

The Environmental Impact of Electronic Waste in India & Proposed Solutions

Er. Harpreet Singh Dalla¹, Er. Gursimran Singh²

¹Head, Dept. of CSE & IT, Patiala Institute of Engg. & Tech. For Women, Patiala, Punjab, India

²Head, Dept. of CSE, Continental Institute of Engg. & Tech., Fatehgarh Sahib, Punjab, India

¹harpreetsingh10@gmail.com, ²gursimran_84@yahoo.co.in

Abstract-The main goal of human is to be in continuous happiness. But human cannot be in continuous happiness, if there is no harmony of human with nature. A new type of waste emerging now days that has drastic effect on our environment. In this paper we have raised the Environmental Impact of Electronic Waste in India on our environment and society and discussed various solutions for the deposition of E-Waste. In today's high paced modern world, technology is moving faster and faster and boosting the speed of our everyday lives. Every eight months there is a new model of some type of technological device reaching the market and the old is being discarded as it is unable to keep up with our fast paced society. Where have the millions of old, unwanted computers and other electronics gone? Many have suspected, that relatively few old PC's are being recycled and that most are stored in warehouses, basements, and closets or have met their end in municipal landfills or incinerators. In recent years a great deal of attention has been devoted to the environmental impact of computers and other electronic equipment as these items pose a massive problem for municipal landfills and hazardous effects to human life. The electronics age made unprecedented impact on human society and enhanced our connectivity across the world. The widespread use of electronic items has made communication easier, boosted business activities and created employment opportunities. However, along with the benefits, it has brought into focus many problems, like the rising problem of e-waste that have to be boldly dealt with by society. In the current scenario, it is always possible that human health and environment would be drastically endangered if concerted legislations and actions were not taken for efficient management and disposal of e-waste. Users' manuals can be a pain to read, nevertheless are pretty handy, they cover most of everything we need to know about newly purchased equipment. What is not covered in the users' manual are the toxic chemicals and heavy metals that go into computers and other electronic devices, nor the waste computer-manufacturing generates E-Waste Management is one of the major areas of concerns today. Researchers are trying to find new ways to reduce, recycle and reuse the E-Waste and governments are trying to find methods of implementations of e-waste management schemes. Developed nations are trying to cope up with this startling problem and the result is the dumping of e-waste

into the developing countries like India. As on year 2013, in India growth of E-Waste is 589893 metric tonnes, source: department of information technology. In this paper we have discussed the E-Waste, from where it comes, it's various hazards, where the e waste is going to deposit and at last we have proposed various E-Waste solutions.

Keywords - E waste, Waste management, recycle, computer, pollution.

I INTRODUCTION

Advances in the field of science and technology brought about industrial revolution in the 18th century which marked a start of new era in human civilization. In the 20th Century, the information and communication technology revolution has brought enormous changes in the way we organize our lives, our economies, industries and institutions. These spectacular developments in modern times have undoubtedly enhanced the quality of our living. At the same time, these have led to various problems including the problem of massive amount of hazardous waste and other wastes generated from electronic and electric products. These hazardous and other wastes pose a great threat to the human health and environment. The issue of proper management of wastes, therefore, is critical to the protection of livelihood, health and environment. It constitutes a serious challenge to the modern societies and requires coordinated efforts to address it for achieving sustainable development.

E-Waste

E-waste encompasses a broad and growing range of electronic devices. E-waste has become a problem of crisis proportions because of two primary characteristics:

E-Waste is generated in great quantities

E-Waste can be hazardous

E-Waste Comes From

E-Waste is generated by three major sectors in the India.

- Individuals and small businesses
- Large businesses, government, and institutions
- Original equipment manufacturers (OEMs)

