



Fastest Growing Waste: E-waste

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Authors' contributions

The manuscript carried out in collaboration among all authors. This work was designed, directed and coordinated by authors SS. Authors SAK and RS as the principal investigator, provided conceptual and technical guidance for all aspects of the project. Author SS planned, performed and analyzed the data with authors SAK and RS. Author SAK designed the study, performed the statistical analysis, wrote the protocol, strategized and wrote the first draft of the manuscript. Author RS managed the examination of the research, surveyed and performed other necessary analysis. The document was written and commented on by all authors. All authors read and approved the final manuscript.

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ABSTRACT

Electrical and electronic waste commonly known as e-waste is now one of the world's major concerns. Industries have been so diligent and successful in recent years. The sales and trend of electronic goods have increased rapidly in the world. But with the increase in the manufacturing of electrical and electronic goods and their trend, the result has been somehow leading us to the concern of e-waste. The obsolescence of electrical and electronics goods has become a huge drawback in the field technology because it is measured that various techniques have been used to solve this issue regarding the e-waste produced by industries but none of the solutions to recycle was very effective in the favors of nature and biodiversity. This research paper aims to particularize highlight and determine, the major concern, the effect of e-waste on environment and health.

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1. INTRODUCTION

We live in a world surrounded by peril, dangers, and risks, and there will always the risk because we are living in between machines and technology. The world of artificial intelligence has now become the present. We desire the most compact and best technology now, to achieve that we are upgrading and modifying our techniques. The devices we use now will not in this much use just after a few months. So these electrical and electronic devices will become waste with a period when nobody will use them. These devices are known as electrical and electronic waste or e-waste.

Such wastes swaddle the enormous extent of electrical and electronic waste such as TV sets, computers, notebooks, laptops, printers, and mobile phones, etc. Electronics household appliances are also encompassing into this waste, refrigerators, air conditioners, microwaves, and telephones, etc [1]. These devices are now obsolescent due to:

1. Advancement, enhancement, and aggrandizement in technology.
2. Change in trend or not accessible anymore.
3. The device's working life span ended.

The devices which are not in use anymore or become useless with a period comes in the category of e-waste. E-waste has also further categorized based on the substances and elements found in the devices. These substantial

element based wastes, in the current situation, are more problematic because plenty of them are very hard to recycle or dispose of [2]. Let's take an example of a computer in Fig. 1, which contains various toxic substances, such as toxic gases, chlorinated and brominated substances, includes metals in which very fewer are recyclable or reusable—also, various hazardous substances to health and environment like acids, biologically active materials, plastics, and plastic additives.

A computer is a combination of all these substances. As you can see, every element and component has different properties, and these are not going to dispose of or reuse just from the same technique.

- Circuit boards contain lead, cadmium, and many more metals.
- Batteries contain cadmium.
- Cathode ray tubes contain lead and barium oxide.
- Brominated flame retardant (BFR) coated on circuits boards and cables to prevent from fire injury.
- Copper cables and plastics released toxic dioxins and furan when burnt.
- LCD monitors contain mercury.
- Capacitors contain PCB (polychlorinated biphenyls).
- Circuit boards and monitors contain solder [3].

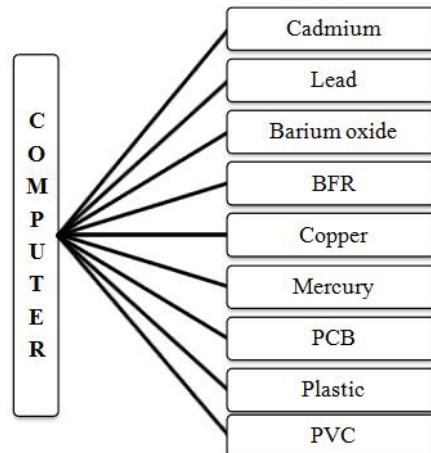


Fig. 1. Hazardous elements found in computer

2. RAPID GROWTH RATE

Globally the quantifiable e-waste production of one year is astounding. According to a report of SBI, electronic waste is growing three times faster than any other type of waste. Also released the growth report of 10 percent in the market from \$6.2 billion to \$6.8 billion (2009) [4].

Production of e-waste globally is unbelievable, 50 million tonnes per year, which worth \$62.5 billion. If the growth is this much rapid, then the production results will be shocking, 120 million tonnes per cent by the year 2050 [5].

3. EFFECT ON ENVIRONMENT AND HUMAN HEALTH

Recycling e-waste is itself a very challenging task. The effect of broken, damaged, unrequired or out of trend electrical and electronic products is a severe issue for all of us. The process of dealing with it is not appropriate for both the market and the environment. Disposal of electronic waste by land filling is becoming very harmful for the environment as well as biodiverse society (living beings). Computer waste contaminates groundwater by producing leachates when buried. Also, the acidification of

soil occurs when computer chips are in melting state dispose of in the ground. Rivers gets polluted due to disposal of recycling wastes, and this may lead us to the scarcity of fresh water [6].

E-waste contains toxic gases, elements and components in overabundance, including metals (lead, gold, copper, cadmium, mercury, lithium and barium, etc.), brominated flame retardants (BFRs) and other additives. All these undeniably affect human health noxiously and hazardously [7].

