International Journal of Business& Management Research (IJBMR)
Volume 4, Issue 1, Pages- 31-35, March, 2016, ISSN: 2347-4696

E-Waste: Problems & Management

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ABSTRACT
In this paper the environmental problems related with the discarded electronic appliances, known as e-waste, are reviewed.E-waste contains toxic substances such as Lead, Cadmium, Mercury, polychlorinated biphenyls (PCBs) which leak into ground water when these electronic goods are dumped on the ground. On the other hand burning of these substances emits toxic fumes. Thus causing pollution at all three levels – air, water and land pollution. Moreover, the current and the future production of e-waste, the potential environmental problems associated with their disposal and management practices are discussed whereas the existing e-waste management schemes in India.

This research paper mainly deals with implications of e-waste & its prevention and control. The researchers try to throw light on various legislations in India and bring into picture indistinguishable convention regarding it. With it, they also put forth some suggestions to reduce the effect of e-waste.

Keywords: e-waste management, environmental pollution, recycling

1. INTRODUCTION

"Electronic waste" may be defined as discarded computers, office electronic equipment, entertainment device electronics, mobile phones, television sets and refrigerators. This definition includes used electronics which are destined for reuse, resale, salvage, recycling, or disposal. Others define the re-usables (working and repairable electronics) and secondary scrap (copper, steel, plastic, etc.) to be "commodities", and reserve the term "waste" for residue or material which is dumped by the buyer rather than recycled, including residue from reuse and recycling operations. Because loads of surplus electronics are frequently commingled (good, recyclable, and non-recyclable), several public policy advocates apply the term "e-waste" broadly to all surplus electronics. Cathode ray tubes (CRT) are considered one of the hardest types to recycle [1]. CRTs have relatively high concentration of lead and phosphors (not to be confused with phosphorus), both of which are necessary for the display. The United States Environmental Protection Agency (EPA) includes discarded CRT monitors in its category of "hazardous household waste" but considers CRTs that have been set aside for testing to be commodities if they are not discarded, speculatively accumulated, or left unprotected from weather and other damage.

Some exporters are accused of deliberately leaving difficult-to-recycle, obsolete, or non-repairable equipment mixed in loads of working equipment (though this may also come through ignorance, or to avoid more costly treatment processes). Protectionists may broaden the definition of "waste" electronics in order to protect domestic markets from working secondary equipment. The high value of the computer recycling subset of electronic waste (working and reusable laptops, desktops, and components like RAM) can help pay the cost of transportation for a larger number of worthless pieces than can be achieved with display devices, which have less (or negative) scrap value. In A 2011 report, "Ghana E-Waste Country Assessment", found that of 215,000 tons of electronics imported to Ghana, 30% were brand new and 70% were used. Of the used product, the study concluded that 15% was not reused and was scrapped or discarded. This contrasts with published but uncredited claims that 80% of the imports into Ghana were being burned in primitive conditions.

2. E-WASTE IN INDIA

India is emerging as a new economic power and this emergence is fueled by Information Technology revolution. The IT revolution and fast technology replacement have increased the e-waste in India.

95% of the E-Waste recycling is in the informal sector in India. E-Waste is the fastest growing pollution problem in India. India generates about 1.5 lakh tones of E-Waste annually.

Maharashtra is the largest contributor to this figure. Its share is 20270 tonnes of E-Waste per year. It is followed by Tamil Nadu (13486.24 tonnes/ year). Andhra Pradesh (12780.33 tonnes/ year).

Major sources of E-Waste in India are personal computers and mobile phones due to fast technology replacement. In India, all the major electronic manufactures have started the take back policy. It

means the obsolete appliances can be returned to the companies.

India has long played as a dumping ground for the developed countries. The USA has dumped around 315 million tones of E-waste between 1997 to 2004.

3. IMPLICATIONS

The discarded appliances find their way in the informal recycling market, get dismantled and intrude into the life cycle of water and air.
The main constituents are:

LEAD: It comes from solder in printed circuit boards, Cathode Ray Tube (CRT), glass panels and gaskets in computer monitors. Lead ions get dissolved in the ground water and contribute to water pollution. Lead affects brain development in children, damage the central and peripheral nervous system, blood system and kidney.

