

Environmental Impact of Technology Waste

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Robert Accettura

<robert@accettura.com>

When many people think of technology, they immediately think of either rooms full of giant computers with flashing lights and dials, or their own computer, cell phone, PDA (Personal Digital Assistants), or other electronic device. Technology has literally taken over everyday life. Everyday we are surrounded by these marvels. Since the PC (Personal Computer) revolution went in full swing in the 1980's, millions of computers have been made. Millions of additional technological devices have been made to accompany these PC's. From PDA's, cell phones, monitors, printers, keyboards, mice, speakers, there have been tons of products sold over the past 20 years. According to Moore's law, "in effect that at our rate of technological development and advances in the semiconductor industry the complexity of integrated circuits doubles every 18 months" (Moore's Law). To put this in easy to understand terminology, that means computers will constantly be getting faster and more powerful. That inherently means current computers will quickly become outdated.

What few home computer users or even corporate IT professionals think about when they purchase technology is, what should be done with their old technology. What is the most cost effective and environmentally friendly way of disposing all this waste? Will there need to be laws governing how this is done? Has the last 20 years of ignorant disposal methods already harmed our environment? All of these questions are on the minds of environmentalists involved with the issue, and some lawmakers, but not in the minds of those poised to make a difference, the consumers who buy the products, use the products, and ultimately decide how they will be disposed. This issue has gotten such little attention it's very possible if not likely many don't even know it's a problem.

To truly understand this topic, it is important to understand just a little bit of what is inside an average computer, and what is so harmful about these useful tools that we should be so worried about? At a computer's very core is electronic circuitry, mainly comprised of a larger board (Motherboard), several smaller expansion boards (PCI Cards, RAM, video cards, etc.), and various other parts, including disk drives, chips, and fans. Much of the circuitry on computers is commonly done with lead solder. While each soldered joint is very tiny, as a whole computer, with thousands of resistors, capacitors, and chips, it can turn into a larger amount than one would think. Holding all this together can be as much as 8lbs of Aluminum. This serves as the frame for the computer's case. Surrounding all that can be as much as 14lbs of plastic.

The worst part of any computer is the display. There are two different types of displays, a CRT (Cathode Ray Tube,) which is identifiable by its larger size in particular depth, and its similarities to a TV, and LCD (Liquid Crystal Display) which is commonly used on flat screen display's, and laptops, because it can be only a few centimeters thick. A CRT can contain 4lbs of lead to shield radiation. An alternative to lead would be gold, but that would be too expensive, according to David Thompson of Panasonic (Cole, 1). This display itself contains mercury among other harmful chemicals. LCD's, which are becoming more popular among new computers, don't have the lead, because they don't emit radiation, but still have the mercury to make them work.

To be fair to computer manufacturers, one should note that a computer today is more environmentally friendly than a computer from a decade ago. They are often smaller, meaning less aluminum and plastic is used. Machine soldering is also more precise, meaning less solder is used, and LCD's are becoming an affordable alternative. Most computers today also consume less power thanks to the Energy Star Program's push to get computers to support low powered mode (US Dept. of Energy). Some computers also use recycled materials, in particular plastic, and lead-free solder. Since this paper was first drafted, Intel announced that it would "begin eliminating approximately 95 percent of the lead used in its processors and chipsets starting later this year." (Intel). This is significant as lead is a very harmful substance found in all computers, and Intel's chipsets are found in most home computers. Improvements to the environmental impact of technology have been made. Motherboard manufacturer VIA just recently announced a "lead-free" motherboard, claiming to be the world's first (Overclockers Club).

Lead is a very toxic metal. It has been widely thought to be linked to cognitive development problems in children (Health Canada). It's already been removed from many products from pencils to paint, in hopes of keeping it from the human body. We no longer use lead pipes, instead use copper, so that it doesn't contaminate our water supply. A very famous theory on the fall of the Roman Empire links it to lead poisoning. Lead can be very dangerous. And a large sum could enter the groundwater from old computer monitors.

All this toxic and space consuming waste is ending up in landfills around the US, and

sometimes overseas. Computers are toxic boxes that potentially can pollute groundwater supplies and harm wildlife in addition to humans. Is there a solution to this crisis? The problem is “500 million computers will be obsolete by 2007, two in every household”, according to Jim Pucket, a network organizer for Basel Action Network (Heyamoto, 1). This is the “fastest growing portion of the municipal solid-waste stream” according to the EPA (Lorek, 1). That’s literally tons of technology being disposed of. If the average computer contains 8lbs of aluminum, that’s as much as 4 billion (4,000,000,000) lbs of aluminum that could possibly be recycled and kept out of landfills. But where does it go?

According to the National Safety Council, only 11% of the 315 million computers retired by April 04 will be taken to a recycling facility (Gaither, 1). The vast majority of the rest will end up in landfills in the US, or overseas, except in California, where it is now illegal to dump old monitors and TV’s in landfills. You can be fined \$25,000 and be given jail time if caught breaking this new law in California. Massachusetts has a similar law (Chaung, 1). In California there is also an upfront fee on CRT’s for their recycling, it bars exporting “e-waste”, and requires that manufacturers phase out harmful chemicals. It is based in part on a similar European law passed recently. According to Gartner Inc, 24 bills are currently in the works (Toxic Legacy, 19).

