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E-waste Management: An Emerging Challenge to Manage and Recover Valuable Resources

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Abstract

Redundant electronic equipment or e-waste is one of the highest increasing waste streams in the industrialized world, owing to the emergent sales and swift obsolescence of these products. E-waste includes a wide and increasing variety of electronic devices like televisions, computers, refrigerators, air conditioners, and mobile phones etc, which consists of different types of toxic materials that can create occupational as well as environmental health hazards apart from polluting the adjacent atmosphere severely. Given the volumes of e-waste being generated and the content of both toxic and valuable materials in them, e-waste, is also emerging as a business opportunity of increasing significance. The fraction including iron, copper, aluminium, gold and other metals in e-waste is more than 60%, while pollutants encompass 2.70%. Waste Electrical and Electronic Equipment (WEEE) make up 8% of municipal waste and is one of the highest increasing waste fractions of solid wastes created (Yoon and Jang, 2006).

This paper intends to present an outline on the e-waste, like how to define e-waste, what it is contains of and what methods can be applied to estimate the quantity of e-waste generated. Further, it will also provide impending legislation and schemes intended to assist the management of increasing quantities of e-waste.

WEEE management in industrializing countries like India has its own characteristics and problems. In India the major challenges are: Unavailability of accurate estimates of the quantity of e-waste generated and recycled; little awareness with manufacturers and

consumers of the hazards of incorrect e-waste disposal; the use of rudimentary techniques (acid leaching and open-air burning) by informal (unorganised) sector which results in severe environmental damage. The E-waste workers have little or no knowledge of health risks coupled with uses of rudimentary techniques and the uneconomical recycling processes that result in significant losses of material value and resources etc.

Keywords: E-waste, WEEE; E-waste initiatives; E-waste assessment; E- waste management; Challenges; Informal sector.

1. Introduction

Due to progress in the field of science and technology brought about industrial revolt in the 18th Century which marked a new era in human civilization. In the 20th Century, the information and communication revolution has brought huge changes in the way we organize our lives, our economies, industries and institutions. These impressive developments in modern times have undoubtedly enhanced the quality of our lives. At the same time, these have led to manifold problems including the problem of massive amount of hazardous waste and other wastes generated from electric products. These hazardous and other wastes pose a great threat to the human health and environment. (Down to earth, 2010) 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. The little or no knowledge of health risks coupled with uses of rudimentary techniques and the uneconomical recycling processes that result in significant losses of material value and resources etc.

2. E-waste Defined

E-waste is defined as the various forms of old electrical and electronic equipment (EEE) that no longer have any value to their possessors. Various approaches have been adopted for the handling e-waste, and there are a number of key actors in the e-waste ecosystem at the local, regional, and international levels.

E-waste comprises the leading and highest emergent manufacturing waste (41.5 million tons in 2011). It is likely to get higher to 93.5 million tons in 2016. In spite of the Basel Convention, much e-waste is exported (77% of that from England and Wales) to Africa, mainly to Ghana and Nigeria (Frazzol, et. al., 2012).

Due to an unregulated accumulation and recycling, problem of e waste has become an instantaneous and long term apprehension which can lead to major environmental harms endangering human health. The creation of innovative and new technologies and the globalization of the economy have made a whole range of products available and affordable to the people changing their lifestyles significantly. The information technology has developed the way we live, work and communicates bringing countless

benefits and wealth to all its users New electronic products have become an integral part of our daily lives providing us with more comfort, security, easy and faster acquisition and exchange of information. But on the other hand, it has also led to unrestrained resource consumption and an alarming waste generation. (Down to earth, 2010) Both developed countries and developing countries like India face the problem of e-waste management. The rapid growth of technology, upgradation of technical innovations and a high rate of obsolescence in the electronics industry have led to one of the fastest growing waste streams in the world which consist of end of life electrical and electronic equipment products.

Many of the trends in consumption and production processes are unsustainable and pose serious challenge to environment and human health. Optimal and efficient use of natural resources, minimization of waste, development of cleaner products and environmentally sustainable recycling and disposal of waste are some of the issues which need to be addressed by all concerned while ensuring the economic growth and enhancing the quality of life. (Business Standard, 2010).

