

e-Waste and Circular Economy – Legal Implications for Sustainable Development

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Abstract

The research below investigates the emerging global challenge of electronic wastes, also referred to as discarded electrical and electronic equipment by customers, such as remotes, mobile phones, and laptop computers. With the generation of over 18.5 lakh tonnes annually, India is the fifth-biggest producer of E-Waste worldwide, and this report projects a compound annual growth rate in the generation of 30%, which is higher than the global rate. E-waste is categorized into seven classifications, which include information and communication technology, office electronics, large and small domestic appliances, consumer electronics, medical equipment, and recreational and athletic equipment. As indicated in the document, improper disposal has harmful impacts on air, soil, water, and human health, and gives a lot of attention to the discharge of hazardous substances and the resulting risks. It then introduces the concept of a Circular Economy and explains how it is based on reduced levels of waste, extended product life-cycles, and the regenerating of natural systems. Legal frameworks are considered; compared to the Indian legislation between 2016 and 2022, much more attention was provided to increased accountability of producers, especially for solar modules. The paper concludes by pointing out problems in E-Waste policy, such as a lack of statistics and unsustainable

practices in the informal sector, while calling for efficient waste collection, enhanced public awareness, and a shift towards formal management of e-Waste as a means towards tackling the emerging global crisis in e-Waste.

Research Methodology

The methodology for the research paper will follow a critical review of available analytical work, government reports, and studies conducted regarding electronic waste (e-waste) all over the world and in India in particular. This forms a basis through which understanding shall be obtained on e-waste, meaning, types, generation rates, and harmful effects. Moreover, data collection techniques through surveys by agencies and by the government itself, even data analysis, has been used in order to collect data on e-waste generation, management practices, and legal frameworks in India. The concept of a circular economy and its application to e-waste management are critically looked into with the aid of an analysis of the relevant policies and initiatives of the government. Finally, the methodology embraces the identification of problems and opportunities of e-waste management based on academic studies and practical experiences. This holistic approach may help in the overall understanding of the problem of e-waste and the possible solutions to it, thus giving its due contribution to the formulation of informed policy decisions and practices within the domain of e-waste management.

Research Questions

- a) Which laws and rules are there to control how we handle and dispose of electronic stuff in a circular economy, how e waste is becoming a rapidly emerging national issue and the end result affecting

everything around it and how do the laws implemented help make things better for the economy and environment?

- b) How do the laws we have now make companies / producers / bulks consumers / refurbishes / dismantlers / recyclers take responsibility for the electronic things they make and use, especially in a system that focuses on recycling and reusing?
- c) What problems and flaws are there in the law and ground implementation and awareness regarding the recycling and reuse of electronic things, making sure it's good for the environment?

Is e-Waste a growing Global Challenge?

Electronic Waste (e-Waste) refers to outdated or broken electronic devices that we no longer require. This includes old phones, laptops, televisions, and even household appliances such as refrigerators and washing machines. This category includes anything that operates on electricity that either quits operating or that we no longer want. Today, we utilize a variety of electronic devices in our daily lives, including phones, laptops, and televisions.¹ When these devices grow outdated or break, they produce electronic waste. This is a major issue since we are producing more and more of these devices, and when we discard them, they might affect the environment. To safeguard the environment, it is critical to properly recycle or dispose of electronic trash.

India produces a lot of electronic garbage (e-waste), ranking sixth globally. Every year, around 18.5 lakh tonnes of e-waste are generated in India. A research from 2016 found that worldwide, roughly 93.5 million tonnes of e-waste were generated that year, and by 2018, it was predicted to exceed 130 million tonnes. India's

¹E-Waste Management in India, DRISHTI IAS, (July 2024) <https://www.drishtiiias.com/daily-updates/daily-news-analysis/e-waste-management-in-india#:~:text=In%20India%2C%20the%20management%20of%20electronic%20waste%20was,the%20Environment%20%28Protection%29%20Act%20of%201986%2C%20was%20issued.>

e-waste is rapidly increasing, with an estimated 52 lakh metric tonnes predicted by 2020, expanding at a rate of 30% per year, far faster than the global average. Unfortunately, India is also experiencing unlawful dumping of e-waste, which is a major issue.² In India, computer equipment accounts for the majority of e-waste (70%), followed by communications equipment (12%) and medical equipment (7%). This demonstrates that as technology advances, so does the amount of e-waste generated, which is bad for the environment.

