

# E-waste Management & Circular Economy Comparative Case Study



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**\_VOIS Planet** portal primarily focuses on environmental sustainability covering various aspects: **Low carbon, Renewable energy usage** and **E-waste management**.

It is aimed at aggregating and helping co-create knowledge and information on environmentally responsive behaviours and concurrently pursuing result-oriented social media campaigns to encourage people and specifically the youth, to take proactive actions in promoting sustainable lifestyle and creating a positive impact on the environmental ecosystem in their surroundings

By: **\_VOIS Planet**

## Executive Summary

Economic growth, urbanisation and industrialisation result in increasing volumes and varieties of both solid and hazardous wastes. This has led to a global problem of managing this electronic waste. The generation of E-waste is rising rapidly and as per the available data, an estimate of 55.5 Mt of E-waste was generated globally in 2019.

E-waste has negative impacts on health as well as increased pollution of air, land and water as the ineffective and inefficient waste management results in greenhouse gas and toxic emissions, and the loss of precious materials and resources. An integrated waste management approach is a crucial part of international and national sustainable development strategies. The E-waste management problem in India has several concerns as the collection and recycling system is majorly practised by the Informal sector. As reported in the United Nations (UN) World Economic Forum in its 2019 report, India's 95% percent of the E-waste was recycled by the informal sector. The current E-waste sector has significant challenges and these gaps need to be bridged to create an effective E-waste management system.

There are organizations working toward managing this E-waste responsibly. These firms have opted for EPR & Circular economy approach and launched planned projects/initiatives to tackle this challenge. The aims & outline of these initiatives were studied to measure the impacts.

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## Introduction

The global community today has achieved technological heights unimaginable a century ago. Globally, every individual is now surrounded by electronic gadgets for almost every purpose one can think of and a single day in the absence of these tech gadgets is inconceivable. Over the last decade, these electrical appliances have slowly crawled into our daily life. The information and communication revolution of the 20th Century has brought enormous changes in the way our lives, our economies, industries and institutions are organised.

These spectacular developments in modern times have undoubtedly enhanced the quality of human life and served numerous benefits. But the boon brought forth by these Electrical and Electronic Equipment (EEEs) has come along with its fair share of bane. These have turned out to be a toxic component for our environment as the production and utilisation of these EEEs have given birth to a serious problem related to the safe disposal and management of the generated E-waste. Due to the slow collection and recycling process externalities –such as the consumption of resources, the emission of greenhouse gases, and the release of toxic substances during informal recycling procedures– illustrate the problem to remain within sustainable limits. Consequently, many countries are challenged by the considerable environmental and human health risks of inadequately managed Waste Electrical and Electronic Equipment (WEEE), widely known as e-waste.

## Background

### E-waste: A Global Issue

As defined by the Central Pollution Control Board (CPCB), Electronic Waste (E-Waste) means electrical and electronic equipment, whole or in part discarded as waste by the consumer or bulk consumer as well as rejects from manufacturing, refurbishment and repair processes. Electrical and Electronic Equipment (EEE) includes a wide range of products with circuitry or electrical components with power or battery supply (Step Initiative, 2014). Almost any household or business uses products like basic kitchen appliances, toys, tools for music, and ICT items, such as mobile phones, laptops, etc. (Forti et al., 2020, 18)

Higher levels of disposable incomes, growing urbanisation and mobility, and further industrialisation in some parts of the world are leading to growing amounts of EEE. On average, the total weight (excluding photovoltaic panels) of global EEE consumption increases annually by 2.5 million metric tons (Mt). After its use, EEE is disposed of, generating a waste stream that contains hazardous and valuable materials. This waste stream is referred to as e-waste.

Many of these substances are toxic and carcinogenic. The materials are complex and have been found to be difficult to recycle in an environmentally sustainable manner causing health hazards. The impacts are found to be worse in developing countries like India where people engaged in recycling E-Waste are mostly in the unorganised sector, living in close proximity to dumps or landfills of untreated E-Waste and working without any protection or safeguards. (E-Waste Management in Current Scenario, n.d.)

