

Environmental Impact of Electronic Waste and its Management

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Abstract

Worldwide electronic waste is piling up in huge quantity while using electronic products after the end of their /useful life. Computers, televisions, VCRs, stereos, copiers, and fax machines commonly in use of every houses and offices now a day's as electronic products. Many of these products can be reused, refurbished, or recycled. With the passage of the Electronic Waste Recycling Act of 2003, certain portions of the electronic waste stream are defined and the systems to recover and recycle them will be administratively regulated beyond the universal waste rules that apply to material handling. This paper describes the impact of these waste products which cannot reuse or recycled, creating environmental hazard. The focus is also given as to how regulate or manage electronic waste?

Keywords: Environment, Electronic Waste, Management, Material Handling, Reuse and Recycle

1.0 Introduction

Society today revolves around technology and by the constant need for the newest and most high-tech products we are contributing to mass amount of e-waste. Rapid changes in technology, changes in media (tapes, software, MP3), falling prices, and planned obsolescence have resulted in a fast-growing surplus of electronic waste around the globe. Technical solutions are available, but in most cases, a legal framework, a collection, logistics, and other services need to be implemented before a technical solution can be applied [1].

Display units (CRT, LCD, LED monitors), processors (CPU, GPU, or APU chips), memory (DRAM or SRAM), and audio components have different useful lives. Processors are most frequently out-dated (by software no longer being optimized) and are more likely to become "e-waste" while display units are most often replaced while working without repair attempts, due to changes in wealthy nation appetites for new display technology. This problem could potentially be solved with modular Smart phones or Phonebloks. These types of phones are more durable and have the technology to change certain parts of the phone making them more environmentally friendly. Being able to simply replace the part of the phone that is broken will reduce e-waste [2]. An estimated 50 million tons of E-waste are produced each year. The USA discards 30 million computers each year and 100 million phones are disposed of in Europe each year. The Environmental Protection Agency estimates that only 15–20% of e-waste is recycled, the rest of these electronics go directly into landfills and incinerators [3-4].

In 2006, the United Nations estimated the amount of worldwide electronic waste discarded each year to be 50 million metric tons[5]. According to a report by UNEP titled, "Recycling – from E-Waste to Resources," the amount of e-waste being produced – including mobile phones and computers – could rise by as much as 500 percent over the next decade in some countries, such as India[6]. The United States is the world leader in producing electronic waste, tossing away about 3 million tons each year [7]. China already produces about 2.3 million tons (2010 estimate) domestically, second only to the United States. And, despite having banned e-waste imports, China remains a major e-waste dumping ground for developed countries [7].

Since the invention of the iPhone, cell phones have become the top source of e-waste products because they are not made to last more than two years. Electrical waste contains hazardous but also valuable and scarce materials. Up to 60 elements can be found in complex electronics [8]. As of 2013, Apple has sold over 796 million iDevices (iPod, iPhone, iPad). Cell phone companies make cell phones that are not made to last so that the consumer will purchase new phones. Companies give these products such short life spans because they know that the consumer will want a new product and will buy it if they make it [9]. In the United States, an estimated 70% of heavy metals in landfills comes from discarded electronics [10-11].

While there is agreement that the number of discarded electronic devices is increasing, there is considerable disagreement about the relative risk (compared to automobile scrap, for example), and strong disagreement whether curtailing trade in used electronics will improve conditions, or make them worse. According to an article in *Motherboard*, attempts to restrict the trade have driven reputable companies out of the supply chain, with unintended consequences[12].

2.0 Electronic Revolution and Culture

The electronic revolution has changed how we lived, communicated and has brought people around the world closer. We are in a great era of technological advancement and we are a generation obsessed with technology. We have gadgets of all kinds – from our appliances to our computers and laptops, to our ever changing cell phones. We change our gadgets almost as often as we buy new clothes. Every time a new upgrade comes out, we throw our old gadgets away and buy a new one. Can you imagine how much electronic waste we generate? Where does it all go?