Categories of e-Waste and Definitions thereof

One cannot deny that there is an enormous amount of waste in the globe. However, the greatest substantial growth in rubbish has occurred in electronic junk. This form of garbage is typically categorized into seven categories:

- (a) **ICT and Telecommunications Equipment:** These are the devices we use to communicate and work with information. Think about computers, monitors, keyboards, and printers. These are very popular nowadays because they are easy to obtain.
- (b) **Office Electronics:** These are the gadgets we use in offices to do tasks. Calculators, copiers, and phones are among examples. They are important, but they can exacerbate the world's rubbish problem.
- (c) **Large Home Appliances:** These are the large devices that we utilize in our homes for functions such as cooking and cooling. Think of appliances like refrigerators, stoves, and air conditioners. When they are finished, they generate a tremendous amount of electronic garbage.³

² Manoj Kumar Sharma, E-Waste Management Rules, 2016, (July 2024) <https://ebooks.inflibnet.ac.in/esp13/chapter/e-waste-management-rules-2016/>.

³ Mita Defitri, Types of Electronic Waste: Definition and Categories, WASTE 4 CHANGE BLOGS, (July 2024), <https://waste4change.com/blog/types-of-electronic-waste-definition-and-categories/>.

- (d) **Small Home Appliances:** These are the smallest machines we use at home, such as hair dryers and toasters. Despite their modest size, they contribute much to electronic trash. Consumer electronics refers to items that we use on a daily basis, such as televisions and game systems. They are termed consumer electronics because they are designed for everyday people like us.
- (e) **Medical Equipment:** It may surprise you, but medical devices also contribute to electronic trash. These gadgets aid in avoiding, diagnosing, and treating illnesses and injuries. As a result, when they are no longer in use, they contribute to the overall amount of electronic waste. Recreational and sporting equipment It- Naturally, as children grow older, they outgrow some toys and activities. There must be some electronics-related goods. If the toy only includes one electronic component, such as a battery, it is still considered e-waste.
- (f) **Environmental Concerns:** Our homes face both security and environmental difficulties. One of the most pressing concerns nowadays is the growing volume of rubbish. We see a number of various types of technological waste piling up.
- (g) **Leftover Technology:** Nowadays, a large portion of electronic waste is not only damaged or obsolete equipment. Even functional gadgets can fast become obsolete because newer, better ones are always released. So, replacing our old gadgets with new ones contributes to the electronic waste pile.

Harmful Effects of e-Waste

Electronic devices contain hazardous materials, so it is critical to exercise caution when using them. When we're finished with them, we need to handle them carefully. Throwing them away in the incorrect places, such as conventional trash bins or open fields, may be extremely harmful to both people's health and the

environment. When electronics are discarded in places like landfills, they begin to degrade, emitting hazardous substances. These pollutants can enter the air we breathe, the soil in which we grow our food, and the water we drink. This can make people sick while also harming animals and vegetation. To keep ourselves and the environment safe, we must properly recycle or dispose of gadgets.⁴

- (a) **Effects on Air Quality:** When electronic waste is improperly disposed of and broken down or burned, hazardous particles and substances such as dioxins are discharged into the atmosphere. This produces pollutants, which can injure our lungs and cause diseases such as cancer. This pollution does not stay in one location; it can spread across large distances, hurting people and animals far away. Workers handling e-waste are particularly vulnerable, but air pollution can also harm animals and plants.
- (b) **Effects on Soil:** When e-waste is discarded improperly, hazardous metals and chemicals can leach into the soil. This can contaminate the earth, damaging the water below and any plants that grow there. When crops absorb these pollutants, they can become unhealthy to eat and may even impair the land's potential to yield food in the future.
- (c) **Effects on Water:** Toxic compounds included in e-waste, such as mercury and lead, can seep into the earth and eventually reach our water sources. This acidifies and poisons the water, threatening animals, plants, and communities. Polluted water can affect locations far from where e-waste is dumped, making it difficult to find safe drinking water and hurting ecosystems in lakes, rivers, and seas.

⁴ E-Waste: Causes, Concerns and Management, CLEAR IAS, (July 2024) <https://www.clearias.com/e-waste/>.

(d) **Effects on Humans:** Chemicals included in electronic trash, such as mercury and lead, can affect our bodies, creating problems with our brains, hearts, and organs. They can even impair our capacity to create healthy infants. To avoid these negative consequences, proper e-waste management is critical. Rather than tossing away our old devices, we can recycle, repair, or sell them.