3. E-waste generation: India

Element of municipal waste across the world, it is estimated that more than 50 MT of e-waste is caused globally every year. A report of the United Nations predicted that by 2020, e-waste from old computers would jump by 400 per cent on 2007 levels in China and by 500 per cent in India. Additionally, e-waste from unnecessary mobile phones would be about seven times higher than 2007 levels and, in India, 18 times higher by 2020. (Young, 2010)

Quantity of WEEE (Waste Electrical and Electronic Equipment) generated in Indian States

State/UT	WEEE (tonnes)
Andaman and Nicobar Islands	92.2
Andhra Pradesh	12780.3
Arunachal Pradesh	131.7
Assam	2176.7
Bihar	3055.6
Chandigarh	359.7
Chhattisgarh	2149.9
Dadra and Nagar Haveli	29.4
Daman and Diu	40.8
Delhi	9729.2
Goa	427.4
Gujarat	8994.3
Haryana	4506.9
Himachal Pradesh	1595.1
Jammu and Kashmir	1521.5

Jharkhand	2021.6
Karnataka	9118.7
Lakshadweep	7.4
Madhya Pradesh	7800.6
Maharashtra	20270.6
Manipur	231.7
Meghalaya	211.6
Mizoram	79.3
Nagaland	145.1
Orissa	2937.8
Puducherry	284.2
Punjab	6958.5
Rajasthan	6326.9
Sikkim	78.1
Tamil Nadu	13486.2
Tripura	378.3
Uttar Pradesh	10381.1
Uttarakhand	1641.1
West Bengal	10059.4
Total	146180.7

Source: WEEE assessment 2005.

4. Pollutants in E-waste

Circuit boards, batteries, plastics, and LCDs (liquid crystal displays) are typically determined pollutants or Toxins in e-waste. Given below is a table showing the major pollutants occurring in waste electrical and electronic equipments:

Pollutants and their incidence in waste electrical and electronic equipment

Pollutant	**Occurrence**
Arsenic	Semiconductors, diodes, microwaves, LEDs (Light-emitting diodes), solar cells
Barium	Electron tubes, filler for plastic and rubber, lubricant additives
Brominated flame- proofing agent	Casing, circuit boards (plastic), cables and PVC cables
Cadmium	**1.** Batteries, pigments, solder, alloys, circuit boards, computer batteries, monitor cathode ray tubes (CRTs)
Chrome	Dyes/pigments, switches, solar
Cobalt	Insulators
Copper	Conducted in cables, copper ribbons, coils, circuitry, pigments

Lead	Lead rechargeable batteries, solar, transistors, lithium batteries, PVC (polyvinyl chloride) stabilizers, lasers, LEDs, thermoelectric elements, circuit Boards
Liquid crystal	Displays
Lithium	Mobile telephones, photographic equipment, video equipment (batteries)
Mercury	Components in copper machines and steam irons; batteries in clocks and pocket calculators, switches, LCDs
Nickel	Alloys, batteries, relays, semiconductors, pigments
PCBs (polychlorinated biphenyls)	Transformers, capacitors, softening agents for paint, glue, plastic
Selenium	Photoelectric cells, pigments, photocopiers, fax machines
Silver	Capacitors, switches (contacts), batteries, resistors
Zinc	Steel, brass, alloys, disposable and rechargeable batteries, luminous substances

Source: Alexander and Bilitewski, (2008)

5. E-waste as an Important Recoverable and Reusable

Delhi and Mumbai are the two main centres where e-waste is re-cycled in India. The other two major centres are Hyderabad and Bangaluru which have been the centres of the electronics and information technology industry. They are among the top ten cities in India which have been generating e-waste (Satyamurty, 2006 and Energy Business Review, 2009).

Globally, 50 million tons of e-waste is creating annually and has all 'potential' to raise at much earlier rate than any other waste streams. It is very motivating to note that even after the due utilize, this particular 'waste' is of great implication & cost. Generally speaking, e-waste consists of more than 92% recoverable and reusable commodities, some of them are highly valuable and limited and in terms of absolute numbers, 50 million tons of e- waste consists of 15 million tons of steel (more than annual production of SAIL), 4 million tons of aluminium, 6 million tons of copper over & above glass, plastic, silver, gold, palladium, platinum, iridium etc. In spite of so resource rich, 80% of e-scrap goes in land fill because of high recycling expenditure in developed nations (Mathew et. al., 2011). In the developing nations, where recycling is a natural phenomenon, unfortunately do not deploy environment friendly practices. Effectively, both the sets of countries are equally damaging the environment and polluting air, water & soil and finally we breathe in polluted air, drink contaminated water and eat grains, vegetables, fruits, fishes etc. with several toxics.

