Electronic Waste in India: Generation, Problems and Management

Nitin Patel[1], Pooja Somani[2]

[1]Assistant Professor, Shree L R Tiwari College of Engineering, Thane, nitinptl2703@gmail.com
[2]Assistant Professor, Saraswati College of Engineering, Kharghar. poojadsomani@gmail.com

Abstract*: e-Waste is by-product of the current technological revolution. In developing countries, like India, e-Waste finds its way into the solid waste, making recycling and disposal a tough task. The e-Waste is increasing at a rate of 20 per cent annually and by the end of year 2017 the total quantity of waste generating in the India will become 8,00,000 tonnes annually. Developed countries export their waste in the developing countries. e-Waste contains valuable recyclable materials and has potential to become lucrative business industries. e-Waste (Management & Handling) Rule, 2011 made by CPCB is the first step in the long process of sustainable e-Waste management in India.

Key Words: CPCB, EPR, e-Waste, Recycling.

INTRODUCTION

Electronic waste (e-Waste) covers waste electronic/ electrical waste that are not fit for their intended use or have reached their end of life. Electronics waste (e-Waste) is an inevitable and unavoidable by-product of the current technological revolution. e-Waste is a collective term, embracing consumer and business appliances, products, components, and accessories nearing the end of their useful life due to obsolescence, malfunction, or exhaustion (e.g., batteries) [4].

e-Waste comprises about 5 per cent of municipal solid waste (MSW) and is one of the fastest growing fractions of the waste stream [2]. Electronic equipment contains metals and other materials that are hazardous when improperly managed.

For example, e-Waste constitutes the source of about 70% of the heavy metals (including Hg and Cd) found in landfills [4] e-Waste contains valuable materials such as copper, silver, gold and platinum which could be processed for their recovery [7]. The fraction including iron, copper, aluminium, gold and other metals in e-Waste is over 60 per cent, while plastics account for about 30 per cent and the hazardous pollutants comprise only about 2.70 per cent [5]. Even though hazardous, if managed properly e-Waste management can provide business opportunity of increasing significance.

COMPOSITION OF e-WASTE

e-Wastes encompasses wide range of electrical and electronic devices such as computers, hand held cellular phones, personal stereos, including large household appliances such as refrigerators, air conditioners etc.

Electronic waste or e-Waste or e-scrap or waste electrical and electronic equipment (WEEE) can be defined as the discarded waste computers, office electronic equipments entertainment device electronics, mobile phones, television sets and the refrigerators. The term e-Waste is loosely applied to consumer and business electronic equipment that is near or at the end of its useful life. It is a waste consisting of any broken or unwanted electrical or electronic appliance [10].

Waste generated from the following electronic equipments is generally referred to as the e-Waste:

- IT and Telecom equipments like computers, laptops, tablets and the systems used in the BPO call centres.
- Large household appliances like washing machines, microwave ovens, refrigerators, television etc.
- Small household appliances like PC's, mobile phones, MP3 players, I-Pods, Tablets etc.
- Consumer and lighting equipments like bulbs, CFL, fluorescent tube lights.
- Toys, leisure and sports machines
- Medical devices like CT scan machine, MRI etc.
- Monitoring and control devices.

ENVIRONMENTAL CONCERNS RELATED TO e-WASTE

e-Waste is not hazardous in its original form. However, the hazardous constituents present in the e-Waste make it hazardous when such wastes are dismantled and processed, since it is only at this stage that they pose hazard to health and environment [4].

Electronics and electrical equipment seem environmentally-friendly, but there are hidden dangers associated with them once these become e-Waste. The harmful materials contained in electronics products, coupled with the fast rate at which we're replacing outdated units, pose a real danger to human health if electronics products are not properly processed prior to disposal [1].

Electronics products like computers and cellphones contain a lot of different toxins. For example, cathode ray tubes (CRTs) of computer monitors contain heavy metals such as lead, barium and cadmium, which can be very harmful to health [7]. The hazardous substances found in e-Waste and their effects on human health is summarized in table 1.

