



INFORMATION TECHNOLOGY VS ENVIRONMENTAL HEALTH

* Shobha S.V.

ABSTRACT

Personal computers (PCs), cell phones, fax machines and related electronic equipment, have become a part of modern life in developed and many developing countries. While these devices have improved our productivity, they also have created a unique problem of disposal of the discarded electronic- or e-waste.

In the United States, PCs become outdated within an average period of 3-4 years. Continued technological innovations, aided by lower price of the new models, further reduce the useful life of PCs to an even shorter period. It is estimated that in the U.S. alone, during the 10-year period, 1997-2007, an estimated 500 million PCs will become obsolete, awaiting disposal.

Owing to the toxic nature of many heavy metals, organic, and inorganic compounds that go into manufacturing the computer and the monitor, their disposal in a landfill or by incineration is not a preferred option. Recyclers attempt to salvage as many of the re-usable materials as possible. However, the labor-intensive process makes computer recycling cost-prohibitive in the United States. This has resulted in shipping the obsolete PCs to countries like Bangladesh, China and India. While this practice enables the domestic recycling companies to

* Department of Environmental Sciences, Mount Carmel College, Vasanth Nagar, Bangalore - 560 052

reduce the cost, it creates serious health and environmental problems for the workers in developing countries. Generally, environmental and labor laws in such countries are not very specific and even where they are, their enforcement is very lax. Such situations lead to recycling crews working in makeshift factories with hardly any provisions to protect them from exposure to hazardous substances-primarily through inhalation of the toxic fumes-causing cancer and other serious health problems.

Introduction

Just beneath the glamorous surface of the benefits and the wealth created by the information technology revolution looms a darker reality. Vast resource consumption and waste generation are increasing at alarming rates. The electronics industry is the world's largest and fastest growing manufacturing industry, and as a consequence of this growth, combined with rapid product obsolescence, discarded electronics or E-waste, is now the fastest growing waste stream in the industrialized world. The growing quantity of E-waste is beginning to reach disastrous proportions and industrialized countries all over the world are just now beginning to grapple with the problem. After initially turning a blind eye to the problem, governments of all sizes have been forced to respond as E-waste begins to seriously inundate solid waste disposal facilities and programs. This waste stream includes electronic products nearing the end of their "useful life" – ranging from computers, televisions and stereo equipment to small appliances such as cellular phones, fax machines etc.

The topic is of great interest because of:

- + The large growth of this waste stream,
- + Much of this waste is currently disposed along with the other solid waste
- + These materials hold great promise for recycling and reuse
- + These materials contain known toxic chemicals, which if disposed in conventional methods can leach down and contaminate ground water.

Proper management of e-waste is one of the major problems confronting the solid waste management professionals and Government authorities. These materials contain known toxic chemicals, which leach from e-waste dumps and pollute the ground water. The true impact of these wastes on the environment when managed using conventional methods is something that should be paid attention to. These materials contain several components which have high potential to be used as raw materials in some industries and can be recycled. The adoption of recycling and

reuse will not only reduce the amount of e-waste but also help minimize the risk of having hazardous chemicals at disposal time. Information pertaining to this is needed to help develop policies and educate the public.

With the rapid increase in population density coupled with increased technological advances the city of Bangalore, which was popularly known earlier as the Garden city has now taken the name "Silicon valley". The city has expanded in all directions and has major IT-sectors in different corners. There is a need to map out the major e-waste generating centers and trace out recycling units. An integrated Management information system is therefore very much a need for the present day.

Magnitude of the Problem

- + Over 20 million personal computers became obsolete in 1998, but only 13 percent were reused or recycled.¹
- + It is estimated that by 2005, 130 million cellular phones will be discarded annually. Counting batteries and chargers as well as the phones themselves, the estimated waste amounts to 65,000 tons a year.²
- + A report released last February by the Silicon Valley Toxics Coalition predicts that 500 million computers will become obsolete between 1997 and 2007, resulting in 6.32 billion pounds of plastic and 1.58 billion pounds of lead. The World watch Institute reported in its annual "Vital Signs" report that more than 2.9 million tons of electronic waste was land filled in 1997.³

Hazards in E-waste

Although it is hardly well known, E-waste contains a witches' brew of toxic substances such as lead and cadmium in circuit boards; lead oxide and cadmium in monitor cathode ray tubes (CRTs); mercury in switches and flat screen monitors; cadmium in computer batteries; polychlorinated biphenyls (PCBs) in older capacitors and transformers; and brominated flame retardants on printed circuit boards, plastic casings, cables and polyvinyl chloride (PVC) cable insulation that release highly toxic dioxins and furans when burned to retrieve copper from the wires.