According to the Global E-waste Monitor report 2020, an estimate of 55.5 Mt of E-waste was generated globally, but only 17.4% of it is documented to be collected and disposed of properly while the remaining world generated a striking 53.6 Mt of e-waste in 2019 with an average of 7.3 kg per capita. Asia generated the highest quantity of e-waste in 2019 at 24.9 Mt, followed by the Americas (13.1 Mt) and Europe (12 Mt), while Africa and Oceania generated 2.9 Mt and 0.7 Mt, respectively.



(Original infographic to be made from the data)

## E-waste in India

According to the Central Pollution Control Board data, India generated 1,014,961 tonnes of e-waste in FY 2019-2020 which is up 32% from FY 2018-2019. Of this, the report found that only 3.6% and 10% were actually collected in the country in 2018 and 2019, respectively. The figures have taken into account the 21 types of electrical and electronic equipment listed in the E-Waste Management Rules, 2016. These include discarded computer monitors, mobile phones, chargers, motherboards, headphones, and television sets, among other appliances.

There are 10 states that contribute to 70% of the total E-Waste generated in the country. 65 cities generate more than 60% of the total E-Waste in India. Among the top ten cities generating E-Waste, Mumbai ranks first followed by Delhi, Bengaluru, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat & Nagpur. The main source of e-waste in India is the government, public and private i.e. industrial sectors– 70%- Contribution of individual households– 15% and the rest is contributed by manufacturers. (E-Waste Management in Current Scenario, n.d.)

## **E-waste management policy framework in India**

In India, 95 per cent of the e-waste is recycled and processed (in the informal sector) in a crude manner as reported in the United Nations (UN) World Economic Forum in its 2019 report on e-waste. The first policy effort was attempted in 2008 with guidelines on environmentally sound management of E-Waste. They were based on the Extended Producer Responsibility (EPR), which was also used by the EU. It acted as a mechanism for managing E-Waste but there were no instructions on its implementation. In 2011, the Government of India established the E-Waste (Handling and Management) Rules, which were then amended into the E-waste (Management) Rules of 2016.

## **Concept of Circular economy**

Due to the ever-increasing demands of the global economy, resources of the planet are being used up at an alarming rate, and pollution along with waste are growing fast. From a life-cycle perspective, waste prevention and minimization generally have priority. The remaining solid and hazardous wastes need to be managed with effective and efficient measures, including improved reuse, recycling and recovery of useful materials and energy. The 3R concept (Reduce, Reuse, Recycle) encapsulates well this life-cycle approach to waste.

Amidst this challenge, the idea of “circular economy” is gaining traction towards a more sustainable economy. The concept of the circular economy works on the lines of recycling & reuse and is being adopted by several tech giants & corporates.

There is no fixed definition of the circular economy however, the 2019 United Nations Environment Assembly, the UN's flagship environment conference, described it as a model in which products and materials are “designed in such a way that they can be reused, remanufactured, recycled or recovered and thus maintained in the economy for as long as possible”. (Agha, 2021)

A study by KPMG and ASSOCHAM says computer equipment accounts for almost 70 percent of e-waste in India, followed by telecom/phones (12 per cent), electrical equipment (8 per cent) and medical equipment (7 per cent). (Iqbal & Swan, 2021)

## **Plastic & E-waste management legislations in India**

Ministry of Environment and Forests (MoEF), Government of India is the nodal agency for policy, planning, promoting and coordinating the environmental programme including electronics waste management. The management of e-waste was covered under the Environment and Forests Hazardous Wastes (Management and Handling) Rules 2008. An exclusive notification on E-waste (Management and Handling) Rules, 2010 under the Environment (Protection) Act, 1986 has been notified (S.O. 1035) on 12th May 2011 to address the safety and environment-friendly handling, transporting, storing, recycling of e-waste and also to reduce the use of hazardous substances during manufacturing of electrical and electronic equipment. These rules came into effect on 1st May 2012. (Dr. S. Chatterjee, n.d.,5)