Table 1: e-Waste Toxins and Affected Body Parts [4]

Components	Components	Affected body parts
Printed circuit boards	Lead and cadmium	Nervous system, kidney, lever
Motherboards	Berillium	Lungs, skin
Cathode ray tubes (CRTs)	Lead oxide, barium and cadmium	Heart, lever, muscles
Switches and flat-screen monitors	Mercury	Brain, skin
Computer batteries	Cadmium	Kidney, lever
Capacitors and transformers	Polychlorinated biphenyls (PCBs)	Endocrine
Printed circuit boards, plastic casings cable	Brominated flame-retardant	Endocrine
Cable insulation/coating	Polyvinyl chloride (PVC)	Immune system
Plastic housing	Bromine	Endocrine

Landfilling of e wastes can lead to the leaching of lead into the ground water. If the CRT is crushed and burned, it emits toxic fumes into the air. These products contain several rechargeable battery types, all of which contain toxic substances that can contaminate the environment when burned in incinerators or disposed of in landfills. The cadmium from one mobile phone battery is enough to pollute 600 m^3 of water [5].

WASTE GENERATION

The Indian electronic waste industry is booming at a very rapid pace. It is expected to increase at a rate of 20% annually. [9], [10]. With increasing per capita income, changing life styles and revolutions in information and communication technologies, India is the second largest electronic waste generator in Asia. A MoEF'2012 report says that Indian electronic waste output has jumped 8 times in the last seven years i.e. 8, 00,000 tones .The future projection of e-Waste in India as per the Dept. Of Information Technology is shown in Figure 1.
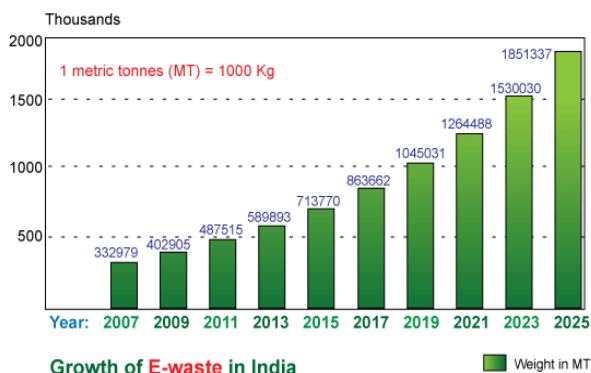

Fig 1: Projection of E-Waste generation in India [10]

Telecommunications and information technology are the fastest growing industries today not only in India but world over. Manufacturers' Association for Information Technology (MAIT) has collected the following statistics on the growth of electronics and IT equipment in India [6]:

- The total PC sales between April 2012 and March 2013 were at 11.31 million, registering growth of 5 per cent over the last fiscal.

- The consumer electronics market is growing at the rate of 13-15 per cent annually.
- The cellular subscriber base was up by more than 100 per cent during 2012-13.

Because of the very big informal recycling industry, calculating the total amount of e-Waste generated in the country in very tough task. However, approximate amount of the waste generated can be calculated from the discard rate of electrical item. Table 2 gives the average discard rate for different equipments:

Table 2: Discard Rate of Electronics Items [7]

Item	Discard/replace rate
Mobile telephone	1 to 3 years
PC	Every 2 Years
Camera	3 to 5 years
Television	10-15 years
Refrigerator	10-15 years
Washing Machine	10-15 years
IT Accessories	Very Fast

Due to the extreme rate of obsolescence, the electronic industry is producing much higher volumes of waste. This has been compounded by the change in the consumption pattern in India which has also contributed to the large volumes of e-Waste being generated in the country. Given below are the quantity of e-Waste generated by top 10 Indian states and cities according to an assessment study conducted by the International Resource Group Systems South Asia Pvt. Ltd (IRGSSA) in 2005:

Table 3: e-Waste Generating Top Ten States [8]

State	e-Waste (Tonnes)
Maharashtra	20270.59
Tamil Nadu	13486.24
Andhra pradesh	12780.33
Uttar pradesh	10381.11
West bengal	10059.36
Delhi	9729.15
Karnataka	9118.74
Gujarat	8994.33
Madhya pradesh	7800.62
Punjab	6958.46

Table 4: e-Waste Generating Top Ten Cities [6]

City	e-Waste (Tonnes)
Mumbai	11017.1
Delhi	9730.3
Bangalore	4648.4
Chennai	4132.2
Kolkata	4025.3
Ahmedabad	3287.5
Hyderabad	2833.5
Pune	2584.2
Surat	1836.5
Nagpur	1768.9

GLOBAL SCENARIO

The Basel Action Network (BAN) which works for prevention of globalisation of toxic chemicals has stated in a report that 50 to 80 per cent of e-Waste collected by the US is exported to India, China, Pakistan, Taiwan and a number of African countries. This is done because cheaper labour is available for recycling in these countries. And in the US, export of e-Waste is legal [7].

e-Waste recycling and disposal in China, India and Pakistan are highly polluting. Of late, China has banned import of e-Waste. Export of e-Waste by the US is seen as lack of responsibility on the part of Federal Government, electronics industry, consumers, recyclers and local governments towards viable and sustainable options for disposal of e-Waste [7], [11].

