



# E-WASTE MANAGEMENT: A HAZARDOUS CHALLENGE FOR HUMAN LIFE

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## ABSTRACT

*In the century of twenty-first, the whole world is facing various types of environmental pollution. In these numerous sorts of pollution e-waste and single-use plastic are a burning concern for each country. These are affecting our daily lives and will definitely affect our next generation's lives. E-waste or Electronic waste includes old, end-of-life electronic appliances such as computers, laptops, printers, TVs, audio-video players, CDs, refrigerators, mobile phones and their chargers, etc. Improper handling of e-waste contains many hazardous and toxic constituents or components that may negatively impact the environment and also affect human health. Various governments and organizations of several countries have continued to adapt and develop environmentally sound decisions, methods and techniques for e-waste management to tackle the ever-growing threat of e-waste to the surrounding and human health. E-waste management is given the highest priority in several developed countries but in rapidly developing countries like India, it is difficult to completely accept or replicate the e-waste management system. This paper studies the e-waste composition, categorization, Global and Indian e-waste scenarios, pollutants in e-waste, recyclability of e-waste, health impacts, hazardous materials found in the e-waste and e-waste management companies in India. It also highlights the best available practices, recycling, and recovery processes followed and their environmental and occupational hazards. The purpose of the present study is to analyze the e-waste issues and various challenges for e-waste management, especially in the Indian scenario.*

**Keywords:** Electronic waste, E-waste recycling, E-waste Management, Single-use plastic

## INTRODUCTION

Advances in the field of science and technology brought about the industrial revolution in the 18<sup>th</sup> Century which marked a new era in human civilization. After that, the information and communication revolution has conveyed enormous changes in the way we organize lives, economies, institutions and industries. No doubt to say that these remarkable developments in the modern era have undoubtedly enhanced the quality of our lives. Every success has some dark side also, as the same here, the enormous growth of humans and their industrialization gave a massive amount of hazardous waste. These hazardous and other wastes pose a great threat to human health and

the environment. The issue of waste management is important for the protection of livelihood, health and atmosphere. It constitutes a serious challenge to modern societies and requires coordinated efforts to address it for achieving sustainable development.

According to the Basel Convention, wastes are those substances or objects, which are disposed of or are required to be disposed of by the provisions of national laws. Additionally, waste is those items which are required to discard by people.

Our daily activities give rise to a large variety of different wastes arising from different sources which include various types of wastes like households generated wastepaper, organic waste, metals etc. The commercial activities of industries also generated various hazardous wastes. Biomedical waste is spawned material which comes from hospitals and other health providers. It consists of various discarded drugs, waste sharps, microbiology and biotechnology waste, human anatomical waste, animal waste etc. Radioactive waste is also a hazardous material which has a high absorption of radio nuclides element which is also very dangerous for health and life. Other sources of waste include useless vehicles, tyres, packaging waste, agricultural waste etc. These waste substances are in the long run hazardous in nature as they are ignitable, reactive, corrosive, explosive, toxic, poisonous or infectious. Hence, they cause a considerable or potential threat to public health and also the atmosphere.

## REVIEW OF LITERATURE

In order to be able to understand the research and establish its objectives, it is necessary to have a good look at past and contemporary research on the topic. The following kinds of literature are related to the research topic.

United Nation Environment Programme (2010) report predicts that by 2020 E-waste from used computers in India will increase to 500 percent; from discarded mobile phones are going to be regarding eighteen times high; from televisions are going to be 1.5 to two times higher; from discarded refrigerators can double or triple; than its individual 2007 levels. Considering the expansion rate, studies show that the volume of e-waste will reach nearly two million MT by 2025.

In a 2011 report of “Ghana E-Waste Country Assessment” found that of 2,15,000 tons of electronics imported to Ghana. In these electronic items 30% were brand new and 70% were used. Of the used product, the study concluded that 15% was not reused and was discarded or scrapped.

Hassan Taghipour et al. (2012) advised that a policy ought to be framed extending producer responsibility (EPR) programme together with a coaching or training programme at totally different levels of society. In Iran, associate degree approach consisting of a mandated product take back is planned for implementing EPR. The Health Ministry and the Environmental Protection Agency ought to strictly supervise E-waste assortment, storage, and employment and/or disposal. The Trade and business Ministries should have control management over the import and production of electronic merchandise.

Peeranart Kiddee et al. (2013), e-waste may be managed by developing eco-design devices, properly collecting e-waste, recover and recycle material by safe strategies, dispose of e-waste by appropriate techniques, forbid the transfer of used electronic devices to developing countries and lift awareness of the impact of e-waste. No single tool is adequate, however along they'll complement one another to unravel this issue. A national scheme like EPR could be a smart policy in finding the growing e-waste issues.