1. U.S. EPA

2. *New York Times*, Oct 8, 2002

3. *Waste Age Magazine*; Silicon Valley Toxics Coalition

Why is E-Waste a Problem?

E-Waste is a problem for four key reasons:

- 1 The proliferation of e-products. Forecasts for U.S. PC CPU shipments rose from about 32 million units in 1997 to more than 55 million units by 2005.
- 2 The increasingly short life spans of electronics products. The average total lifespan for most electronics is only 4-6 years. It is estimated that the lifespan of PCs will decline from 4.5 years in 1992 to just 2 years by 2007. The number of obsolete PCs entering the waste stream grows each year. Over the timeframe of 1997-2007, an estimated 500 million PCs will be obsolete.
- 3 The toxic material constituents found in the products. PCs contain several toxic materials, including lead, mercury, cadmium, arsenic, and beryllium.
- 4 There is currently no cogent strategy for end-of-life management of electronic equipments: While many companies and government agencies are implementing various pilot programs, there is no cogent national strategy in place to manage e-waste.

Significance of E-waste Management

- In 1998, over 112 million pounds of materials were recovered from electronics, including steel, glass, and plastic, as well as precious metals.
- Reusing and recycling the raw materials from end-of-life electronics conserves natural resources and avoids the air and water pollution, as well as greenhouse gas emissions, that are caused by manufacturing new products.
- We can achieve the goals of sustainability by properly managing the e-wastes i.e. resource recovery and reuse resulting in reduction on the dependency on fresh materials.

E-waste and Environmental Health

Due to the hazards involved, disposing and recycling E-waste has serious legal and environmental implications. When computer waste is land filled or incinerated, it poses significant contamination problems. Landfills leach toxins into groundwater and incinerators emit toxic air pollutants including dioxins. Likewise, the recycling of computers has serious occupational and environmental implications, particularly

when the recycling industry is often marginally profitable at best and often cannot afford to take the necessary precautions to protect the environment and worker health.

According to the SVTC (Silicon Valley Toxics Coalition), a lack of data complicates our understanding of the potential health effects from exposure to e-wastes. Ultimately, e-waste poses the most direct health risks when it degrades and the internal chemicals are released to the environment. Lead and mercury are highly potent neurotoxins, particularly among children, who can suffer IQ deficiency and developmental abnormalities at very low levels of exposure. Cadmium, a toxic metal found in circuit boards, is listed by the EPA as a "probable human carcinogen", and also produces pulmonary damage when burned and inhaled. Hexavalent chromium, also used in circuit boards, has been found to produce lung and sinus tumors when inhaled at high doses.

In addition to metals in electronics, many environmentalists worry that the BFRs in plastic pose health risks. BFRs are among a group bad actors known as persistent organic pollutants-specifically, chemicals with a high affinity for fats and accumulate in human, animal, and fish tissues. Animal experiments have shown that a number of these chemicals affect thyroid function, have estrogenic effects, and act through the same receptor mediated pathways as does dioxin (Charles W. Smith), which is among the most potent animal carcinogens known. Further, environmentalists charge, electronics recyclers have not really come to grips with the special environmental problems that they say are inherent in the prolific use of BFRs in e-waste plastics. Jim Puckett, coordinator for the Seattle, Washington-based Basel Action Network (BAN) that serves as a watchdog on issues of "toxic trade", says that "there have been almost no studies on the ultimate fate of BFRs when they are melted or burned in recycling or incineration applications".

Copper, common in E-waste, is a catalyst for dioxin formation. This is of particular concern as the incineration of brominated flame-retardants and PVC leads to the generation of extremely toxic dioxins and furans and copper makes their formation more likely. Some producers send their E-waste to cement kilns for use as an alternative to fuel. But cement kilns present much the same problems posed by incinerators.

Table # 1: Health Concern from the E-waste stream

<i>Element</i>	<i>Use/Location</i>	<i>Health Effects</i>
<i>Lead</i>	<i>Metal jointing, radiation shield / CRT, PWB (Printed Wiring board)</i>	<i>Damage to Central and peripheral nervous system, circulatory system and kidneys; brain development affected</i>
<i>Chromium</i>	<i>Decorative, hardener/ (Steel) housing</i>	<i>Ulcers, convulsions, liver and kidney damage, strong allergic reactions, asthmatic bronchitis, may cause DNA damage</i>
<i>Cadmium</i>	<i>Older CRTs, SMD chip resistors, infra-red detectors and semiconductor chips</i>	<i>Accumulation in the human body particularly kidneys and cause irreversible effects</i>
<i>Mercury</i>	<i>Thermostats, sensors, relays, switche (e.g.PCBs and measuring equipment), medical equipments, lamps, mobile phones, and in batteries</i>	<i>Damage to brain, kidneys as well as the fetus. When inorganic Mercury comes in contact with water methylated mercury is formed and accumulates in living organisms</i>
<i>Barium</i>	<i>PC's front panel of a CRT</i>	<i>Short term exposure causes brain swelling, muscle weakness, damage to the heart, liver and spleen</i>

Recommendations

In finding a solution to e-waste management the following aspects must be addressed:

1. The Physical Aspect: incorporates the collections and sporting of materials.
2. The Social Aspect: includes programs and materials to inform the public.