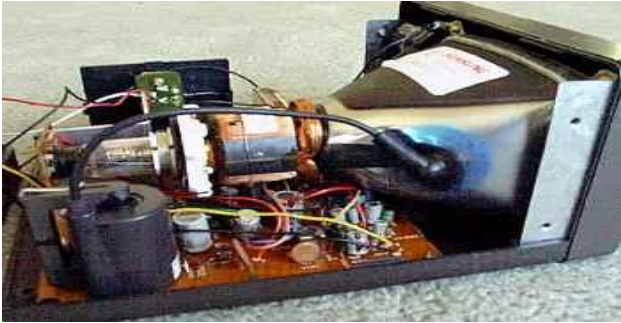


Fig. 1 Computer waste

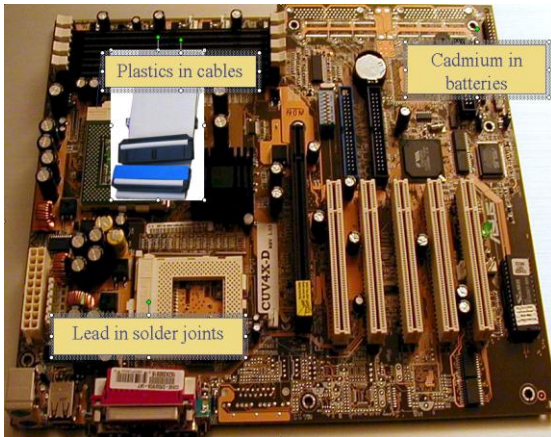


Fig. 2 computer motherboard containing harmful particles

How much E-Waste?

E-waste consists of all waste from electronic and electrical appliances which have reached their end-of-life period or are no longer fit for their original intended use and are destined for recovery, recycling or disposal. It includes computer and its accessories- monitors, printers, keyboards, central processing units; typewriters, mobile phones and chargers, remotes, compact discs, headphones, batteries, LCD/Plasma TVs, air conditioners, refrigerators and other household appliances. The composition of e-waste is diverse and falls under 'hazardous' and 'non-hazardous' categories. Broadly, it consists of ferrous and non-ferrous metals, plastics, glass, wood and plywood, printed circuit boards, concrete, ceramics, rubber and other items. Iron and steel constitute about 50% of the waste, followed by plastics (21%), non-ferrous metals (13%) and other constituents. Most of the IT products, especially computers and mobile phones, have a short lifespan. The products are not designed for longevity and

become obsolete in no time. The most commonly used PC, which earlier had a lifespan of seven years, today has an average lifespan of two to five years. The shorter lifespan of products is a marketing strategy to maintain the pace of consumption and production processes. Therefore, new technologies and 'upgrades' come into the market almost every 18 months influencing consumption patterns.

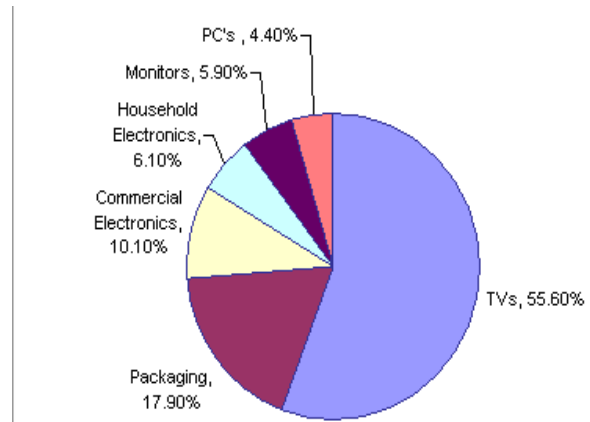
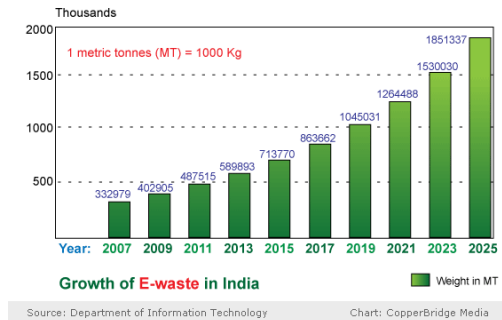


Fig. 3 Composition of E waste in India



How Much E-Waste Generated?

Although no definite official data exist on how much waste is generated in India or how much is disposed of, there are estimations based on independent studies conducted by the NGOs or government agencies. According to the Comptroller and Auditor-General's (CAG) report, over 7.2 MT of industrial hazardous waste, 4 lakh tonnes of electronic waste, 1.5 MT of plastic waste, 1.7 MT of medical waste, 48 MT of municipal waste are generated in the country annually. In 2005, the Central Pollution Control Board (CPCB) estimated India's e-waste at 1.47 lakh tonnes or 0.573 MT per day. A study released by the Electronics Industry Association of India (ELCINA) at the electronics industry expo – "Componex Nepcon 2009" had estimated the total e-waste generation in India at a

whopping 4.34 lakh tonnes by end 2009. The CPCB has estimated that it will exceed the 8 lakh tonnes or 0.8 MT mark by 2012. There are 10 States that contribute to 70 per cent of the total e-waste generated in the country, while 65 cities generate more than 60 per cent of the total e-waste in India. Among the 10 largest e-wastes generating States, Maharashtra ranks first followed by Tamil Nadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab. Among the top ten cities generating e-waste, Mumbai ranks first followed by Delhi, Bengaluru, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat and Nagpur. Following is the situation of four major cities of India regarding E-Waste:

