances (DARPG), Ministry of Home Affairs in association with Vision India Foundation (VIF). She has also worked as a freelance research intern with private sector and academic institutes.

"There is no such thing as 'throwing away', when we throw something away it must go somewhere."

– Annie Leonard