2.1 A culture of use and throw-away

E-Waste are electronic devices and gadgets nearing or at the end of its useful life. It covers discarded obsolete electronic devices, cellphones, notebooks, game consoles and their components.

Here are some electronic waste facts that you will find interesting and alarming:

- We generate around 40 million tons of electronic waste every year, worldwide. That's like throwing 800 laptops every second.
- An average cellphone user replaces their unit once every 18 months.
- E-waste comprises 70% of our overall toxic waste.
- Only 12.5% of E-Waste is recycled.

- 85% of our E-Waste are sent to landfills and incinerators are mostly burned, and release harmful toxins in the air!
- Electronics contain lead which can damage our central nervous system and kidneys.
- A child's mental development can be affected by low level exposure to lead.
- The most common hazardous electronic items include LCD desktop monitors, LCD televisions, Plasma Televisions, TVs and computers with Cathode Ray Tubes.
- E-waste contains hundreds of substances, of which many are toxic. This includes mercury, lead, arsenic, cadmium, selenium, chromium, and flame retardants.
- 80% of E-Waste in the US and most of other countries are transported to Asia.
- 300 million computers and 1 billion cellphones go into production annually. It is expected to grow by 8% per year.

2.2 Is E-Waste Bad?

Many of our E-Waste end up in Asia or Africa landfills. The recycling method in these landfills is not the “recycling” that we have in mind. E-Waste is bad, for you and me, for our planet and most especially for the workers on the landfills. E-Wastes are buried or incinerated in landfills where their toxins pollute our land, air and water. Most of the time, they are sent to developing countries where workers extract the precious metals from the discarded electronics. Workers on E-Waste sites are paid an average of \$1.50 per day. They are unprotected while working with the toxic substances on the site. They are the first to inhale the toxins that are released in the air when electronic parts are burned. Many of these workers are children!



(a)



(b)

Figure: 1(a) and (b): Electronic Waste at Shop and Disposed Places

2.3 Why we should recycle Electronics

- Cellphones and other electronic devices contain precious metals like gold and silver. The US alone throws away cellphones with \$60 million worth of gold/silver yearly.
- Recycling 1 million laptops saves energy equivalent to the energy used by 3600 homes in the US annually.
- Most of the components of E-Waste are electronic equipments that can be re-used and recycled for materials recovery.

2.4 What can we do about our personal E-Waste

There are several options when it comes to the proper disposal of your electronic devices.

- Your old cellphone can still be used by another person. Same with your old computer or television. Donate it to friends, charities or community outreach programs – even to a stranger! This is better than the hazardous e-waste materials ending up in a

landfill somewhere. At the same time, you make someone happy. It's a win-win option!

- Find a Certified E-Waste Recycler. Those who are not certified will just send it off somewhere else where it can do its damage.

Be part of the solution and help reduce our electronic waste. We cannot stop you from changing your devices as often as you want, but discard your old ones properly. When it comes to E-Waste, there is probably another person in the world who can benefit from your unwanted devices. Find them before you throw it away. Let's keep our electronic waste as far away from landfills as possible.

3.0 Electronic Hazardous Waste (E-Waste)

Due to ongoing technological advancement, many of electronic products become obsolete within a very short period of time, creating a large surplus of unwanted electronic products, or "e-waste." Disposing of e-waste in landfills has the potential to cause severe human and environmental health impacts. To avoid these risks, the Electronic Waste Recycling Act (Senate Bill 50) was signed into law in 2004. SB 50 established and funded a program for consumers to return, recycle, and ensure safe and environmentally sound disposal of covered electronic devices (CEDs).

DTSC has also adopted regulations (Chapter 23 of Title 22 of the California Code of Regulations) designating e-wastes as universal wastes. Because they pose lower immediate risk to people and the environment when properly managed, universal wastes can be handled and transported under more relaxed rules compared to hazardous wastes. However, e-wastes contain hazardous materials and must be taken to a designated handler or recycler. Find an e-waste handler or recycler in your county, or visit the CalRecycle's Directory of the companies that collect, reuse and recycle electronic wastes.