Understanding Circular Economy

A circular economy is a manner of doing things that aims to use resources effectively and reduce waste. Instead of extracting resources, manufacturing items, and then discarding them, we strive to reuse, recycle, and renew as many things as possible. This includes conserving resources, transitioning to renewable resources, and recycling materials when they are no longer needed.⁵

A circular economy aims to rebuild all types of resources, including money, people, communities, and the environment. It's like a never-ending loop of reuse. This differs from the old way of doing things, known as a linear economy, in which we take resources, manufacture goods, and then discard them, resulting in a lot of waste. A circular economy is about changing the way we do things so we don't waste resources and harm the environment.

Principles of Circular Economy

(a) **Reduced Waste and Pollution:** The goal here is to generate less rubbish and pollution when we manufacture and use goods. Instead of tossing things away once we've used them, we discover ways to reuse or recycle them. This helps to keep the environment cleaner and healthier for everyone.

⁵ CFI Team, Circular Economy, CORPORATE FINANCE INSTITUTE, (July 2024), <https://corporatefinanceinstitute.com/resources/economics/circular-economy/>.

- (b) **Increase the Useful Life of Items and Materials:** In a circular economy, we want things to endure longer. Instead of discarding items when they fail or become obsolete, we attempt to repair or repurpose them. This saves resources and money while also benefiting the environment.
- (c) **Natural system regeneration:** It entails assisting nature in recovering and maintaining its health. In a circular economy, we try to enhance the environment by planting trees, reducing pollution, and caring for ecosystems. This ensures that we have clean air, water, and land for future generations.

Opportunities in Circular Economy

- (a) **Benefits of ICT Sector in Recycling Electronics:** The information and communication technology (ICT) sector can help recycle electronic equipment, which benefits both the environment and the economy. Reusing materials from outdated gadgets allows us to save important resources, create jobs, and protect the environment from pollution.⁶
- (b) **Economic Opportunity:** Recycling electrical equipment can reduce costs and promote economic stability. Finding reputable suppliers can be difficult due to the high resource requirements of electronics manufacturing. However, by recycling obsolete devices, firms can obtain the resources they require at a lesser cost. This change to recycling also helps to avoid industrial delays and job losses.
- (c) **Environmental Benefits:** Recycling electronics improves the environment by reducing trash and pollution. It also reduces the need for mining, which can degrade natural environments. Using eco-friendly recycling solutions helps to reduce pollution and rehabilitate damaged environments. Furthermore, recycling reduces greenhouse gas emissions and prevents climate change.

⁶ Circular Economy in Electronics and Electrical sector, Ministry of Electronics and Information Technology, (July 2024) https://www.meity.gov.in/writereaddata/files/Circular_Economy_EEE-MeitY-May2021-ver7.pdf.

Legal Frameworks for e-Waste Management

- (a) **Scope of Application:** The government's regulations regarding electronic garbage (e-waste) have evolved over time. In 2016, the restrictions applied to a wide range of people who manufacture, sell, and deal with e-waste. However, in 2022, the rules are limited and only apply to certain groups. This adjustment is intended to make the laws more stringent and focused on the most critical aspects of the e-waste system.
- (b) **Scope of E-Waste:** In 2016, the restrictions only applied to a restricted number of electronic gadgets. However, in 2022, they expanded to encompass a wide range of gadgets, including tablets, GPS devices, and medical equipment. This adjustment reflects the expanding number of technological gadgets that we use and must manage properly.
- (c) **Registration Requirements:** According to the 2016 rules, different people involved in e-waste required authorization from several pollution control bodies. However, beginning in 2022, everyone participating will be required to register online with the Central Pollution Control Board. This makes it easier to keep track of who is doing what and ensures that everyone adheres to the guidelines.⁷
- (d) **E-Waste Management Compliance:** The 2022 guidelines give producers of electronic devices more responsibility for ensuring that their products are properly recycled. They must satisfy recycling targets and obtain certificates from licensed recyclers. If they do to obey these regulations, companies may incur penalties under environmental laws.

⁷ Nawneet Vibhaw, Himanshi Pabreja, E-Waste Management Rules, 2022: An Overview, MONDAQ, (July 2024) <https://www.mondaq.com/india/waste-management/1303420/e-waste-management-rules-2022-an-overview>.