MERCURY: Its sources are flat screen monitors, circuit breakers, printed circuit boards. Mercury also seeps, through the landfills, into the ground water and render it unfit for drinking purpose. It causes chronic damage to brain, respiratory system and also causes skin disorders.

CADMIUM: Its main sources are chips, resistors, semi conductors, printed circuit boards, computer batteries, plating metal enclosure, metal parts in subassemblies. It accumulates in kidney and liver causing damage to them. It causes birth defects in humans.

CHROMIUM: It is found in the form of hexavalent chromium in the steel casing of the CPU. It causes asthmatic bronchitis and damage to the DNA structure in humans.

BARIUM: It is found in the front panels of CRTs and causes muscle weakness. It also causes damage to heart, liver and spleen.

PLASTICS: It is found in the body casing of electronics appliances like mobiles, mixtures etc. they are hazardous to environment as well as to humans. It causes reproduction and development problems. It also damages the immune system and interferes with regulatory hormones.

4. E-WASTE GENERATORS AROUND THE WORLD

According to the latest data, USA leads the pack of countries which lead the contribution of e-waste.
USA is followed by China (2.3 million tonnes in 2011), Germany (1.1 million tonnes), UK (915,000 tonnes), Denmark (118,000 tonnes), Canada (67000 tonnes) as the major contributors.

5. PROBLEMS CAUSED BY ELECTRONIC WASTE

Electronic waste is a valuable source for secondary raw materials, if treated properly, however if not treated properly it is major source of toxins. Rapid technology change, low initial cost and even planned obsolescence have resulted in a fast growing problem around the globe. Technical solutions are available but in most cases a legal framework, a collection system, logistics and other services need to be implemented before a technical solution can be applied.

Due to lower environmental standards and working conditions in China, India, Kenya, and elsewhere, electronic waste is being sent to these countries for processing – in most cases illegally. Delhi and Bangalore in India Uncontrolled burning, disassembly, and disposal are causing environmental and health problems, including occupational safety and health effects among those directly involved, due to the methods of processing the waste. Trade in electronic waste is controlled by the Basal Convention.

Electronic waste is of concern largely due to the toxicity of some of the substances if processed improperly. The toxicity is due in part to lead, mercury, cadmium and a number of other substances. A typical computer monitor may contain more than 6% lead by weight, much of which is in the lead glass of the CRT. Up to thirty-eight separate chemical elements are incorporated into electronic waste items. The unsustainability of discarded electronics and computer technology is another reason for the need to recycle – or perhaps more practically, reuse – electronic waste.

Electronic waste processing systems have matured in recent years following increased regulatory, public, and commercial scrutiny, and a commensurate increase in entrepreneurial interest. Part of this evolution has involved greater diversion of electronic waste from energy intensive, down-cycling processes (eg. conventional recycling) where equipment is reverted to a raw material form. This diversion is achieved through reuse and refurbishing. The environmental and social benefits of reuse are several: diminished demand for new products and their commensurate requirement for virgin raw materials (with their own environmental externalities not factored into the cost of the raw materials) and larger quantities of pure water and electricity for associated manufacturing, less packaging per unit, availability of technology to wider swaths of society due to greater affordability of products, and diminished use of landfills.

Challenges remain, when materials cannot or will not be reused, conventional recycling or disposal via

landfill often follow. Standards for both approaches vary widely by jurisdiction, whether in developed or developing countries. The complexity of the various items to be disposed of, cost of environmentally sound recycling systems, and the need for concerned and concerted action to collect and systematically process equipment are the resources most lacked -- though this is changing. Many of the plastics used in electronic equipment contain flame retardants. These are generally halogens added to the plastic resin, making the plastics difficult to recycle.

6. EFFECTS ON HUMAN HEALTH [2]

- Damage to central and peripheral nervous systems, bloodsystems and kidney damage.
- Affects brain development of children.
- Chronic damage to the brain.
- Respiratory and skin disorders due to bioaccumulation in fishes.
- Asthmatic bronchitis.
- DNA damage.
- Reproductive and developmental problems.
- Immune system damage.
- Lung Cancer.
- Damage to heart, liver and spleen.