4. GLOBAL AND INDIAN SCENARIO OF E-WASTE

E-waste is now an enormous problem for the globe. Due to innumerable factors, rapid growth in technological fields, enhancement in media tools, urbanization, planned obsolescence, etc. give rise to the surplus of electronic waste (e-waste). In a recent study, the actual numbers came in light that every year 50 million tonnes of e-waste produced globally. In the total amount of e-waste, China leads the way, with 7.2 million tonnes per annum (TPA), whereas the USA 6.3 million TPA, Japan 2.1, India 2.0 and Germany 1.9 trail behind. In the top ten, most of the countries, surprisingly, are in Europe and the

Table 1. List of diseases from few E-waste constituents [8]

Mercury
<ul style="list-style-type: none"> • Neurological and behavioural disorders. • Kidney and thyroid diseases.
Cadmium
<ul style="list-style-type: none"> • Weakening to bone density and kidney. • Cancer.
Lead
<ul style="list-style-type: none"> • Neurological diseases and high blood pressure. • Risk of heart disease, kidney disease, and reduced fertility.
Polyvinyl Chloride (PVC)
<ul style="list-style-type: none"> • Heart rhythm problems (arrhythmias). • It weakens the heart muscle (cardiomyopathy).
Barium
<ul style="list-style-type: none"> • Gastrointestinal effects, such as diarrhea, gastric pain, vomiting, and nausea. • Exposure may lead to damage to heart, brain swelling, or muscle weakness
Brominated flame retardants (BFRs)
<ul style="list-style-type: none"> • Fat distribution disorder.
Polychlorinated biphenyls (PCBs)
<ul style="list-style-type: none"> • Liver damage, immune suspension, nerve damage, reproductive damage and cancer promotion.
Dioxins and Furans
<ul style="list-style-type: none"> • Liver problems, skin disorders. • Impairment of the immune system, reproductive system and endocrine system.

rest are in the USA, and the more interesting fact that countries Denmark, Sweden, Norway and Iceland are in the top seven which are Nordic countries [9].

The current scenario of India for e-waste management is not of that hype. In India, a large proportion of e-waste is collected by the rag pickers house by house, or the people directly dispose of the e-waste by landfilling or incinerating, which is extremely harmful. These rag pickers pay some amount to the people from whom they receive the rags or e-waste content. They gather almost every waste like papers, books, magazines, cardboard, polythene, metals, etc. including e-waste then they sell or deal with intermediaries or scrap dealers. Afterwards, it's up to scrap dealers how to recycle or reuse the e-waste. Presently, this whole process is a common practice in India. India still does not produce e-waste in overabundance according to per capita population [10].

5. TECHNIQUES TO MANAGE AND UTILIZE E-WASTE [11,12]

1. **Donate old electronics:** Donating of extra/spare/non-required/old electronics will also contribute to the reduction of e-waste.
2. **Sell old electronics:** Selling of electronic waste to the needful buyer. One of the most reliable and best practices to reduce e-waste is selling or donating.
3. **Recycle & dispose of E-waste:** Recycling old electronic devices provides a chance to their inside items to reuse. It is best because it saves environment & gives rise to lucrative products and business opportunities from huge pile of e-waste.
4. **Maintain your electronics:** Time to time maintenance of electronics leads to a long life span of the device. Keep your devices well-maintained to avoid issues.
5. **Repurpose or reevaluate:** Always reconsider or reevaluate the purpose before making a purchase or throwing/disposing of electronics.
6. **Use cloud storage:** In modernization, you can keep/store your data online. It is the most efficient way to use less hardware device and more virtual space, ultimately contribute to reducing e-waste.
7. **Buy energy star rated electronics:** Energy star rated electronics indirectly contributes to environment saving by consuming less energy (resource).
8. **Rent electronic equipment instead of buying:** Try not to purchase the full new

product when you can use it by borrowing or renting instead, which is also a better or reliable way.

9. **Do not engage in malpractices:** Government have restricted those unethical activities which were affecting the environment and humans like the incineration of e-waste, landfilling by e-waste, etc.
10. **Spread awareness:** Aware people, so they do not try improper or informal methods to get rid of e-waste. Try to convince them not to dispose of e-waste in landfills. Acknowledge them with demerits of inappropriate practices and merits of proper or formal methods like recycling or reusing.

6. CONCLUSION

Educate people about the harmful effects (demerits) and recycling electronic wastes should be our primary concern. Both activities should be practice simultaneously, the minimization of production of e-waste and recycle/reuse the existing stock of e-waste. Also, adopt the best available practices from different countries to manage e-waste production or how to reuse/recycle them effectively and efficiently. Recycling is the primary solution or key to reducing e-waste. Practicing proper methods to extract/recover the working, usable items from the enormous pile of e-waste will turn the map of e-waste into many business opportunities. But to accomplish this, we need to work together. Responsibility will be upon all of us, manufacturers, business companies, industrial companies, government, and consumers (public). The government can restrict the improper disposal of e-waste strictly and also set some guidelines for the manufacturing industries, so the process gets initiated from the beginning of the product manufacturing. Manufacturers should have to take proper sustainable steps towards the management of e-waste, which includes the selection of raw material, product, and process of design because these can be the vital step towards "Design for Environment". The people of the country also occupy a crucial role here as they are the consumers of electronic products primarily.

Every year less than 20% of the e-waste recycled formally, whereas at least 80% end up in landfills, incineration, or unscrupulously informal practices. All over the world, improvement through research and development must increase because the production of e-waste is uprising day by day.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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