- (e) **Management of Solar Photo voltaic Modules:** The 2022 guidelines include particular standards for those who manufacture or utilize solar panels. They must register, trace their products, and follow requirements for storing and recycling e-waste. This is significant because solar panels are becoming more ubiquitous, and they must be carefully managed when no longer in use.
- (f) **Bulk Consumer concept and Responsibilities:** The concept of a bulk consumer has altered under the 2022 guidelines. It now encompasses anyone who uses at least a thousand electronic gadgets per year. This modification simplifies things and eliminates the need for various types of consumers. Everyone, including shops, is responsible for ensuring that e-waste is properly recycled.

e-Waste Management: Issues and Challenges for Policy

- (a) **Poor Data on E-Waste Generation Rates:** The rules passed in 2012 mandated that each state keep track of how much electronic garbage (e-waste) it generates. So far, however, no state pollution control bodies have taken this action. It is difficult to obtain precise data on e-waste because sales information for electronic devices is typically only available at the national level. Additionally, some e-waste enters the country illegally from other sources. It is difficult to develop effective systems for collecting and recycling e-waste without accurate data on how much is produced and where it comes from.⁸
- (b) **Unsustainable Practices in the Informal Sector:** Even if there are more official recycling facilities, the majority of e-waste is still handled by informal labour. This is because it is more convenient for people to just give their old equipment to informal collectors who visit their homes. These collectors offer tiny amounts of money, making it more appealing for consumers to give them their e-waste rather

⁸ [E-Waste Management in India - Challenges and Strategies](https://hindrise.org/resources/e-waste-management-in-india/) , HINDRISE, (July 2024), <https://hindrise.org/resources/e-waste-management-in-india/>.

than delivering it to an official location. However, the informal sector's handling of e-waste is detrimental to both the environment and human health.

(c) **Market Frictions for End-of-Life Products:** Private companies that seek to recycle e-waste have difficulty obtaining enough of it to make their operations profitable. Setting up recycling systems is expensive, and without enough e-waste to recycle, enterprises cannot cover their expenditures. Furthermore, there is a lack of information on cost-effective recycling methods, and many are unfamiliar with proper e-waste management. This makes it difficult for e-waste recycling companies to expand.

(d) **Insufficient Regulatory Design and Enforcement:** The guidelines enacted in 2012 did little to ensure that businesses accepted responsibility for properly treating e-waste. The adjustments implemented in 2016 were slightly better, but they put a lot of strain on the organizations responsible for enforcing the regulations. Also, some people try to prevent the regulations from being implemented since they profit when things are not adequately regulated. This makes it difficult for India to manage e-waste efficiently in the future.

Responsibilities of State Government for Environmentally Sound Management of e-Waste

(a) **Worker Groups for Recycling and Dismantling Facilities:** To make it easier to set up locations where e-waste may be recycled and dismantled, worker groups should be formed to accomplish these tasks. Government bodies in charge of labour or industry should ensure that these workers are

recognized, registered, and given safety training. They should also inspect these sites every year to ensure the workers' safety.

(b) Setting aside Industrial Space: The government can designate particular locations for recycling and disassembling electronic trash. This helps ensure that these activities take place in safe and supervised environments, away from residential areas.⁹

(c) Expenses of Sampling and Testing: When new electronic items are manufactured, the producer is responsible for covering the expenses of testing them to ensure that they fulfil safety standards. The Central Pollution Control Board will randomly test certain items to ensure that they follow the rules. If a product fails the test, the maker must rectify it or remove it from the market.

(d) Compliance Monitoring and Enforcement: The Central Pollution Control Board will conduct random tests on electronic products to see whether they contain dangerous compounds. If a product does not meet the criteria, the manufacturer must take action to correct it. This ensures that electronic devices on the market are safe for consumers and the environment.

Details of e-Waste collected and processed during FY 2021-22 across States and Union Territories

| No. | Name of the State / Union Territory | e-Waste collected and processed (in Tonnes) |
|-----|-------------------------------------|---|
| 1. | Andhra Pradesh | 2021.19 |
| 2. | Assam | 67.00 |

⁹Shangliao Sun, E-waste in India - statistics & facts, STATISTA, (July 2024), <https://www.statista.com/topics/11764/e-waste-in-india/#topicOverview>.

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A Publication of KnowLaw

Volume 03

KnowLaw

| | | |
|-----|------------------------------------|-----------|
| 3. | Andaman & Nicobar Island | 0.78 |
| 4. | Bihar | 41.07 |
| 5. | Chhattisgarh | 4167.90 |
| 6. | Chandigarh | 67.92 |
| 7. | Delhi | 2130.79 |
| 8. | Dadra and Nagar Haveli & Daman Diu | 12.34 |
| 9. | Gujarat | 30569.32 |
| 10. | Haryana | 245015.82 |
| 11. | Himachal Pradesh | 373.20 |
| 12. | Jammu & Kashmir | 561.61 |
| 13. | Jharkhand | 366.71 |
| 14. | Karnataka | 39150.63 |
| 15. | Kerala | 1249.61 |
| 16. | Madhya Pradesh | 553.59 |
| 17. | Maharashtra | 18559.30 |
| 18. | Mizoram | 14.85 |
| 19. | Odisha | 477.54 |
| 20. | Punjab | 28375.27 |
| 21. | Puducherry | 31.77 |
| 22. | Rajasthan | 27998.77 |

| | | |
|-----|--------------|--------------------|
| 23. | Sikkim | 8.47 |
| 24. | Tamil Nadu | 31143.21 |
| 25. | Telangana | 42297.68 |
| 26. | Tripura | 13.67 |
| 27. | Uttarakhand | 51541.12 |
| 28. | West Bengal | 320.44 |
| | Total | 5,27,131.57 |