7. LEGISLATIONS N INDIA

The real piece of legislation concerning E-Waste came recently under Environmental Protection Rules, 1986 (amended in 2004). But there is still no direct standard which can address pollutants from an electronics manufacturing or recycling industry.

Later, the management of E-Waste was covered under the Environmental and Forest Hazardous Waste (Management and Handling), Rules, 2008.

Recently, the E-waste (Management and Handling) Rules, 2011 has been notified and they came into force in May 2011. These rules aim at reduction in the use of hazardous substance in electrical and electronic equipments, by specifying the threshold limits of hazardous materials such as mercury, lead and cadmium.

8. E-WASTE MANAGEMENT

There are four points discuss below for the e-waste management are as follows**:**

8.1 RECYCLING

Today the electronic waste recycling business is in all areas of the developed world a large and rapidly consolidating business. Part of this evolution has involved greater diversion of electronic waste from energy-intensive down cycling processes (e.g., conventional recycling), where equipment is reverted to a raw material form. This diversion is achieved through reuse and refurbishing. The environmental and social benefits of reuse include diminished demand for new products and virgin raw materials (with their own environmental issues); larger quantities of pure water and electricity for associated manufacturing; less packaging per unit; availability of technology to wider swaths of society due to greater affordability of products; and diminished use of landfills [3].

Audiovisual components, televisions, VCRs, stereo equipment, mobile phones, other handheld devices, and computer components contain valuable elements and substances suitable for reclamation, including lead, copper, and gold.

One of the major challenges is recycling the printed circuit boards from the electronic wastes. The circuit boards contain such precious metals as gold, silver, platinum, etc. and such base metals as copper, iron, aluminum, etc. Conventional method employed is mechanical shredding and separation but the recycling efficiency is low. Alternative methods such as cryogenic decomposition have been studied for printed circuit board recycling [4], and some other methods are still under investigation.

8.2 CONSUMER AWARENESS EFFORTS

In the US, the Consumer Electronics Association (CEA) urges consumers to dispose properly of end-of-life electronics through its recycling locator. This list only includes manufacturer and retailer programs that use the strictest standards and third-party certified recycling locations, to provide consumers assurance that their products will be recycled safely and responsibly. CEA research has found that 58 percent of consumers know where to take their end-of-life of electronics, and the electronics industry would very much like to see that level of awareness increase. Consumer electronics manufacturers and retailers sponsor or operate more than 5,000 recycling locations nationwide and have vowed to recycle one billion pounds annually by 2016, a sharp increase from 300 million pounds industry recycled in 2010.

AddressTheMess.com is a Comedy Central pro-social campaign that seeks to increase awareness of the dangers of electronic waste and to encourage recycling. Partners in the effort include Earth911.com, ECOInternational.com, and the U.S. Environmental Protection Agency. Many Comedy Central viewers are early adopters of new electronics, and produce a commensurate amount of waste that can be directed towards recycling efforts. The station is also taking steps to reduce its own environmental impact, in

partnership with NativeEnergy.com, a company that specializes in renewable energy and carbon offsets.

The Electronics TakeBack Coalition [5] is a campaign aimed at protecting human health and limiting environmental effects where electronics are being produced, used, and discarded. The ETBC aims to place responsibility for disposal of technology products on electronic manufacturers and brand owners, primarily through community promotions and legal enforcement initiatives. It provides recommendations for consumer recycling and a list of recyclers judged environmentally responsible.

The Certified Electronics Recycler program for electronic recyclers is a comprehensive, integrated management system standard that incorporates key operational and continual improvement elements for quality, environmental and health and safety (QEH&S) performance.

The grassroots Silicon Valley Toxics Coalition (svtc.org) focuses on promoting human health and addresses environmental justice problems resulting from toxins in technologies.