Shubham Gupta et al. (2014) studied that in developing countries like China, Indonesia, Brazil, India's industrial organizations tend to focus a lot of on economic aspects instead of environmental laws of e-waste employment. So, for the profitable recovery of reusable materials and sustainable environment, the efficient recycling of this waste has been rendered indispensable and is considered as a challenge for today's society.

Yamini Gupta and Samraj Sahay (2015) advised that the financial responsibility of the producers and separate collecting and recycling agencies contribute significantly to the success of the extended producer responsibility-based environmental policies. Regulatory provisions, takeback responsibility and financial flow come out to be the three most significant aspects of the extended producer responsibility. The presence of the informal sector had a negative impact on the regulatory provisions.

Prof. Arnav Chowdhury and Prof. Jitendra Patel (2017) 'E-Waste Management and its Consequences: A Literature Review', research paper define and analyze the main areas of research on electrical and electronic waste while offering a broader analysis of the relevant literature. On the basis of some key points, it observed that many countries don't have any standardized technique to estimate e-waste generation. Further, there is a need to implement and frame policies for proper e-waste management in developing countries so as to solve environmental issues related to informal recycling practice. Based on the few key points it has observed that many countries don't have any standardized method to estimate e-waste generation. Further, there is a need to implement and frame policies for proper e-waste management in developing countries. There is also a need for developing a legal framework for the management of this e-waste fraction is one of the challenges for the policymakers in developing countries. For handling e-waste, more and more awareness programs should be generated and gives proper training and education.

## RESEARCH METHODOLOGY

Research Design: Exploratory and empirical research design based on secondary data.

Source of Data: Secondary sources of data like recent newspaper and journal articles, authentic web resources etc. have been evaluated for the purpose of this study. Through such resources, an attempt has been made to formulate an inventory of E-waste in the Indian context, which in turn helps in identifying the wide range of diverse stakeholders in the E-waste generation. For the research work, secondary data will be used, due to availability of secondary data which are highly dispersed and diversified in order to accommodate the current scenario and research related to E-waste in India.

## RESEARCH OBJECTIVES

1. To identify e-waste products.
2. To identify the pollutants and their occurrence in waste electrical and electronic equipment.
3. To identify the health and environmental impacts of e-waste including hazardous substances, their occurrence and impacts.
4. To identify the e-waste condition in the world and in Asia.
5. To identify the Indian companies who are resolving the e-waste.

Tools of Analysis: The Data collected for the study have analyzed logical and meaningfully to arrive at a meaningful conclusion.

## WHAT IS E-WASTE?

The term 'e-waste' is usually understood to confer with unspecified, obsolete, end-of-life appliances using electricity that are disposed of by their owners. It includes electronic merchandise like unused or obsolete computers, mobile, telephones sets, television sets, radios, chargers, earphones, home appliances and other gadgets which are any electrical or electronic appliance that has reached its end-of-life.

For understanding more clearly the e-waste can be categorized as follows:

1. Automatic dispensers
2. Consumer equipment
3. Electrical and electronic tools
4. IT and telecommunications equipment
5. Medical devices (with the exception of all implanted and infected products)
6. Large household appliances
7. Lighting equipment
8. Monitoring and control instruments
9. Small household appliances
10. Toys, leisure and sports equipment

## COMPOSITION OR POLLUTANT ELEMENTS OF E-WASTE

Pollutants or toxins in e-waste are typically present in circuit boards, batteries, plastics, and LCDs (liquid crystal displays). Given below table is showing the major pollutants occurring in waste electrical and electronic types of equipment:

**TABLE: 1**

### **POLLUTANTS AND THEIR OCCURRENCE IN WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT**

S. No.	Pollutant	Occurrence
1.	Arsenic	Semiconductors, diodes, microwaves, solar cells, LEDs (Light-emitting diodes),
2.	Barium	Electron tubes, filler for plastic and rubber, lubricant additives