3.1 Information for E-waste Handlers and Recyclers

There are various reporting requirements to consider before becoming an e-waste handler. DTSC has prepared several guidance documents and newsletters on complying with our regulations. Under California law, generators are responsible for determining whether their e-waste is hazardous waste (Cal. Code Regs, tit. 22, Section 66262.11).

3.2 E-waste Legislation and Regulation

DTSC regulates and enforces this Electronic Waste Recycling Act, and the Department of Resources Recycling and Recovery (CalRecycle) manages the payment system [13-14].

- See our new universal waste regulations that were adopted February 4, 2009. This version is in boldface where significant changes were made.
- See our summary table summarizing substantive amendments to the universal waste regulations.
- View the DTSC workshop presentations: Preparing for a DTSC Inspection of Your E-waste Facility, Mini-Workshop for Universal Waste Handlers.

3.1 Information for E-waste Handlers and Recyclers

3.3 Managing Discarded Cell Phones

Unwanted cell phones are regulated as universal waste electronic devices in California. Under the Cell Phone Recycling Act of 2004, retailers who sell cellular telephones are required to take them back from consumers. DTSC has prepared a fact sheet that explains the provisions of this law.

4.0 Environmental impact

The processes of dismantling and disposing of electronic waste in developing countries led to a number of environmental impacts as illustrated in the graphic. Liquid and atmospheric releases end up in bodies of water, groundwater, soil, and air and therefore in land and sea animals – both domesticated and wild, in crops eaten by both animals and human, and in drinking water [15].



Figure 2: Old keyboards and one mouse.

One study of environmental effects in Guiyu, China found the following [16]:

- Airborne dioxins – one type found at 100 times levels previously measured
- Levels of carcinogens in duck ponds and rice paddies exceeded international standards for agricultural areas and cadmium, copper, nickel, and lead levels in rice paddies were above international standards
- Heavy metals found in road dust – lead over 300 times that of a control village's road dust and copper over 100 times

The environmental impact of the processing of different electronic waste components.

Table 1: different electronic waste components

E-Waste Component	Process Used	Potential Environmental Hazard
Cathode ray tubes (used in TVs, computer monitors, ATM, video cameras, and more)	Breaking and removal of yoke, then dumping	Lead, barium and other heavy metals leaching into the ground water and release of toxic phosphor
Printed circuit board (image behind table – a	De-soldering and removal of computer	Air emissions and discharge into rivers of glass dust, tin, lead, brominated

thin plate on which chips and other electronic components are placed)	chips; open burning and acid baths to remove metals after chips are removed.	dioxin, beryllium cadmium, and mercury
Chips and other gold plated components	Chemical stripping using nitric and hydrochloric acid and burning of chips	PAHs, heavy metals, brominated flame retardants discharged directly into rivers acidifying fish and flora. Tin and lead contamination of surface and groundwater. Air emissions of brominated dioxins, heavy metals, and PAHs
Plastics from printers, keyboards, monitors, etc.	Shredding and low temp melting to be reused	Emissions of brominated dioxins, heavy metals, and hydrocarbons
Computer wires	Open burning and stripping to remove copper	PAHs released into air, water, and soil.

4.0 Conclusion

From the above study it is observed that Electronic waste is becoming serious problem worldwide due to use and through concept. There is serious need to observe the following points for minimizing it:

- E-waste Legislation and Regulation must be followed judicially.
- Every developing country must focus its re-use and recycle on priority basis. Thus can only be followed when be introduce by back system.
- TV, VCR, Computers, Telephones, mobiles or other useful gadgets must be standardized and their casing should be of standard size so that it can be re-assembled with new circuits.

There is tremendous scope for research for reduction of electronic waste by introducing technological development. Ultimately it will help in reducing environmental hazards.

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