Recycling is the ultimate end to a computer. But there are many other cost effective ways to reduce the amount of technology waste. Computers themselves can be reused. Just because it’s not good enough for one task, doesn’t mean it’s useless. It can be

reassigned a new task for which it's capable. Here are a few that I've gathered (Chaung, 1) (and done some myself).

The first option is to sell the outdated computer. There are several PC Manufacturers that will buy back your old computer and give you credit on a new computer purchase. The company then recycles the computer, rather than just throw it out. HP has a trade-in website setup already with information targeting corporate customers (Heyamoto, 1). You can also sell a computer on EBay, or an ad in the paper, or on various websites devoted to used computer sales. Just because it isn't powerful enough for one person's use, doesn't mean it can't be useful to someone else. A programmer, graphic artist, or engineer needs a state of the art computer, but a casual home would find their "obsolete" systems to be more than adequate for their needs.

Another option is to donate the computer. Just because a computer isn't powerful enough for its first owner, doesn't mean someone else can't use it. It may also be a tax deduction if donated to a charity or a school. In Lake County, FL, there is currently a debate on what to do with the county's old computers. The school district updated their computers with the plans of disposing of their old technology. Now people are proposing to give them to needy students, rather than just throw them out (Lake County, 1). There are also groups like Goodwill who will take older computers and find new homes for them (Chaung, 1). There are also several organizations that from time to time accept donated computers for use by low income families. A quick search online can help find if a local organization is conducting such a campaign.

Yet another option is to upgrade. Most computers made recently can be relatively easy to upgrade. A new Hard Drive can be purchased and installed by a local computer store, or by the customer for a nominal fee to provide more storage (Chaung, 1). RAM for more memory, or a new CD/DVD-RW drive can also be purchased for a smaller price than a new computer. For most people, it would enhance the life of their computer, and save them money. Extra PCI slots allow for expansion with USB 2.0, Firewire, and a new sound card. You can also upgrade the video card for a better gaming experience. By doing this, I've got a 5 year old computer still performing fairly well. This is much cheaper than buying a new computer, only because you need something that costs \$100 to add. Macintosh users can find a fair amount of processor upgrades in addition to the above, allowing you to take an older slower computer into a significantly faster computer.

Yet another option is to find a new use for old hardware. This is a situation where I have personal experience. My father's employer was looking to discard a bunch of older office systems, and decided to sell them to employees for \$50. The systems were older Revision 1 Apple Power Mac G3 Desktops, no monitor. I decided to buy a new Hard Drive, and a faster drive controller, and set it up as a home file server, dubbed "Bender", after the robot from the TV show Futurama. Connected to my home network, it now serves as an easy place to backup all my work from the desktops in my house, and my laptop. While too old for corporate use, the system is more than capable of storing large amounts of data for me. Buying an equivalent network storage device would cost a few

hundred dollars. I can now access my files from any computer at home. I also took the time to install some software allowing it to converse and provide information like weather, TV listings, and various other toys over popular Instant Messaging services, allowing me to take further advantage of the system. It at one point also had an industrial strength spam filter which I sometimes used to clean up my email, saving me time and effort in the fight against spam, though I found better methods for that now. It could also easily be setup to stream music around the house. While a more advanced trick, there are many uses for older systems, including backup storage, a jukebox to play Mp3's, or just to check email when the primary computer is occupied.

If I wanted more power, I could invest in a CPU upgrade, and more memory, and easily get more performance out of the system, which still it's too bad for its intended task.

Looking at the manufacturing date, it was made in 1999, and purchased by me in early 2003. Now in 2004, it's still running, with no end in sight, far from early retirement. It's already been working a year after it would have been scrapped.

A tip I personally learned is that you should always buy a high quality monitor. Because display technology changes so slowly, it can outlast a computer or two. So a good large high quality display can last several years, saving money, and reducing the environmental impact of upgrading a computer. There's no need to buy a brand new display each time you need more speed. That can save 4lbs of lead from ending up in a landfill. An even better alternative is to get a good LCD display that will last several years (look for one that uses both a VGA and DVI connection so it will connect to newer graphics cards).

That one slightly more expensive monitor can serve in place of 2 or 3 monitors that you could have bought. That's a significant long term savings

These solutions help keep computers out of the trash, but eventually, it may end up just taking up space and never being used. The final option is to recycle the computer. There are actually multiple ways to recycle technology. The Computer Recycling Center, a 501 (c)(3) nonprofit organization devoted to the topic put it quite nicely on their website "Reuse of entire units is given highest priority, followed by disassembly for reuse of parts, and finally recycling for the elements of unusable remaining items" (Computer Recycling Center) According to the Computer Recycling center they kept over 6 million pounds of computer equipment from landfills last year through this method.

