E-Waste–a major threat to environment and health

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Abstract

The electronic industry is the world's largest and fastest growing manufacturing industry. During the last decade, it has assumed the role of providing a forceful leverage to the socio- economic and technological growth of a developing society. The consequence of its consumer oriented growth combined with rapid product obsolescence and technological advances are a new environmental challenge-the growing menace of "electronics waste" or "e waste" that consists of obsolete electronic devices. The production of electrical and electronic devices is the fastest growing sector of the manufacturing industry in industrialized countries. At the same time, technological innovation and intense marketing engender a rapid replacement process. Every year, 20 to 50 million tones of electrical and electronic equipment waste ("e-waste") are generated world-wide, which could bring serious risks to human health and the environment. The paper highlights the emerging problem of health and environmental impact of e-waste.

Keywords: E-waste, health impact, environmental impact.

Introduction

The electronics industry is the world's largest and fastest growing manufacturing industry. The increase in consumption rates of electrical and electronic products and higher obsolescence rates are leading to growing generation of e-waste (waste electronic and electrical equipment or WEEE). 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. One of the special mark of our time is the availability of countless number of electronic products. Our growing dependence on these electronic products has given rise to a new environmental challenge: electronics waste (EPA, 2001). E-waste is defined as any electrical equipment or appliances that are past their useful lives. (Sinha *et al.,* 2005). Another definition for E-waste is the result when consumer, business and household devices are disposed or sent for recycling (Iles, 2004). Examples of e-waste are televisions and monitors, computers, audio/stereo equipment, VCRs DVD players, video cameras, telephones, fax and copying machines, cellular phones, wireless devices, and video game consoles (EPA, 2001).

The production of electric and electronic devices is a very resource-intensive activity. The environmental burden due to the production of electrical and electronic products ("ecological baggaged") exceeds by far the one due to the production of other household materials. A UN study found that the manufacturing of a computer and its screen takes at least 240 kg (530 pounds) of fossil fuels, 22 kg (48 pounds) of chemicals and 1.5 tonnes of water-more than the weight of a rhinoceros or a car (kuehr & Williams 2003). Radios and televisions are devices that can be found in nearly every home. Personal computers (PCs) assisted us first in our offices, then in our homes, and now during our travels as laptops as well as pocket- PCs. Personal digital assistants (PDAs) are expected to make our lives easier. In terms of production, internal consumption and electronics export industries have emerged as the fastest growing segment of Indian industry. In the last 5 years (1995-2000), the Indian IT industry has recorded a CAGR (Compounded annual growth rate) of more than 42.4 percent, which is almost double the growth rate of IT industries in many of the developed countries. In the IT action plan, the government has targeted to increase the present level of penetration, from 5 per 500 people to 1 for 50 people, by 2008. This envisages applying IT in every walk of the economic and social life of the country.

The total e-waste generation in India is approximately 1, 46,000 tonnes to 3.3 lakh tonnes a year and is expected to touch 4.7 lakh tonnes by 2011. 'The projected growth for e-waste generation for India is about 34% 'year' on year says Sinha (Associate director of toxics link). E-waste is one of the fastest growing waste streams in India due to increasing "market penetration" in developing countries, "replacement market" in developed countries and "high obsolescence rate".

The composition of e-waste is very diverse and differs in products across different categories. It contains more than a 1000 different substances, which fall under "hazardous" and "non-hazardous" categories. Broadly, it consists of ferrous and non-ferrous metals, plastics, glass, wood and plywood, circuit boards, concrete and ceramics, rubber and other items. Iron and steel constitutes about 50% of the e-waste followed by plastics (21%), non ferrous metals (13%) and other constituents 16%. Non-ferrous metals consist of metals like copper, aluminium and precious metals like silver,

Table 1. E-Waste/WEEE generation in top ten states & it cites.