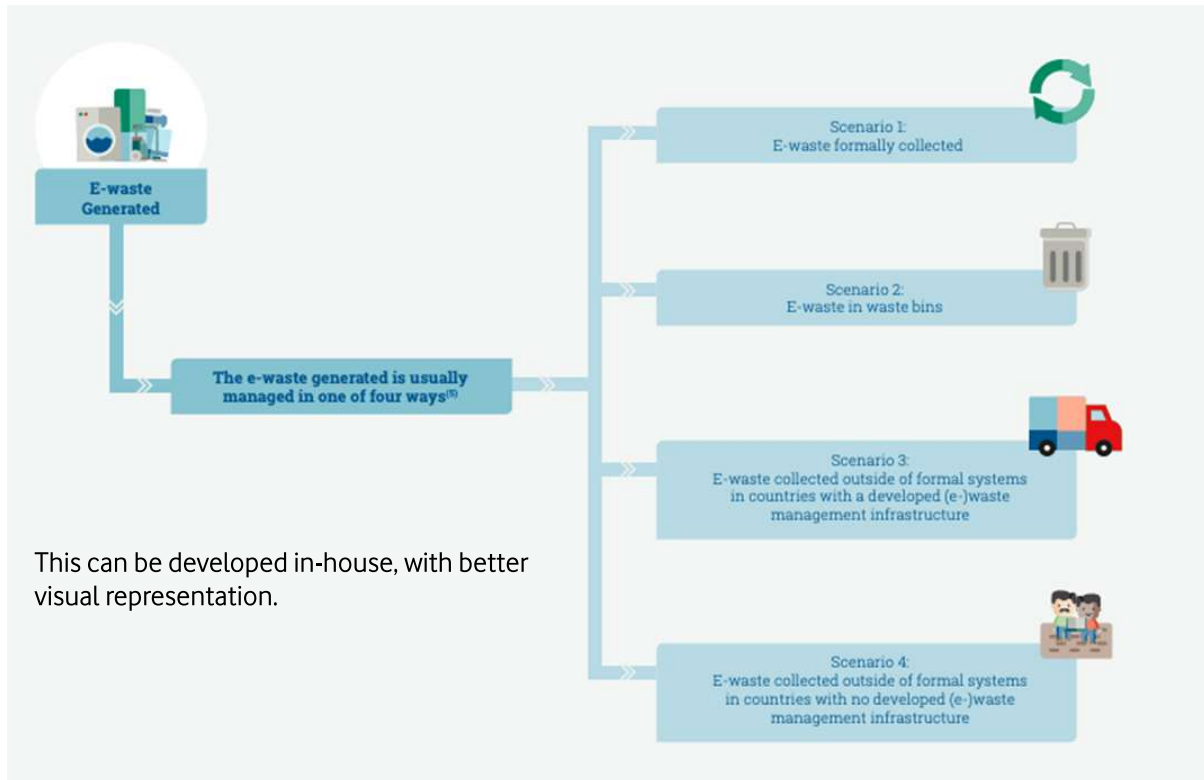
The Ministry notified Plastic Waste Management Rules, 2016 on 18th March 2016. As per the Rules, the generators of waste have been mandated to take steps to minimise the generation of plastic waste, not to litter the plastic waste, ensure segregated storage of waste at the source and hand over segregated waste to local bodies or agencies authorised by the local bodies. The rules also mandate the responsibilities of local bodies, gram panchayats, waste generators, retailers and street vendors to manage plastic waste.

“Extended Producer Responsibility” is defined as a policy principle to promote total life cycle environmental improvements of product systems by extending the responsibilities of the manufacturer of the product to various parts of the entire life cycle of the product, and especially the take-back, recycling and final disposal of the product.

## **E-waste collection issue**

In 2019, the formal documented collection and recycling was 9.3 Mt, thus 17.4% compared to e-waste generated globally. It grew by 1.8 Mt since 2014 with an annual growth of almost 0.4 Mt. However, the total e-waste generation increased by 9.2 Mt, with an annual growth of almost 2 Mt. Thus the recycling activities are not keeping pace with the global growth of e-waste. The statistics show that in 2019, the continent with the highest collection and recycling rate was Europe with 42.5%, Asia ranked second at 11.7%, the Americas and Oceania were similar at 9.4% and 8.8%, respectively, and Africa had the lowest rate at 0.9%. (Forti et al., 2020, 14)