Delhi

A report by the Toxics Link in 2004 found that 70 per cent of electronic waste collected at recycling units in New Delhi was actually exported or dumped by the developed countries. According to the last survey conducted in 2007 on the quantity of waste being produced in Delhi, it was estimated that about 5,000 metric tonnes (MT) of hazardous waste was produced annually. The amount of e-waste generated annually is about 12,000 tonnes. Delhi is the leading processing center of e-waste in the country. According to the study conducted by the GTZ in 2007. The work takes place in small illegal units where neither regulations nor environment or health safeguards are in place. Due to lack of any facility for proper storage and disposal of such waste, mishaps like the ones that occurred in Mayapuri, where a worker got exposed to the radiation and in Mundka, where a plastic fire broke out, are the kind of risks that the workers face each day.

Mumbai

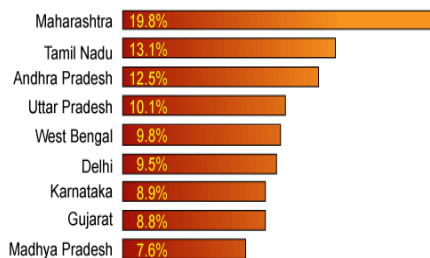
Mumbai ranks first among top ten cities generating E-Waste in India. Mumbai, the financial nerve center of India, is also India's largest port city. The city has a large network of scrap traders, with the main centers in Kurla, Saki Naka, Kamthipura- Grant Road, Jogeshwari and Malad. The total electrical and electronic waste generation in Maharashtra is 20270.6 tonnes, out of which Navi Mumbai contributes 646.48 tonnes, Greater Mumbai 11017.06 tonnes, Pune 2584.21 tonnes and Pimpri-Chinchwad 1032.37 tonnes.

Bengaluru

Bengaluru is the Silicon capital of India. In Bengaluru e-waste recycling is a multi-crore market where e-waste is received in Gowripalya and Nayandahalli. The e-waste scrap dealers send the segregated and dismantled e-waste parts to Delhi and Mumbai every alternative day. According to industry surveys, 8,000 to 10,000 tonnes of e-waste is generated each year by IT firms and electronics manufacturers in and around Bengaluru.

Hyderabad

Hyderabad has been known as the emerging Silicon capital of India. The annual e-waste generation has been estimated for Hyderabad at 3,263,994 MT from computers, printers, television and mobile phones. In 2013, with a projected population of 81.8 lakh, the total e-waste volume is expected to reach 1,07,886 kgs. including 47,117 computers, 58,890 televisions and 1,881 mobile phones.



State-wise E-waste Generation in India (Tonnes/year)

Source: Department of Information Technology

Chart: CopperBridge Media

E-Waste contain following hazards

- Lead
- Cadmium
- Mercury
- Chromium
- Plastics including PVCs
- Brominated Fire Retardants
- Barium
- Beryllium
- Toners
- Phosphor and Additives
- Heavy metals (lead, mercury, cadmium)
- Batteries containing cadmium
- Cathode ray tubes with lead oxide & barium
- Brominated flame-retardants on printed circuit boards, cables and plastic casing.
- PVC-coated copper cables and plastic cases
- Mercury in switches and flat screens
- Poly Chlorinated Biphenyl's (PCB's) in older capacitors & transformers

Where Does E-Waste Go?

- Storage.
- Landfill & Incineration.
- Reuse.

- Domestic Recycling.
- Prisons.
- Export to Developing Countries.
- Majority of waste electronics disposed in landfills
 - Heavy metals may eventually leach into groundwater.
 - CRTs banned from landfills.
 - 50 - 80% of waste electronics collected for recycling in the U.S. is exported overseas to Asian countries.
- Most electronics recyclers export some portion of their waste electronics overseas.
- Frequent destinations: developing countries.