3.	Brominated flame proofing	Casing, circuit boards (plastic), cables agent and PVC cables
4.	Cadmium	Batteries, pigments, solder, alloys, circuit boards, computer batteries, monitor cathode ray tubes (CRTs)
5.	Chrome	Dyes/pigments, switches, solar
6.	Cobalt	Insulators
7.	Copper	Conducted in cables, copper ribbons, coils, circuitry, pigments
8.	Lead	Lead rechargeable batteries, solar, transistors, lithium batteries, PVC (polyvinyl chloride) stabilizers, lasers, LEDs, thermoelectric elements, circuit boards
9.	Liquid crystal	Displays
10.	Lithium	Mobile telephones, photographic equipment, video equipment (batteries)
11.	Mercury	Components in copper machines and steam irons; batteries in clocks and pocket calculators, switches, LCDs
12.	Nickel	Alloys, batteries, relays, semiconductors, pigments
13.	PCBs (polychlorinated biphenyls)	Transformers, capacitors, softening agents for paint, glue, plastic
14.	Selenium	Photoelectric cells, pigments, photocopiers, fax machines
15.	Silver	Capacitors, switches (contacts), batteries, resistors
16.	Zinc	Steel, brass, alloys, disposable and rechargeable batteries, luminous substances

## HEALTH AND ENVIRONMENTAL IMPACTS OF E-WASTE

E-Waste is a diverse combination of various types of toxic elements, which are capable of creating an irreversible impact on human health and the environment. The relationship between cause and effect is important in all types of waste. Here in causes may be characterized as the causes for the generation and rapid degeneration of electrical and electronic equipment. The reasons for prompt generation and obsolesces of E-waste include rapid economic process or growth, urbanization, industrialization, increased consumerism etc. The consequences effects of e-waste are associated with the health and environmental risks. The effects of improper disposal of E-waste are observed after a relatively long period of time. When an electronic gadget is disposed of with all its hazardous elements embedded in it, precarious health and environmental effects are not observed immediately. It takes a considerable amount of time to have an outlook of the actual risk from the waste. This intensifies the problem of



realization of the hazards from waste. The various hazardous substances, their impacts on human health as well as the environment are incorporated in the following table.

**TABLE: 2**  
**HAZARDOUS SUBSTANCES IN E-WASTE, THEIR OCCURRENCE AND IMPACTS**

S. No.	E-waste components	Toxic metals	Disease caused by the exposure to above permissible limit
1.	Batteries, LCD switches, backlight bulbs or lamps	Hg	Damages brain, kidney and fetuses
2.	Ceramic capacitors, switches batteries	Ag	Excessive amount causing blue pigments on body, damages brain, lung, liver, kidney
3.	Cooling units and insulation foam	CFC	Impacts on the ozone layer which can lead to liver damage in human
4.	Electron tube, lubricant, fluorescent, lamp, CRT gun	Ba	Causes brain swelling, muscle weakness, damage to the heart
5.	Gallium arsenide is use in light emitting	As	Chronic effect and causes skin disease and lung cancer and impaired nerve signaling
6.	Mobile, telephone, batteries	Li	Diarrhea, vomiting, drowsiness, muscular weakness
7.	Monitors, keyboards, cabling and plastic computer housing	PVC	Hazardous and toxic air contaminants, release of HCI causes respiratory problems.
8.	PCBs, battery, CRTs, semiconductors, infrared detectors,	Cd	Pose a risk of irreversible impacts on human health particularly the kidney
9.	PCBs, casing, PVC cables	Br	Thyroid gland damage, hormonal issues, skin disorder, DNA damages, hearing loss
10.	Power supply boxes, motherboard	Be	Causes lung cancer, skin disease, carcinogens

Source: Pathak et. al,(2017)

From the above table: 2, e-waste has been one of the fastest growing waste streams in the world. We can understand that there are many dangerous effects on human health from e-waste. E-waste consists of waste from electronic products like personal computers, mobile telephones and household appliances. E-waste contains valuable materials such as aluminum, copper, gold, palladium and silver, it also contains harmful substances like cadmium, lead and mercury. It is considered hazardous waste due to its toxic ingredients like heavy metals and harmful chemicals such as lead, cadmium, mercury, arsenic with the potential to pollute the environment and damage human health when it is processed, recycled or disposed of.