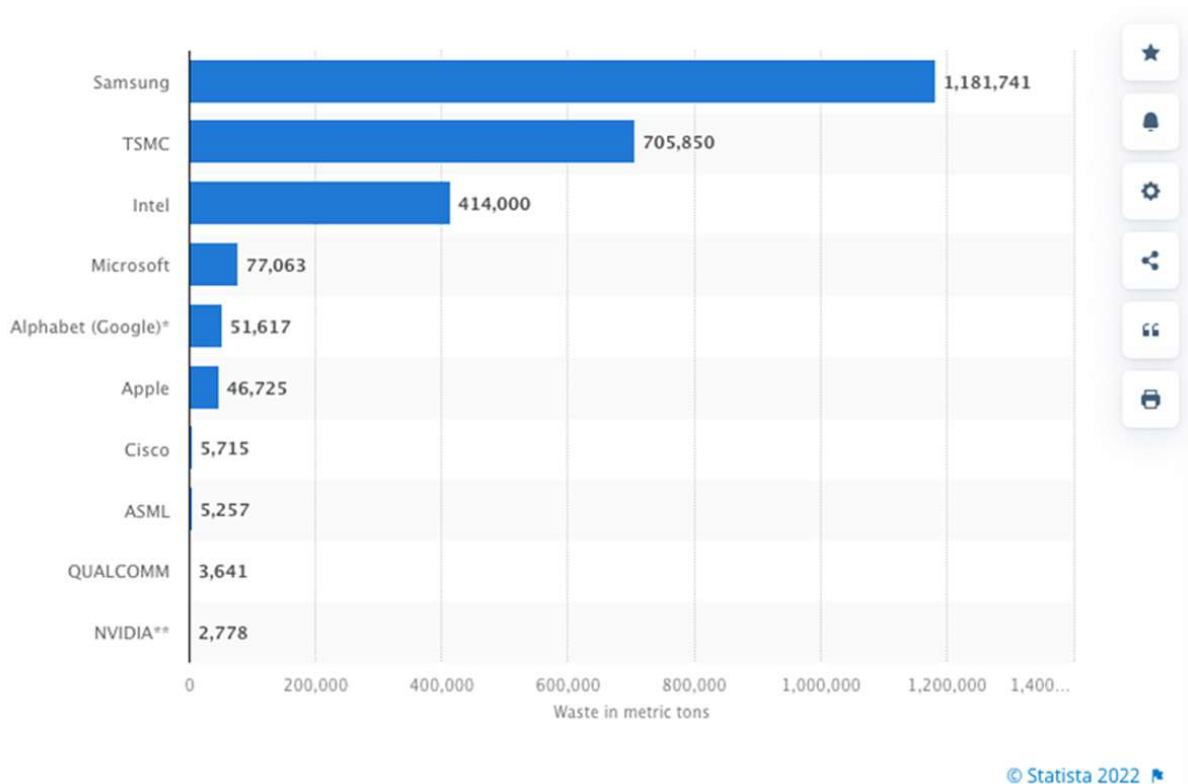
## E-waste collection process



(Source: Global E-waste monitor)

## E-waste generation by tech giants

As per the Global E-waste Monitor report 2020, globally about 55.5 Mt of E-waste was generated in 2020. This electronic waste is directly proportional to the production and demand for electronic consumer goods as they comprise a huge proportion of this total generated e-waste. This waste comes in many forms, with 31 per cent generated by small electronics such as microwaves, shavers, and cameras. Approximately 28 per cent is generated by large electronics such as washing machines and refrigerators. Smart devices, smartphones, computers, televisions, lamps, and other devices make up the rest. (Forti et al., 2020.)



Waste generated from leading tech companies worldwide in 2020 (in metric tons)  
(Source: Statista)

## Type of E-waste generated

Companies	Types of E-waste generated
Tata Group	Aluminium body of vehicles, Refrigerator, Washing Machine & Air Conditioner, Microwave Oven and Water purifier, etc.
Godrej Electronics	Home Appliances: Refrigerators. Washing Machines. Disinfecting Appliances. Dishwashers. Air Conditioners. Microwave Ovens, etc. Commercial Appliances: Medical Refrigerators. Deep Freezers. Food & Beverage Cooler. Disinfecting Appliances, etc.
Infosys	Centralised Data Processing units- Mainframe, Minicomputer, Switch, Router, Power Cords/Cables, Adaptors & Servers
Tech Mahindra	IT consumables such as laptops, desktops, printers and any other electronic hardware used for business operations of the company
Asus	Tablet Notebook Projector LCD Monitor, PC, EBox and PC accessory Mobile Phone Removable Rechargeable Battery Other related products, such as motherboards, media cards, Internet equipment, optical access equipment