State	WEEE (Tones)	City	WEEE (Tones)
Maharashtra	20270.59	Ahmadabad	3287.5
Tamil Nadu	13486.24	Bangalore	4648.4
Andhra Pradesh	12780.33	Chennai	4132.2
Uttar Pradesh	10381.11	Delhi	9730.3
West Bengal	10059.36	Hyderabad	2833.5
Delhi	9729.15	Kolkata	4025.3
Karnataka	9118.74	Mumbai	11017.1
Gujarat	8994.33	Nagpur	1768.9
Madhya Pradesh	7800.62	Pune	2584.2
Punjab	6958.46	Surat	1836.5

Source: E-waste management in India-consumer voice, April 2009

Table 3. Availability of take back service in India.

Available in India	Not available in India
Acer, Dell*, HCL, Hewlett-Packard (HP)**, Lenovo, LG Electronics*^, Motorola, Nokia, WIPRO, Zenith and Samsung	Apple, Microsoft, Panasonic PCS technology, Philips, Sharp, Sony, Sony Ericsson and Toshiba

** Information regarding take-back in India is only available on global website; ^ Take-back service is only available for mobile phone **Take-back service is only available for corporate customers.*

Source: An assessment of E-waste take back in India, www.designouttoxics.org

Table 4. Take back service on ground in India.

Properly working	Partially working	Not working at all
Acer, HCL, WIPRO	LG Electronics Motorola & Nokia	Dell, Hewlett-Packard (HP), Lenovo and Zenith
Accessibility of Information on Take-Back Service in India		
Easily	Accessible partially accessible	Not accessible
HCL and WIPRO	Acer, Lenovo, Motorola, Nokia	Dell , LG Electronics & Zenith

Source: An assessment of e-waste take back in India, www.designouttoxics.org

Table 2. Environmental & health hazards.

Computer/e-Waste component	Process	Potential occupational hazard	Potential environmental hazard
Cathode ray tubes	Breaking, removal of copper yoke and dumping	Silicosis, cuts from CRT glass, inhalation or contact with phosphor containing cadmium or other metals	Lead, barium and other heavy metals leaching into ground water and release of toxic phosphor
Pinter circuit boards	Disordering and removing computer chips	Tin and lead inhalation, possible brominated dioxin, beryllium, cadmimum and mercury inhalation	Air emission of the same substances
Dismantled printed circuit board processing	Open burning of waste boards	Toxicity of workers and nearby residents from tin, lead, brominated dioxin, beryllium cadmium and mercury inhalation	Tin and lead contamination of immediate environment, including surface and ground waters, brominated dioxins, beryllium, cadmium and mercury inhalation
Chips and other gold – plated compounds	Chimals stripping using nitric and hydrochloric acid alone riverbanks	Acid contact with eyes, skin may result in permanent injury	Hydrocarbon, heavy metals, brominated substances etc. discharged directly into river and banks
Plastics from the computer and peripherals	Shredding and low temperature melting	Probable hydrocarbon, brominated dioxin and APH exposure to workers living in the burning works area	Emission of brominated dioxins and heavy metals and hydrocarbons
Secondary steel or copper and precious metal smelting wires	France recovers steel or copper from waste open burning to recover copper	Brominated and chlorinated dioxin and PHA exposure to workers living in the burning works area	Hydrocarbon and ashes, including PAHs discharged into air, water and soil.

Source: E-waste hazard

gold, platinum, palladium etc. However, exports estimate that:

- More than 500 million computers will become obsolete in the USA alone between the years 1997 and 2007.
- 130 million cellular phones will be discarded in the USA by the year 2005, resulting in 65000 tonnes of phone waste (BAN 2004).
- 610 million mobile phones are to be disposed of in Japan by 2010 (Uryu *et al.,* 2003).
- Every year, an EU citizen leaves behind 25 kg of e-waste (SECO & EMPA, 2003).
- 20 To 50 million tonnes of e-waste are generated per year world-wide.

The waste thus produced goes into the hands of informal sector. Over 1 million poor people in India are involved in the manual recycling operations. Most of the people working in this recycling sector are the urban poor with very low literacy levels and hence very little awareness regarding the hazards of e-waste toxins. There are a sizeable number of women and children who are engaged in these activities and they are more vulnerable to the hazards of this waste.