A document published by research unit (LARRDIS) of Rajya Sabha Secretariat, also mentioned that developed countries circumvent the electronic waste to the developing countries as the cheap alternative to disposal in their own states.

INDIAN SCENARIO

In India, recycling of e-Waste is almost entirely left to the informal sector, which does not have adequate means to handle either the increasing quantities or certain processes, leading to intolerable risk for human health and the environment. [6]

The issue of e-Waste disposal import and recycling has become the subject of serious discussion and debate among the Government organizations, environmentalist groups and private sector manufacturers of computers and consumer electric equipment in start of the year 2004. While the Municipal Solid Waste (Management & Handling) Rules regulate the disposal of the municipal solid waste in an environmentally acceptable manner, and the Hazardous Waste (Management & Handling) Rules define and regulate all aspects of the hazardous waste, there were no specific environmental laws for the management and disposal of e-Waste.

Considering it necessary in the public interest, the Government introduced the draft e-Waste (Management & Handling) Rules, 2010. These rules came into force on 1 January, 2012 and implemented through the State Pollution Control Board.

e-WASTE MANAGEMENT IN INDIA

The major components of e-Waste management are:
1. e-Waste collection, sorting and transportation
2. e-Waste recycling; it involves dismantling, recovery of valuable resource, and sale of dismantled parts and export of processed waste for precious metal recovery

The stakeholders, i.e., the people who can help in overcoming the challenges posed by e-Waste, are:
1. Producer
2. Bulk Consumers
3. Extended Producer Responsibility
4. Collection Centre is a centre
5. Dismantler
6. Recycler
7. SPCBs/PCCs
8. CPCB

Responsibility of Producer

Extended producer's responsibility (EPR) is the main feature of the e-Waste (Management and Handling) Rules, 2011, wherein the producer of electrical and electronic equipment has the responsibility of managing such equipment after its 'end of life', thus the producer is responsible for their products once the consumer discards them. Under this EPR, producer is also entrusted with the responsibility to finance and organize a system to meet the costs involved in complying with EPR [3].

The scope of implementing the EPR by the producers is explained in the schematic diagram given below:
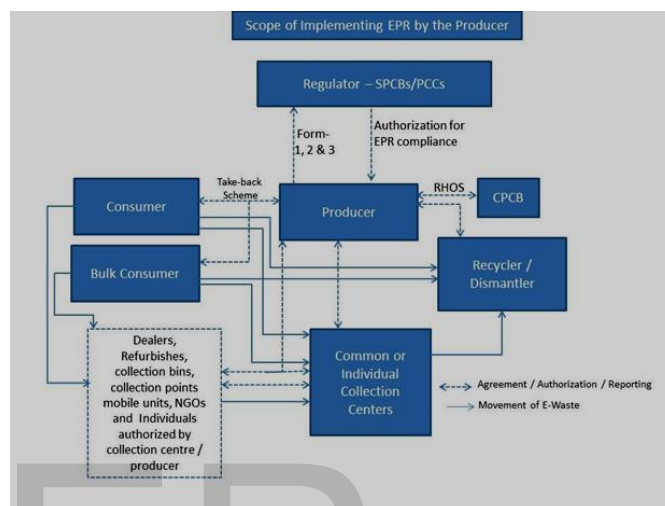
Fig 2: Scope of Implementing EPR [3]

Responsibilities of collection centers

Collection centre shall-
1. Obtain an authorization in accordance from the State Pollution Control Board or Pollution Control Committee concerned as the case may be and provide details such as address, telephone numbers/helpline number, e-mail, etc., of such collection centre to the general public;
2. Ensure that the e-Waste collected by them is stored in a secured manner till it is sent to registered dismantler(s) or recycler(s) as the case may be;
3. Ensure that no damage is caused to the environment during storage and transportation of e-Waste;
4. File annual returns to the State Pollution Control Board or Pollution Control Committee concerned on or before the 30th day of June following the financial year to which that return relates; and
5. Maintain records of the e-Waste handled and make such records available for scrutiny by the State Pollution Control Board or the Pollution Control Committee concerned.