## E-waste management & Circular economy approach by corporates

Companies	
Tata Group	<p>Tata at present is functioning in the resource-intensive sectors such as steel, chemicals, infrastructure etc. and hence it is ensuring the long-term security of raw materials and shifting towards efficient industrial processes to minimise waste and focus on resource productivity.</p> <p>Keeping this in mind, the group has been strategically working on a three-pronged approach to enhance resource productivity and embed circular principles within the group:</p> <ul style="list-style-type: none"> <li>● Creating awareness</li> <li>● Applying the CE Concept to Identify Business Opportunities</li> <li>● Policy Advocacy on Resource Productivity</li> </ul>
Godrej Electronics	<p>Godrej Group committed as a signatory to the 'Mission on Sustainable Growth-CII Code for Ecologically Sustainable Growth'. Godrej is committed to reduce resource intensity &amp; emissions, discharge &amp; waste generation by 2-6% every year.</p> <p>Godrej believes in the Reduce, Reuse, Recycle (3 Rs) element in their processes. As an initiative in this space, Godrej has taken a step toward reusing discarded materials as a resource for manufacturing.</p>
Infosys	<p>Infosys's waste management approach is based on the philosophy of Reduce, Reuse and Recycle to minimize waste, including e-waste. The brand seeks to uphold its ambition of zero waste to landfills through active minimization combined with technology investment in recycling and streamlining systems and processes.</p> <p>With strategic efforts, Infosys contribute to a circular economy and convert waste into a resource.</p>
Tech Mahindra	<p>Tech Mahindra's E-waste management policy complies with the Government of India's E-waste (Management and Handling) Rules, 2011. It is disposed of through government authorized certified vendors for recycling. Tech Mahindra has taken a target of 100% compliance with E-waste mgmt. Policy.</p>
Asus	<p>Asus defines the circular economy as the key to sustainable operations. They have evolved from a policy of passive pollution prevention to taking active, preemptive measures with the goal of further detaching economic growth from resource consumption that produces carbon emissions.</p> <p>ASUS works with recycling vendors with the highest standards for protecting our environment, ensuring worker safety, and complying with global environmental laws.</p>



## Projects/Initiatives to manage E-waste

Companies	Projects/Initiatives
Tata Group	<p><b>REALCAR Recycled Aluminium Car:</b> Recycled ALuminium CAR, launched in 2008 and funded by Innovate UK, sought to create a closed-loop value chain to recycle vehicles at the end of their lifecycles. REALCAR took the post-industrial waste from aluminium body panel stamping and recycled it back to the supplier (Novelis) to be incorporated into new body panels.</p> <p>Many Tata companies generate byproducts that have secondary life. These product materials could be reused after a recycling process.</p>
Godrej Electronics	<p><b>Godrej take back policy:</b> Godrej stands committed to implement E-Waste Rules. For this purpose, Godrej has partnered with the recyclers with a valid authorization from the Pollution Control Board to facilitate our customers to enable them to dispose of e-waste products after their end-of-life* in an environmentally conscious manner.</p> <p>This initiative covers pick up of e-waste related to only Godrej air-conditioners, washing machines and refrigerators and the consumers need not pay any amount in this process.</p>
Infosys	<p><b>Waste management project:</b> Infosys is a technology company and the campuses' obsolete &amp; unusable systems and parts become e-waste. All these non-hazardous dry waste goes to authorised recyclers and is thus diverted from landfills.</p> <p><b>Buy Back model:</b> Infosys has an <b>EPR (End Producer's Responsibility)</b> approach &amp; a buy-back model by which vendors buy laptops and desktops back that are no longer in use. They refurbish the machines and get them into working order.</p>
Tech Mahindra	<p><b>Tech Mahindra</b> has adopted the <b>E-waste management policy</b> through the process to reduce, reuse, recycle and recover across the value chain to decrease plastic waste. The company has a robust waste management system of segregation at source, collection and management of both hazardous and non-hazardous waste.</p>
Asus	<p><b>Waste management policy:</b> With the circular economy approach in product designing, Asus aims to achieve zero waste in business operations. ASUS classifies waste into general waste and hazardous waste. Hazardous waste mainly included R&amp;D materials and waste, which are treated and recycled by approved recyclers.</p> <p><b>#DiscardResponsibly campaign:</b> Asus announced an initiative, #DiscardResponsibly last year on International E-waste Day to evoke a sense of accountability amongst citizens. According to the company, the new initiative is a step towards building a sustainable environment by creating awareness around the impact of careless dumping of electronic waste on the environment. As a part of the new initiative, the company also organised digital consumer engagement activities.</p> <p><b>Trade-in program:</b> In order to promote recycling and e-waste management, Asus has initiated a trade-in program whereby consumers can submit their obsolete electric goods and can get cash discounts on their new purchases.</p>