II HAZARDOUS WASTE SOLUTIONS

- Waste Management: Minimize Impact
- Waste Prevention: Minimize the Volume
 - Reduce waste and pollution
 - Reuse as many things as possible
 - Recycle and compost as much waste as possible
 - Chemically or biologically treat or incinerate
 - Bury what is left
- Waste combustion and landfilling

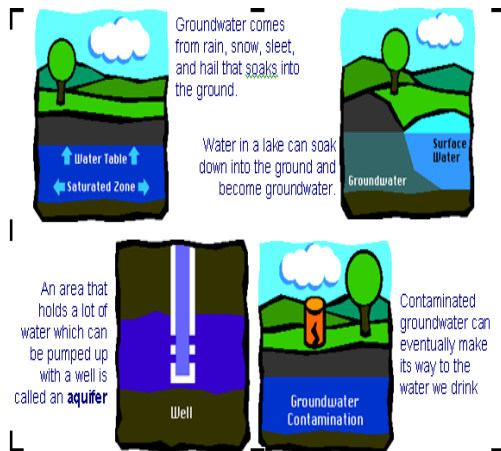


Fig. 4 Ground water pollution caused by e waste

III VARIOUS HAZARDS INVOLVED IN RECYCLING THE E WASTE

- Heavy metals (lead & cadmium in circuit boards)
- Batteries containing cadmium
- Cathode ray tubes with lead oxide & barium

- Brominated flame-retardants on printed circuit boards, cables and plastic casing.
- Poly Vinyl Chloride(PVC)-coated copper cables and plastic computer casings
- Mercury switches and flat screens
- Poly Chlorinated Biphenyl's (PCB's) in older capacitors & transformers
- Hazards of throwing e-scrap into regular waste streams
- Sources and effects of major toxic materials
 - Lead
 - Cadmium
 - Mercury
 - Hexavalent Chromium
 - Polyvinyl Chloride PVC
 - Brominated Flame Retardants

IV FOUR BASIC PRINCIPLES

The four principles called 4 R's can greatly reduce the generation of e waste in India.

- Reduce: Manufacturers can reduce the amount of hazardous components in electronic products.
- Reuse: Users can share obsolete product with other users to reuse the discarded product again.
- Recycle: This is the responsibility of manufacturers to include maximum of those components in the product that can be recycled again, when the product will be discarded.
- Respond: Government, manufacturers, producers and media has to respond to this burning issue of e waste, so that less amount of e waste will generate and there should be proper deposition of e waste.



Fig. 5 Four way principle (4 R principle)

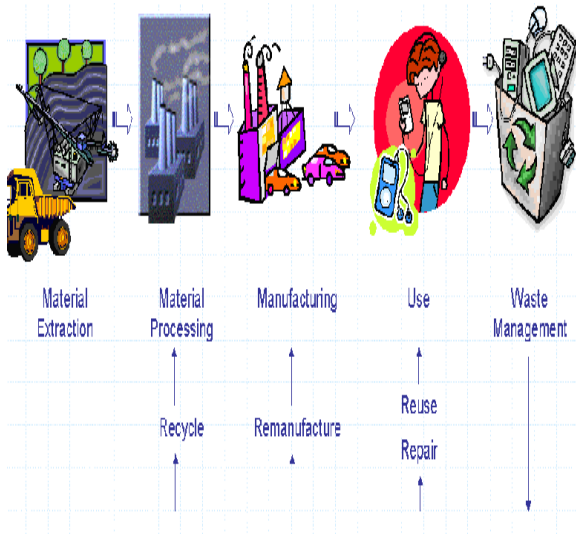


Fig. 6 Proposed recycle process

V E-WASTE SOLUTIONS

Need for Legal Framework

- Ban on total imports of E waste.
- There should be provision for issuing license for import or export of E-Waste.
- Domestic legal framework to address these gaps in import of E Waste
- Need to address safe disposal of domestic waste.
- Tie recycling in with take-back product responsibility.
- There should be formulation of framework, which includes guidelines for the producers of products regarding the E-waste.
- Separate legal units should be established for the disassembly, extraction, recycling of harmful components from E-waste with proper facility.

Public Education

“... public education and outreach may well be the most important component. That is because no matter what infrastructure is available and developed, what the laws are, and what the option are, no one will be aware of it without public education.”

- Waste Management: Minimize Impact
- Waste Prevention: Minimize the Volume
 - Reduce waste and pollution
 - Reuse as many things as possible

- Recycle and compost as much waste as possible
- Chemically or biologically treat or incinerate
- Bury what is left

Students will understand the harmful effects of E-waste components on the environment... and on themselves.