6. Methods of Estimation of e-waste Generation

There is a methodology followed to estimate the future outflows of electronic waste (e-waste) in India. For finding out the current & future quantities of e-waste in India we

developed a time-series multiple lifespan end-of-life model proposed by Peralta and Fontanos is adopted. Firstly the above mentioned model estimates future e-waste generation quantities by modeling their usage and disposal. This model can assist formal recyclers in India to make calculated assessment in planning for appropriate recycling infrastructure and institutional capacity building. Also an extension of the model proposed by Peralta and Fontanos is developed with the objective of helping decision makers to conduct WEEE estimates under a variety of assumptions to suit their region of study (Peralta and Fontanos, 2006). During 2007–2011, the total WEEE estimates will be around 2.5 million metric tons which include waste from personal computers (PC), television, refrigerators and washing machines. During the period, the waste from PC will account for 30% of total units of WEEE generated. (Dwivedy and Mittal, 2010).

7. Management of E-waste in India

Every year there is generation of electrical & electronic waste, especially computers and televisions, has believed frightening proportions. International Association of Electronics Recyclers (IAER) in 2005, projected that 3 billion electronic and electrical appliances would become WEEE or e-waste by 2010. That would tantamount to an average e-waste generation rate of 400 million units a year till 2010. Globally, about 20-50 MT (million tonnes) of e-wastes is disposed off each year, which accounts for 5% of all municipal solid waste. 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. (Kang and Schoenung, 2005)

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-waste 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. The main sources of electronic waste in India are the government, public and private (industrial) sectors, which account for almost 70 per cent of total waste generation. The contribution of individual households is relatively small at about 15 per cent; the rest being contributed by manufacturers. Though individual households are not large contributors to waste generated by computers, they consume large quantities of consumer durables and are, therefore, potential creators of waste. An Indian market Research Bureau (IMRB) survey of ‘E-waste generation at Source’ in 2009 found that out of the total e-waste volume in India, televisions and desktops including servers comprised 68 per cent and 27 per cent respectively. Imports and mobile phones comprised of 2 per cent and 1 per cent, respectively.

8. Conclusion

Electronic waste is considered the fastest growing section of the environmental and human health conservation reforms in the society. It is necessary to establish a viable means of shortening this vice to minimize or eliminate the pollution and impact on environment. Although it is difficult to quantify global e-waste amounts, but, it is well known that large amount ends up in places where processing occurs at a very rudimentary level (Tysdenova and Bengtsson, 2011). This raises concerns about resource efficiency and also the immediate concerns of the dangers to humans and the environment. As of now many events are going on for the E-waste problem, beginning from an idea that someone has for a new product and then its production, ending in its purchase and eventual disposal by the end user.

References

[1] Alexander J. and B. Bilitewski, (2008) 'Hazardous substances in waste electrical and electronic equipment' *In: E-waste: Implications, regulations and management in India and current global best practices,* (Rakesh Johri, ed.) TERI, New Delhi, p.93.

[2] *Business Standard* (2010) 'Creating Best out of (e) Waste', SME Trends: A Commerical Report, , New Delhi, 8 September 2010.

[3] *Down to Earth* (2010) 'IT's underbelly'. vol.19, no.1, May16 - 31, 2010.

[4] Dwivedy M and Mittal RK. (2010) Estimation of future outflows of e-waste in India. *Waste Management.* Mar 30 (3):483-91.

[5] *Energy Business Review* (2009)'Mumbai to Start First Re-cycling Plant', (EBR), 6 July, 2009.

[6] Kang, H.Y. and Schoenung J.M. (2005): Electronic Waste Recycling: A review of US Infrastructure and Technology Options. *Resources, Conservation and Recycling.* 45, 368-400.

[7] Mathew, B., E. A. Christos and Bijikumar R. (2011) *In:* Proceedings published by International Journal of Computer Applications (IJCA) *International Conference on Emerging Technology Trends (ICETT)*. Pp-7-11.

[8] Peralta, G.L. and Fontanos, P.M., (2006) E-waste issues and measures in the Philippines. *Journal of Material Cycles and Waste Management.* 8, 34–39.

[9] Satyamurty, K. (2006) 'Managing e-waste without harming environment', *The Hindu*, 03 April, 2006.

[10] Tysdenova O. and Bengtsson, M. (2011). Chemical Hazards Associated with Treatment of Waste Electrical and Electronic Equipment. *Waste Management* 31: 56-61.

[11] WEEE assessment study by *the International Resource Group Systems South Asia Pvt. Ltd* (IRGSSA) (2005) m/s IRG Systems South Asia Pvt. Ltd.

[12] Yoon H. and Y. Jang. (2006) The Practice and Challenges of Electronic Waste Recycling in Korea with Emphasis on Extended Producer Responsibility (EPR) *In: proceeding of: International symposium on Electronics and the Environment,* 2006.

[13] Young T. (2010) 'E-waste a growing problem for China and India', 22 February 2010, http://www.computing.co.uk.