Basel Action Network (BAN.org) is uniquely focused on addressing global environmental injustices and economic inefficiency of global "toxic trade". It works for human rights and the environment by preventing disproportionate dumping on a large scale. It promotes sustainable solutions and attempts to ban waste trade. It requires companies to be either ISO 14001 or R2 certified.

Texas Campaign for the Environment (texasenvironment.org) works to build grassroots support for e-waste recycling and uses community organizing to pressure electronics manufacturers and elected officials to enact producer takeback recycling policies and commit to responsible recycling programs.

The World Reuse, Repair, and Recycling Association (wr3a.org) is an organization dedicated to improving the quality of exported electronics, encouraging better recycling standards in importing countries, and improving practices through "Fair Trade" principles.

Take Back My TV [6] is a project of The Electronics TakeBack Coalition and grades television manufacturers to find out which are responsible and which are not.

8.3 PROCESSING TECHNIQUES

In developed countries, electronic waste processing usually first involves dismantling the equipment into various parts (metal frames, power supplies, circuit boards, plastics), often by hand, but increasingly by automated shredding equipment. A typical example is the NADIN electronic waste processing plant in Novi Iskar, Bulgaria -- the largest facility of its kind in Eastern Europe [7]. The advantages of this process are the human's ability to recognize and save working and repairable parts, including chips, transistors, RAM, etc. The disadvantage is that the labor is cheapest in countries with the lowest health and safety standards.

In an alternative bulk system [8], a hopper conveys material for shredding into an unsophisticated mechanical separator, with screening and granulating machines to separate constituent metal and plastic fractions, which are sold to smelters or plastics recyclers. Such recycling machinery is enclosed and employs a dust collection system. Some of the emissions are caught by scrubbers and screens. Magnets, eddy currents, and trommel screens are employed to separate glass, plastic, and ferrous and nonferrous metals, which can then be further separated at a smelter. Leaded glass from CRTs is reused in car batteries, ammunition, and lead wheel weights [9], or sold to foundries as a fluxing agent in processing raw lead ore. Copper, gold, palladium, silver and tin are valuable metals sold to smelters for recycling. Hazardous smoke and gases are captured, contained and treated to mitigate environmental threat. These methods allow for safe reclamation of all valuable computer construction materials [10]. Hewlett-Packard product recycling solutions manager Renee St. Denis describes its process as: "We move them through giant shredders about 30 feet tall and it shreds everything into pieces about the size of a quarter. Once your disk drive is shredded into pieces about this big, it's hard to get the data off" [11] .

An ideal electronic waste recycling plant combines dismantling for component recovery with increased cost-effective processing of bulk electronic waste.

Reuse is an alternative option to recycling because it extends the lifespan of a device. Devices still need eventual recycling, but by allowing others to purchase used electronics, recycling can be postponed and value gained from device use.

8.4 BENEFITS OF RECYCLING

Recycling raw materials from end-of-life electronics is the most effective solution to the growing e-waste problem. Most electronic devices contain a variety of materials, including metals that can be recovered for future uses. By dismantling and providing reuse possibilities, intact natural resources are conserved and air and water pollution caused by hazardous disposal is avoided. Additionally, recycling reduces the amount of greenhouse gas emissions caused by the manufacturing of new products. It simply makes good sense and is efficient to recycle and to do our part to keep the environment green [12].

9. SUGGESTIONS AND PROPOSALS

- A blanket ban on dumping of E-waste by the developed countries in India is needed.
- Better implementation of notified rules in the formal and informal sectors.
- Increase in the use of sustainable electronic components in the manufacturing of electronic appliances and mobile telephony.
- E-waste also contains some valuable metals such as gold that results in the illegal trading of e-waste at a very large scale in the veil of scrap trading. This illegal trading needs to be curbed and the recycling of such valuable metals should come under the government's scrutiny.

10. CONCLUSION

Earlier it is already stated that health is the paramount factor and has got a priority over economic development. Though development is essential but not at the cost of health and environment. E-waste, if properly recycled, can generate monetary benefits by the extraction of valuable metals from it, but becomes dangerous if remains unchecked. Better implementation of rules and more research and development in the field of e-waste recycling will lead to prosperity from danger.

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