Objective

The study highlights the health and environmental impact of e-waste.

Methodology

A study fully depends on secondary data. The secondary data are based on publications like books, journals, magazines, and websites and so on.

E-waste scenario in India

The Indian information technology industry has a prominent global presence today largely due to the software sector. The following three categories of e-Waste / WEEE account for almost 90% of the generation of waste.

1. Large household appliances, 42%,
2. Information and communications technology equipment, 33.9% and
3. Consumer electronics, 13.7%.

More recently, policy changes have led to a tremendous influx of leading multinational companies into India to set up manufacturing facilities, R&D centres and software development facilities. The domestic market is getting revitalized due to buoyant economic growth and changing consumption patterns. This growth has significant economic and social impacts. India's rate of PC obsolescence is growing dangerously .Of the nearly 8 million PCs in India, 2 million are either of the generation represented by the chip Intel 486 or lower. As up gradation beyond a point becomes uneconomical and incompatible with new software, a vast amount of Hardware will soon be added to the waste stream. Individual households contribute the least to this, being only 20 percent of the overall market. Most of them prefer to pass old computers to friends and family or exchanging them through retailers, rather then sell them as junk. On the basis of scrap handled by Delhi-based scrap dealers, the total number of PCs meant for dismantling would be around 15,000 per year. This figure does not include pcs handled by large dealers who get scraps from foreign sources. Visual identification of their storehouses revealed more than 1,000 monitors being kept at a time for dismantling. The computers handled by these dealers are 486s, 386s and 286s, and few with defective Pentium processors. The 486s or lower configuration include both working and non-working computers. As the consumption pattern increase, e-waste generation also increases. The top ten states and cities in India generating e-waste are as follows.

From the above it is noted that Andhra Pradesh and Karnataka stands 3rd and 7th respective in the list among the e- waste generators. As regards to the cities, Bangalore is 2nd and Hyderabad is 5th in generation of e-waste. Northern India is not a leading generator, it happens to be the leading processing centre of e-waste in the country. There are three formal recyclers in the South of India (at Chennai, Hyderabad & Bangalore) and one in Western India. According to Manufacturer's association for information technology (MAIT) report, India in 2007 generated 3, 80,000 tones of e-waste from discarded computers, televisions and mobile phones. This is projected to grow to more than 8, 00,000 tones by 2012 with a growth rate of 15%. The estimate includes 50,000 tones of such e-waste imported from developed countries as charity for reuse, which mostly end up in informal recycling yards either immediately or once the re-used product is discarded. This is a conservative and restricted estimate. Complex, ambiguous definitions of second-hand electronic equipment has made it difficult for the customs department to trace, identify and stop the illegal inflow of e-waste.

Health & environmental Impact of e-waste

EEEs are made of multitude of components, some containing toxic substances that have an adverse impact on human health and the environment if not handled properly. Often, these hazards arise due to the improper recycling and disposal processes used. A computer contains highly toxic chemical like lead, cadmium, mercury, beryllium, BFR, polyvinyl chloride and phosphor compounds.

Health impacts

The physiological and health impacts on humans and animals of many of the toxic substances contained in e-Waste are

- *Reproduction:* damage to both male and female reproductive systems, including interfering with development of the testes; reduction in semen production and quality; abnormal morphology of

sperm; low egg hatchability; and reduced fertility rates.