## Impacts

Companies	Impacts
Tata Group REALCAR project-	<p><b>Closed-loop volumes:</b> REALCAR took the post-industrial waste from aluminium body panel stamping and recycled it back to the supplier (Novelis) to be incorporated into new body panels. JLR is also closing the loop on its precious materials, recycling and reusing them as part of its circular economy. REALCAR reclaimed over 50,000 tonnes of aluminium press shop scrap in the production process during 20 15/16.</p> <p><b>Reduced emissions:</b> With this approach, the JL group managed to reduce a significant amount of carbon emissions as aluminium recycling requires up to 95% less energy than primary aluminium production.</p>
Godrej Electronics	As a part of Extended Producer's Responsibility in India, we have collected and safely disposed of 20,500 MT of post-consumer plastic packaging waste during the fiscal year 2020-21 from 28 states and 6 UTs. This constitutes 100% equivalent to plastic waste generated from the sale of our products pan India. We're now plastic neutral and committed to maintaining this status going forward.
Infosys	Infosys's multi-tiered waste disposal approach was able to divert more than 706 tons of hazardous waste from the landfills in fiscal 2019.
Tech Mahindra	<p>In FY21 Tech Mahindra sent about 143.77 tonnes of E-waste and battery waste for recycling through an authorised recycler.</p> <p>Disposed 54.969 tons of e-Waste from Bengaluru, Noida, Pune, Kolkata, Hyderabad, and Gandhinagar to the Pollution Control Board authorised agency.</p>
Asus	The brand successfully provided recycling services in more than 28 countries and recycled about 13.4 % of electronic waste.

The above-mentioned corporates working in the tech domain were studied closely to identify the projects and initiatives that were undertaken by them respectively aligned with the E-waste management & circular economy approach. It has been identified that these firms are significantly putting efforts to manage electronic waste generated. The Reduce, Recycle and Reuse approach is observed to be common among them and is aligned with the EPR (Extended Producer Responsibility) and circular economy goals.

## Challenges in the E-waste sector

### Inadequate E-waste management Infrastructure

According to the report by the United Nations World Economic Forum 2019 report, India's 95 per cent of e-waste is recycled and processed through the informal sector. This number highlights the urgency for an adequate E-waste management infrastructure as India generated about 1,014,961 tonnes of e-waste in FY 2019-2020 highlighted CPCB. The registered E-waste recyclers in the country have the ability to manage only 1/5th of the total amount of e-waste generated annually.

### Lack of Awareness

One of the key factors behind the stunted growth of the e-waste management sector in India is the lack of awareness among society. There is a lack of public awareness of e-waste hazards in India, and recycling is, therefore, very low. Most consumers do not know or have less knowledge about the hazardous nature of e-waste components or the penalties for improper disposal. They are not informed about e-waste management practices conducted by urban municipal or state government agencies.

The majority of people and urban household consumers used to sell e-waste or get some discount in exchange when they purchase any new electrical or electronic products from small-scale retail shops. Since consumers lack market information about prices for e-waste and various e-waste components, they have few financial incentives for responsibly disposing of their e-waste. (Bajpai, n.d.)

### Inefficiency of the Informal recycling Sector

The informal sector managing e-waste in India comprises local waste collectors and the convenience and monetary incentives they provide have made them the first choice among every household. However, the informal e-waste sector still lacks the new technology and infrastructure to safely dispose of the collected e-waste.

E-waste management practices pose serious environmental and health hazards to the workers themselves as well as the larger public. It presents a potential moral dilemma for public policy, and the sustained success of any e-waste management in India will hinge on resolving this dilemma. (Bajpai, n.d.)

