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 tonnes 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/WEENE generation in top ten states & cites.

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

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

Table 2. Environmental & health hazards.

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

Source: E-waste hazard

Table 3. Availability of take back service in India.

<table>
<thead>
<tr>
<th>Available in India</th>
<th>Not available in India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acer, Dell*, HCL, Hewlett-Packard (HP)<strong>, Lenovo, LG Electronics</strong>, Motorola, Nokia, WIPRO, Zenith and Samsung</td>
<td>Apple, Microsoft, Panasonic PCS technology, Philips, Sharp, Sony, Sony Ericsson and Toshiba</td>
</tr>
</tbody>
</table>

*Information regarding take-back in India is only available on global website; **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.

<table>
<thead>
<tr>
<th>Properly working</th>
<th>Partially working</th>
<th>Not working at all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acer, HCL, WIPRO</td>
<td>LG Electronics Motorola &amp; Nokia</td>
<td>Dell, Hewlett-Packard (HP), Lenovo and Zenith</td>
</tr>
</tbody>
</table>

Accessibility of Information on Take-Back Service in India

<table>
<thead>
<tr>
<th>Easily</th>
<th>Accessible partially accessible</th>
<th>Not accessible</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCL and WIPRO</td>
<td>Acer, Lenovo, Motorola, Nokia</td>
<td>Dell, LG Electronics &amp; Zenith</td>
</tr>
</tbody>
</table>

Source: An assessment of e-waste take back in India, www.designouttoxics.org
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 upgradation 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 than 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
dimethylene mercury is also of concern. Uncontrolled sites. The vaporization of metallic mercury and far worse for older or less stringently controlled dump throughout their lifetimes and a certain amount of the best "state of the art" ones are not completely sealed become common knowledge that all landfills leak. Even 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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18. Shift+F3Find previous
19. Edit online
20. Download original
21. Save in Google Docs
22. Ctrl+P Print (PDF)
23. Zoom in
24. Zoom out
25. Fit page to screen
26. Fit two pages to screen
27. Shift+Ctrl+F Compact controls
28. Plain HTML
29. 