- DNA: damage in lymphocytes, fatal and developmental toxicity; growth retardation; abnormal brain development, which can result in intellectual impairment; and possible long-term impacts on memory, learning and behaviour.
- *Nervous system*: damage to the central nervous system (CNS) and blood system, including CNS depression and neurotoxicity; immune system suppression, including inhibition of a key blood cell enzyme.
- *Organs:* damage to the brain, including swelling; liver, including liver necrosis; kidney, including renal toxicity; thyroid; pancreas; lymph nodes; spleen; and bone, including bone toxicity.
- *Skin:* contact dermatitis; skin lesions; carcinogenic, including tumour promotion and lung cancer; anaemia; CBD (a Currently-Incurable, Debilitating Disease that can Sometimes be Fatal); and mortality.
- *Hormonal system:* Disruption to endocrine systems including the oestrogen, androgen, thyroid hormone, retinoid and corticosteroid systems; inhibition of human and organ hormone reception; and ability to mimic natural oestrogen hormones, leading to altered sexual development in some organisms.
- *Other*: hypertension (high blood pressure); cardiovascular and heart disease; respiratory tract irritation, including irritation of the nose, mouth and eyes.

Existing legislations & policy related to e-waste

Draft hazardous materials (Management, handling & transboundary movement). Rules, 2007 (dated: Sep 28, 2007), part of the environment production act, 1986. India is a signatory to basal convention. (Basel convention is the UN environment programme) on the control of transboundary movement of hazardous wastes and their disposal.

Landfill-disposal

The vast majority of e-waste ends up in our landfills or incinerators. According to the US environmental protection agency (EPA) in 2000 more than 4.6 million tonnes of e-waste ended up in landfills nationally. It has become common knowledge that all landfills leak. Even the best "state of the art" ones are not completely sealed throughout their lifetimes and a certain amount of chemical and metal leakage will occur. The situation is far worse for older or less stringently controlled dump sites. The vaporization of metallic mercury and dimethylene mercury is also of concern. Uncontrolled fires may begin at such landfills, posing additional health and environmental risks.

1. The volume of e-waste is mainly due to the throw away ethic, which is partly driven by the potential for massive increase(s) in corporate profits, particularly when the electronics industry does not have to bear the financial burden of downstream costs.
2. According to the US national safety councils (NSC) in recycling of selected electronic products in the US. Only 11% of the 20 million computers that became obsolete in the US in 1998 were recycled.

E-waste recycling in India

In the industrial areas of Delhi, e-waste recycling is a clandestine operation. Tonnes of e-waste lie hidden behind high fenced walls of recycling units. Work carries on round the week, for over 12 to 14 h a day. Within these secure quarters, workers sit on the ground amongst piles of computer parts, separating them with amazing dexterity. All of them work with bare hands, without masks, cleaning, crushing or heating the parts. It is a far cry from the sight one would see at a computer manufacturing unit where workers would sit in clean rooms donning protective masks and gloves. However, the disposal and recycling of computer waste in the country has become a serious problems since the methods of disposal are very rudimentary and pose grave environmental and health hazards. In addition, besides handling its own computer waste, India now also has to manage the waste being dumped by other countries. Solid waste management, which is already a mammoth task in India, has become more complicated by the invasion of e-waste, particularly computer waste. Hence there is a clear reason to be concerned about the trade, the technology in practice and the existing poor disposal practices of computer waste in India.

As regards to the take back policy in India, Apple, Microsoft, Panasonic, PCS, Philips, Sharp, Sony, Sony Ericsson and Toshiba observes take back option at their production plant. Samsung claims to have a take back service but only one collection point for the whole of India, other nine branded companies do not have take back service. Two brands stand out as having the best take back practice in India, HCL and WIPRO. Other brands that do relatively well are Nokia, Acer, Motorola and LGE. The details of availability of take back service, service on ground reality and accessibility of information on take back service in India is as follows.

Conclusion

Solid waste management, which is already a mammoth task in India, is becoming more complicated by the invasion of e-waste, particularly computer waste. There exists an urgent need for a detailed assessment of the current and future scenario including quantification, characteristics, existing disposal practices, environmental impact etc. Institutional infrastructures, including e-waste collection, transportation, treatment, storage, recovery and disposal, need to be established, at national and /or regional levels for the environmentally sound management of e-wastes. Establishment of e-waste collection, exchange and recycling centres should be encouraged in partnership with private entrepreneurs and manufacturers. Large

scale awareness campaigns should be conducted to cover all level of people.

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