## **Inadequate Regulatory Design and Enforcement**

The mandatory take-back system for producers, without accompanying collection targets have no incentives to take responsibility and therefore induced few improvements in e-waste management practices. Certain amendments were proposed, which provided more regulatory certainty by specifying gradual and increasingly stricter collection targets. However, the regulatory design places a significant burden on the already ill-equipped regulatory agencies. The regulators must review the EPR plan submitted by the producers, grant authorization, and enforce the EPR plan's provisions. (Bajpai, n.d.)

The regulations must also specify, elaborate standards and processes for other entities for dismantlers, collectors, recyclers, and bulk consumers and require the agencies to enforce compliance with specific standards. The regulatory authorities must capture benefits from poor enforcement, lack of transparency, and unwillingness to publicly share information on compliance and regulatory actions. It has long afflicted environmental regulatory enforcement in India, and e-waste regulations are no exception. It poses a significant public policy challenge to the future of e-waste management in India. (Bajpai, n.d.)

## **Improvement scope in the E-waste sector**

### **Public Awareness**

The current level of awareness about E-waste, impacts of e-waste and other aspects related to e-waste management is quite low. There is little to no understanding of the harmful environmental impacts such as the emission of greenhouse gases, and the release of toxic substances during informal recycling procedures.

The current e-waste regulations require the producers to provide, on the websites, information on the impacts of e-waste, appropriate disposal practices, and other issues. There is also a requirement for awareness campaigns at regular intervals. Stricter guidelines/regulations to the producers on these awareness campaigns' frequency and mode might improve the situation. On its part, the government must consider integrating e-waste awareness campaigns with other waste streams such as batteries and municipal solid waste. (Bajpai, n.d.)

## Training and Upskilling Informal Sector Players

The first step to boosting the E-waste management sector in India could involve recognizing the informal sector as the stakeholder in the future e-waste regime. The initial step to engage the informal sector with adequate resources to manage the safe disposal and recycling of electronic waste could help in targeting local households.

The government must institute a platform that facilitates consultations among various stakeholders like informal sector workers, NGOs working with the informal sector, third parties, private entities, registered recyclers, and manufacturers. The forums can be constituted under the Ministry of Environment, Forest and Climate Change at a certain level under the State Department. (Bajpai, n.d.)

### Regulatory Enforcement

In 2011, the Government of India established the E-Waste (Handling and Management) Rules, which were then formulated into the E-waste (Management) Rules of 2016. The rules outline the regulations for producers/manufacturers, recyclers, dismantlers and dealers to obtain due authorisation from government agencies and administrators to manage e-waste. They also identify the collection centres, refurbishment providers and consumers for handling e-waste. All EEE and their components are categorised and assigned unique e-waste codes. Producers are then informed of the recycling targets based on the amount of e-waste generated. The rules however lack strict compliance but, there is no clear indication of the penalties imposed on the EPR defaulters or on consumers who dispose of e-waste carelessly, or on those who carry out unsafe practices.

The State and Central Pollution Control Board will still be required to monitor and enforce compliance with the standards specified for collection centres, dismantlers, recyclers, and PROs. The MoEFCC must make regulatory actions related to e-waste transparent. Regulatory actions like authorizations and their conditions, data on inspections of registered facilities, and inspected facilities' compliance status should all be made publicly available for scrutiny.

## Conclusion

The growth in urbanisation, globalisation and industrialisation in the 21st century has witnessed unimaginable landmarks. But, unknowingly in the path of achieving these technological milestones we have given birth to a menace known as e-waste. The rapid economic growth and urbanisation are one of the biggest drivers in generating this electronic waste. Besides negative impacts on health as well as increased pollution of air, land and water, ineffective and inefficient waste management results in greenhouse gas and toxic emissions, and the loss of precious materials and resources.

There is an urgent need to address this global problem and especially the corporate tech giants contributing to the generation of e-waste must opt for effective strategies to manage this electronic waste. The projects/initiatives must be aligned with the Extended Producer Responsibility (EPR) and circular economy approach and include the 3R (Reduce, Reuse & Recycle) strategy to create a significant impact. From establishment to implementation and awareness there is a multilevel approach that is required to overcome this problem of e-waste management.



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