Students will analyze the chemical elements and compounds that make E-waste so hazardous and difficult to manage.

Fig. 7 Public education

Recycling

- Collection, ... processing, marketing
- Saves resources, energy, money
- Reduce pollution of extracting resources
- Reduce new landfills and incinerators
- Ban hazardous waste exports
- Get the poisons out
- Exercise precaution-no new poisons
- Make the producer responsible
- Require producers to take back
- Design for longevity, upgrade, repair, reuse
- Rethink the Product Design
- Rethink Manufacturing Processes
- Use Renewable Materials and Energy
- Use Safer Non-renewable Materials
- Cleaner Manufacturing Methods

Manufacturers can be responsible by

- Reducing flame retardants
- Reducing packaging
 - Designing for disassembly
 - Recycling their own products
 - Not exporting waste

Industry Examples

- Apple Design Practices
- HP Recycling Procedures
- Dell Trade-ins

- Gateway Rebates
- Office Depot Cartridge Refills

Hospitals in India can come up with different initiatives to help in this regard, such as:

- To conduct the public health awareness programs on dangers of uncontrolled e-waste recycling.
- To find the impact on health on people working in E-waste recycling units in India.
- To find the impact on health on people living near the E-waste recycling units in India, specially the pregnant women and children.
- To relate to specific health problems and their increase to e-waste recycling issues.
- The hospitals can take the initiatives of keeping a check or recording the patient's health history if it is suspected to be related to E-Waste mis- management. The hospitals can also further publish reports, based on such recordings for making the government alert on the increase of health problems of people in a given location, which is suspected to be related to E-waste.

Motivation for disposing of e-waste

- Most corporate take back schemes today emphasize recycling. "The whole green movement tried so hard to communicate the concept of recycling to people, but now we're trying to get across the idea that we probably made a mistake on that," says Jenkins. From an environmental perspective, recycling strategies for PCs that have been used by a single customer don't highlight the cost of consumption, he says. Manufacturing PCs is a high energy-intensive process, so frequent consumption of new ones is itself an environmental hazard. Instead of recycling, it's better to both extend your own refresh cycles and hand them down to other users, he says.
- "That's considerably better than those machines going for recycling, where there will be some recovery of raw material but it will be fairly low grade," he says, adding that the energy consumption during the recycling process can be significant.
- Depending on the brand, those companies wanting to take his advice can resell their old equipment back to the manufacturer. "If the equipment is quite new then we can buy it back from you and refurbish it and resell it, and if there's any residual value that goes back to the customer," says Kirstie McIntyre who is part of HP's UK environmental team. Dell will also refurbish and resell equipment.

VI CONCLUSION

In this paper we have raised various issues regarding hazards and e waste solutions in India. As far as e-waste is concerned, it has emerged as one of the fastest growing waste streams worldwide today. The sheer amount of electronic equipment reaching end-of-life poses a huge challenge. Computers and electronics equipment are designed without paying sufficient attention to the aspects such as downstream impacts, and the ease of recycling. Thus, their dismantling is also extremely labour-intensive. As long as electronic products continue to contain an assortment of toxic chemicals and are designed without recycling aspects, they would pose a threat to environment and public health at their end-of-life. We hope that the proposed principle, recycling process and channels of awareness discussed in the paper will lead to the harmless deposition of e waste in country. For the sake of environment, let's hope the proposed solutions come into existence sooner rather than later to make people's life happier in India.

REFERENCES

- [1] Joshi, T.K. and Gupta, N., "Impact of E-Waste on Health along with case studies".
- [2] A Rajya Sabha Report, "E-Waste in India", , June, 2011.
- [3] Comments and Suggestions made by the Ministry of Environment and Forests, Government of India on the draft backgrounder titled 'E-waste in India' prepared by the Research Unit of Rajya Sabha Secretariat. O.M. No. 23-4/2011-HSMD, dated 19 April, 2011.
- [4] Corporate Catalyst in India, Electronics Industry in India: A report on Indian Electronics Industry,2009 [7] Press Release: 'The e-waste industry in India: CSE exposes what lies beneath', Centre for Science and Environment, New Delhi, 18 May, 2010,
- [5] Dalla, H.S., Singh, G. and Thaman, G., "The Environmental Impact of Electronic Waste" Institution of Engineers (India), Nov, 2010.