The Physical Aspect: Recycling and Reuse

- The recycling facilities can either be state-run or contracted to the private sector.
- This creates jobs for citizens of the state, and also generates revenue.
- Recycling saves energy, as recycled materials bought in bulk are easier to use than re-mining the substance.
- Recycling also keeps the environment free of the toxins that would have been released from the electronics.

The Social Challenge: Educating the Public

- Focus on the fact that electronics such as computers, televisions, and VCRs contain more toxins than any other consumer waste.
- Encourage public to adopt alternatives by introducing tax-deductible donations to schools, community organizations and non-profit organizations.
- Have laws that require them to recycle electronics waste
- Advertise until they get the message, Provide more education through the media
- Provide a small monetary value as an incentive to recycle
- Have bins placed around town that are easy to get to.
- Encourage brokers and businessmen involved in the recycling of e-wastes.

What can be done to minimize contribution to e-waste stream?

- **Lease equipment.** Users do not assume ownership of the product in a lease arrangement. When it's time to upgrade to a newer product, the old unit is returned to the vendor, often for a credit toward a future purchase. When acquiring new computer equipment, ask and learn about lease options.
- **Avoid "gadgets."** Electronic versions of traditional household appliances and tools may not actually be an improvement, may be more costly, and may wear out faster.

- **Identify durable products.** When shopping for electronic and electrical items, review the product's repair history and consumer reliability ratings.
- **Repair instead of replace.** Repairing an electronic or electrical item may be cheaper than replacing it.
- **Buy upgradeable gear.** Some products can be upgraded by replacing a single component instead of the entire unit. This saves money and reduces waste.

Design for the environment

Manufacturers of electronic products should develop and use safer, less toxic materials; design for durability, upgradability and disassembly; avoid designing 'disposable' products; and reduce consumption of water and energy resources throughout the product lifecycle.

Closed-loop recycling

The electronics industry should design products to be easily repaired and upgraded to extend their useful life; incorporate recycled content and remanufactured components into new products; and develop closed materials cycles.

Zero Waste

The goal is to ban all discarded electronic equipment from going to landfills or trash incinerators and to end environmentally unsound recycling practices.

Conclusions

In the past decade, technological advances in electronic data management and communications have spurred economic growth and improved people's lives in countless ways. However, our growing dependence on electronic products both at home and in the workplace has given rise to a new environmental challenge: electronics waste. A recent study by EPA shows that electronics already make up approximately one percent of the municipal solid waste stream. Research completed in Europe shows that electronics waste is growing at three times the rate of other municipal waste. To the extent possible, electronics waste should be prevented, and older electronics should be reused and recycled.

References

1. <http://www.crra.com/ewaste/>
2. www.grrn.org
3. "Exporting Harm: The High-Tech Trashing of Asia", <http://www.crra.com/ewaste/ttrash2/ttrash2/index.html>
4. "E-Waste" is a Hidden Cost of Holidays, http://yubanet.com/artman/publish/article_1233.shtml
5. "Electronics: A New Opportunity for Waste Prevention, Reuse, and Recycling", http://www.epa.gov/epaoswer/osw/elec_fs.pdf
6. "ENVIRONMENTAL FACT SHEET", <http://www.scdhec.net/recycle/forms/crtfactsheet.pdf>
7. <http://www.svtc.org/cleancc/pubs/2002report.htm#double>
8. "E-Waste: Dark Side of Digital Age", <http://www.wired.com/news/technology/0,1282,57151,00.html>
9. "E-WASTE: A NEW CHALLENGE IN WASTE MANAGEMENT", http://gsa.confex.com/gsa/2002AM/finalprogram/abstract_42097.htm
10. <http://www.electroniccycle.com/about.htm>
11. "Basic Description of the Basel Convention", <http://www.basel.int/about.html>
12. "Environmentally Sound Management", <http://www.basel.int/pub/environsound.html>
13. Charles W. Schmidt, "e-Junk Explosion" and "Who Pays for e-junk", *Environmental Health Perspectives*, Vol 110/No 4/April 2002
14. Ching-Hwa Lee, Ssu-Li Chang, King-Min Wang and Lih-Chyi Wen, "Review: Management of Scrap Computer Recycling in Taiwan", *Journal of Hazardous Materials*, A73 (2000) 209-220