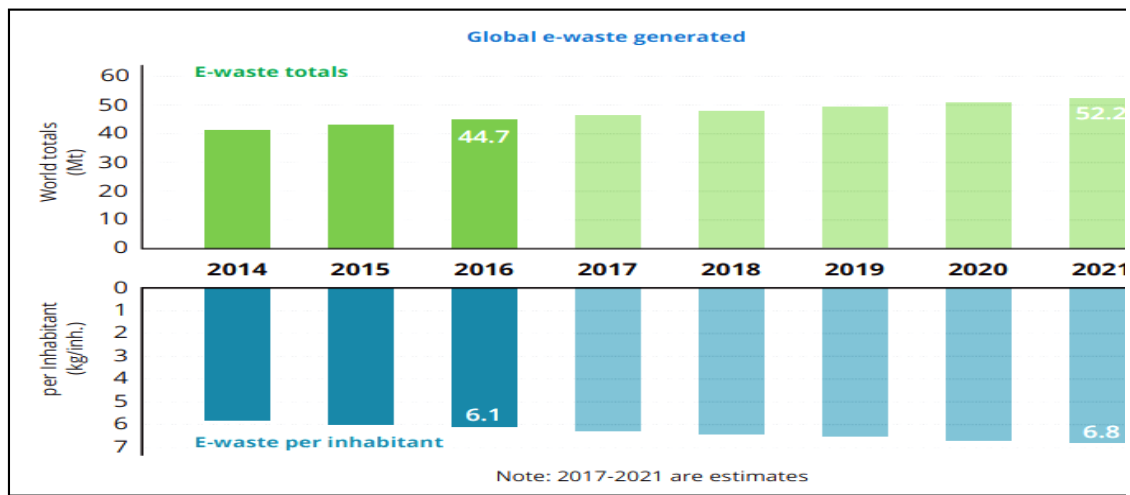


Figure : 1

From the figure 1, In 2016, 44.7 million metric tons of e-waste was generated. This is an equivalent of almost 4,500 Eiffel towers. In Asia, the total e-waste generation was 18.2 Mt in 2016. China generates the highest e-waste quantity both in Asia and in the world (7.2 Mt). Japan generated 2.1 Mt, and India 2 Mt. The top four Asian economies that have the highest e-waste generation in relative quantities are: Cyprus (19.1 kg/inh), Hong Kong, China (19 kg/inh), Brunei and Singapore (around 18 kg/inh). An average of 72% of the population in Asia is covered by a national legislation on e-waste since the most populous countries in Asia (China and India) have e-waste rules. In East-Asia, the official collection rate is close to 25%, whereas in other sub-regions, such as Central and South Asia, it is still 0%, likely leaving most of the e-waste managed by the informal sector. Table 3 is showing the e-waste management companies in India.

**TABLE: 3**  
**LIST OF E-WASTE MANAGEMENT COMPANIES IN INDIA**

S. No.	Companies Name	Place in India
1.	A2Z Group	Gurgoan
2.	Ash Recyclers	Bangalore
3.	Attero Recycling	Noida
4.	Cerebra Integrated Technologies Limited	Bangalore
5.	Earth Sense Recycle Private Limited	Chennai
6.	Eco Recycling Limited	Mumbai
7.	E-Parisara Private Limited	Bangalore
8.	E-R3 Solutions Private Limited	Bangalore
9.	E-WaRDD & Company	Bangalore
10.	e-Waste Recyclers India	New Delhi
11.	Global e-Waste Management and Services	Chennai
12.	Green Scape Eco	New Delhi
13.	Hi-Tech Recycling India Private Limited	Pune
14.	INAA Enterprises	Chennai

15.	Re Globe	Faridabad
16.	TES AMM Private Limited	Sreeperumbudur
17.	Trishyiraya Recycling India Private Limited	Chennai
18.	Ultrust Solutions (I) Private Limited	Chennai

## CONCLUSION

This study was an attempt to find the aspects, practices, health issues, rules-regulations and controls for e-waste around the globe by keeping in mind local problems and research objectives. E-waste is a serious issue on local as well as global scales. Solid waste management, which is already a very complex task in India, is becoming more complicated by the invasion of E-waste. The problem of e-waste has become an immediate and long-term concern as its unregulated accumulation and recycling is lead to major environmental problems endangering human health. E-waste consists of a variety of materials, some of which contain hazardous substances which lead to severe environmental influence and public health risks. In India, the amount of E-waste generated is rising rapidly. With the increasing of the dependency on electronic and electrical equipment, the rise of e-waste generation drastically increases. Over the last few decades, India has become a major destination for e-waste exports from the developed nations.

Due to the lack of awareness, people discard e-waste without proper manner. People tend not to care about the faith of the waste once these are discarded, thus satisfying the principle of "out of sight, out of mind." Establishment of e-waste collection, exchange and recycling centres should be encouraged in partnership with private entrepreneurs and manufacturers. An effective take-back program providing incentives for producers to design products that are less wasteful, contain fewer toxic components, and are easier to disassemble, reuse, and recycle may help in reducing the waste. This would assist governments, policymakers, firms in designing better e-waste management to mitigate e-waste impacts on the environment. Creating awareness among the e-waste generating sectors is the important task now otherwise it will be dangerous for the whole of human life.

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