Central Pollution Control Board shall publish the methods for Sampling and Analysis of Hazardous Substances¹⁰

- (a) **Transport of e-Trash:** When electronic trash (e-waste) needs to be disposed of or recycled, it must be transported properly utilizing a manifest system. This means there is a clear record of where it is going and how it is handled, ensuring that everything is done correctly.
- (b) **Accident Reporting:** If an accident occurs while e-waste is being processed or transported, anyone concerned, such as the manufacturer, carrier, or recycler, must immediately report it to the State Pollution Control Board. This allows authorities to respond promptly and prevent more harm to the environment or people.
- (c) **Liability for E-Waste Handling:** Everyone involved in the handling of e-waste, from the manufacturer to the recycler, is liable for any damage caused if the waste is not correctly managed.

¹⁰ Aprajita Sharma, Ewaste management in India , Policies and Best Practices, [E-waste management in India , Policies and Best Practices \(itu.int\)](#).

This includes damage to the environment and harm to others. If the regulations are broken, the responsible parties will face sanctions.

- (d) Inclusion of Informal Sector:** The guidelines also seek to incorporate informal labour, such as trash pickers, into the formal economy. This allows these individuals to receive sufficient training and assistance while guaranteeing that e-waste is handled securely and responsibly.
- (e) Enforcement of Guidelines:** The Central Pollution Control Board has warned more than 200 electronic device makers, including large corporations, for failing to observe e-waste regulations. This demonstrates that the administration is serious about enforcing these regulations to preserve the environment and public health.
- (f)** The Central Pollution Control Board (CPCB) calculates how much electronic garbage (e-waste) is created across the country. They accomplish this by analyzing how long different electrical items endure on average and how many are sold across the country. They get this information from the corporations who manufacture these devices.¹¹
- (g)** The e-waste generated in India from 21 different types of electronic equipment, as defined in the E-Waste (Management) Rules of 2016, has been tracked since the fiscal year 2017-18. This means they keep track of how much e-waste is generated annually from these specific categories of electronic gadgets.

¹¹*Generation of E-waste*. PIB Ministry of Environment, Forest and Climate Change, (27 JUL 2023 3:38PM), <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1943201>.

| Financial Year | Generation (Tonnes) |
|-----------------------|----------------------------|
| 2017-18 | 7,08,445.00 |
| 2018-19 | 7,71,215.00 |
| 2019-20 | 10,14,961.21 |
| 2020-21 | 13,46,496.31 |
| 2021-22 | 16,01,155.36 |

Conclusion and Recommendations

The analysis that views electronic waste as a critical global concern, also aliasing it as e-waste, cites India as one of the contributors to this growing problem. Coupled with many types of e-waste and the alarming trend of unauthorized disposal in the country, this makes the need to act very urgent. The harmful effects observed on air, soil, water, and human health underline the need for instant action. The new thing about the proposed transition to a circular economy is that it does include an all-in approach, focusing on reduction of waste, longevity of products, and restoration of natural systems. This underlines the requirement of legislative frameworks in managing e-waste, where greater producer responsibility will play an important role. The present study emphasizes collective actions in deploying sustainable practices and circular economy concepts with stringent regulatory measures across regions to reduce the adverse impacts of e-waste while encouraging responsible electronic waste management worldwide.

This paper presents a huge global challenge of electronic waste or e-waste and points out the important contribution that comes from India to this rapidly growing problem. The variability of the types of e-waste,

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Volume 03

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together with the concerning trend of illegal disposal within the country, further points to the urgency with which the situation needs to be addressed. The known effects on air, soil, water, and human health underline the criticality of action. The new transition to be based on reducing wastes, extended time cycles of products, and regenerating natural systems. Or even legal frameworks for e-waste disposal are highly regarded, with increased liability of producers. The way forward, therefore, calls for a collaborative and collective readiness to embrace sustainable practices, circular economy principles, and stringent legal frameworks in mitigating e-waste harm toward which responsible e-waste management is moving globally.