Responsibilities of dismantler

Every dismantler shall-
1. Obtain authorization and registration from the State Pollution Control Board;
2. Ensure that no damage is caused to the environment during storage and transportation of e-Waste;

3. Ensure that the dismantling processes do not have any adverse effect on the health and the environment;

4. Ensure that the facility and dismantling processes are in accordance with the standards or guidelines published by the Central Pollution Control Board from time-to-time;

5. Ensure that dismantled e-Waste are segregated and sent to the registered recycling facilities for recovery of materials;

6. Ensure that non-recyclable/non-recoverable components are sent to authorized treatment storage and disposal facilities;

7. File a return, to the State Pollution Control Board or the Pollution Control Committee concerned as the case may be, on or before 30th June following the financial year to which that return relates;

8. Not to process any e-Waste for recovery or refining of materials, unless he is registered with State Pollution Control Board as a recycler for refining and recovery of materials

Responsibilities of recycler

Every recycler shall-

1. Obtain authorization and registration from State Pollution Control Board

2. Ensure that the facility and recycling processes are in accordance with the standards laid down in the guidelines published by the Central Pollution Control Board from time-to-time;

3. Make available all records to the Central or State Pollution Control Board or Pollution Control Committee of Union territories for inspection;

4. Ensure that residue generated thereof is disposed of in a hazardous waste treatment storage disposal facility;

5. File annual returns, to the State Pollution Control Board or Pollution Control Committee concerned as the case may be, on or before 30th June following the financial year to which that returns relate.

CONCLUSIONS

Proper sanitation and Solid waste management are already a very big task in India. Introduction of e-Waste in solid waste stream is making the process more complicated. It is fact that e-Waste generation is increasing at a very rapid rate due to the introduction of newer technologies and obsolescence of the EEEs. People are either store the obsolete equipment in their home or sell it to the local collectors for monetary benefits.

In India e-Waste management is more complicated because e-Waste is not properly segregated from the solid waste. Apart from that proper data about the quantity and quality of waste is not available because of very big informal sector and imported waste. 90 per cent of the e-Waste recycling is done by informal recycler and very little or no attention is given toward the safety of worker and environment by these recycler.

The CPCB has made new e-Waste (Management & Handling) Rule, 2011 which came in force since 1st may 2012 governing all stakeholders of e-Waste but it is volunteer kind of law applicable on registered recyclers but encourage informal recyclers to work in ambit of CPCB guidelines issued in 2008.

To reduce the impact of e-Waste on environment, Product design must be employed to help to minimize not only the nature and amount of waste, but also to maximize end-of-life recycling. Manufacturers, retailers, users, and disposers should share responsibility for reducing the environmental impacts of products. Laws related to e-Waste need to be more stringent.

REFERENCES

[1] B. J. Mohite,"Issues and Stratei\gies in Managing E-waste in India", *IJRMVSS Trans*. Vol. 1, Issue 1, pp. 46-51, Mar. 2013.

[2] Electronics Take Back Coalition. 2011. Facts and Figures on E-Waste and Recycling. Available from: http://www.electronicstakeback.com/wp-content/uploads/Facts_and_Figures_on_EWaste_and_Recycling.pdf

[3] E-waste (Management and Handling) Rules, 2011.

[4] J. Picthel, *Waste Management Practice: Municipal, Hazardous and Industrial*, 2nd ed. New York, U.S: CRC Press, 2014, ch. 22, pp. 591-611.

[5] Jospeh Kurian."Electronic Waste Management in India: Issues and Strategies" in *Proc. Sardinia 2007, 11th International Waste Management and Landfill Symposium*, Cagliari, Italy, 2007, pp. 201-209.

[6] MAIT. (July 2013). On PC market faced the headwinds, grew only by 5 per cent. On November 2, 2015 Available: http://www.mait.com/newsdetails.aspx?mpgid=49&pgidtrail=49&nid=12

[7] P. D. Badoni, "E-waste management in India" in *Technology Focus*, R. Chopra, Ed. New Delhi, India: EFY, 2009, pp. 52-58.

[8] Rajya Sabha Secretariat Research Unit, "E-Waste in India", New Delhi, 2011.

[9] S. Jadhav, "Electronic Waste: A Growing Concern in Today's Environment Sustainability", *IJSSIR Trans*, vol. 2, no. 2, pp. 139-147, feb. 2013

[10] T. Pradhan, "E-waste Generation in India", *RRST Trans*. Vol. 5, no. 5, pp. 83-87, 2013.

[11] X. Chi, M. streocher-Porte, M.Y.L. Wang, M.A. Renter, "Informed Electronic Waste Recyclin: A Sector Review with Special Focus on China", in *Waste Management*, vol. 31, Elsevier, 2011, pp. 731-741.