According to a paper called "Disposal and End-of-Life Options for Personal Computers" on the Carnegie Mellon website "metals account for over 70% of the residual value of a computer. This is rather significant, because the reduction of metals such as aluminum in a computer, could actually make recycling even more costly, since there is less to recoup after processing the waste (Matthews). Another problem adding to the complexity of the issue is exporting technology waste. According to the Seattle Times, a global environmental coalition detailed that as much as 80% of the nations recycled computers were being shipped to Asia where laws are more lax regarding environmental laws and worker safety.

All articles that interview a representative of a technology recycling tend to say

something similar to that of Renee StDenis, the head manager at HP's recycling plant: "I know there are hundreds of millions of PCs in the US not being used," she said. "How do I get them out of consumers' hands?" (Gaither, 1) Many consumers don't even know this is a problem and don't even know how harmful their computers can be to the environment. The biggest issue of all is the cost. Nobody wants to pay to throw something away, especially when there is a free option (trash can). I believe this is why some lawmakers are looking towards building in a recycling cost in the initial purchase, so customers essentially pay for the disposal when they buy their computer. Dell, in an effort to keep recycling costs low, contracted prison labor to disassemble computers in their recycling plant, but this caused some controversy over reports that the methods were dangerous to the prisoners. Dell claims it meets all OSHA standards (Swett, 1). HP also has had an incentives program to encourage recycling of old computers. This shows there has been some industry recognition of the problem and an attempt at a solution.

Ultimately the issue as I see it boils down to two things, cost vs. benefit. Most companies and home users don't see their computer sitting in a landfill and leaking into groundwater. In many cases it may not even end up in a nearby landfill. So to them, there is no benefit in their minds to paying for recycling, when they can just place their old computer at the curb for pickup. They get the same benefit (removal of waste), at a lower cost by using curbside pickup. Not to mention, no hassle of boxing it up to ship to the recycling plant like HP and Dell require, or finding a place to donate it to.

I see two key aspects to this problem, which I think will collide and ultimately solve the problem. The first aspect is simply how technology itself is evolving. First computers are consuming less and less power themselves, both by being energy star compliant, and from better hardware, like LCD displays becoming more available, and more efficient parts. Using less power also means less heat being generated, improving reliability. According to NewsFactor, IDC reported “within the great numbers, we're seeing a dramatic shift from desktops to notebook buying” (Maguire). Laptops use less power by design so they can run off of batteries for the longest possible time, and contain LCD displays which don't contain lead. To increase the battery life, companies are looking to cut power usage as much as possible, driving efficiency. Yet another benefit of laptops is the smaller size means less space occupied if they do end up in a landfill. Computers are large, imagine all of those 500 million computers that are due to be outdated in the next few years each being 6 square inches. That's very small, much smaller than average, and it's still a tremendous amount of space in landfills. The batteries can be recycled along with most other batteries, which is a well established program. Batteries are full of chemicals if you look at the names of them (Nickel-Cadmium, nickel metal hydroxide etc.). All of these chemicals are very toxic. Cadmium is especially toxic. As a result widespread recycling programs have been in place for several years.

Until there is government regulation at a federal level, I don't think this situation will improve. It's clear that several computer manufacturers have made an honest effort to deal with it themselves without intervention by the government, by offering incentives to recycling, and building recycling plants like HP has. But as noted by Computerworld,

the laws on the state level are more like patchwork, and inconsistent (Toxic Legacy). It will be very hard for the technology industry to abide by 50 different sets of laws. I personally believe in the future there will end up being a tax, that will cover disposal of technology equipment. That way all technology purchased already has money allocated for proper disposal, removing the question of value when recycling. A tax would be binding, and ensure that it's always collected, and a tax would ensure no technology is bought without factoring in disposal costs.

Work Cited

Chaung, Tarmara. "California Residents Who Throw Away Their Computers Could Be Breaking Law" Knight Ridder Tribune Business News 28 Dec. 2002: p 1. ProQuest. ProQuest Direct.
10 Mar. 2004 <<http://www.proquest.com>>.

Computer Recycling Center Information. 14 Mar. 2004
<<http://www.crc.org/info/index.html>>.

Cole, Michelle. "Within Limits, Manufacturers Say Computers Getting More Environment - Friendly" Knight Ridder Tribune Business News 16 Dec. 2002: p 1. ProQuest. ProQuest Direct.
10 Mar. 2004 <<http://www.proquest.com>>.

Gaither, Chris. "Efforts to Recycle Personal Computers Still Have Long Way to Go" Knight Ridder Tribune Business News 22 Apr. 2003: p 1. ProQuest. ProQuest Direct.
10 Mar. 2004 <<http://www.proquest.com>>.

Heyamoto, Lisa. "Three Seattle-Area Firms Pledge to Recycle PCs Responsibly" Knight Ridder Tribune Business News 26 Feb. 2003: p 1. ProQuest. ProQuest Direct.
10 Mar. 2004 <<http://www.proquest.com>>.

Intel Working To Get The Lead Out. 7, Apr. 2004

<<http://intel.com/pressroom/archive/releases/20040407tech.htm>>

“Lake County, Fla., Stops Dumping Old Computers; Will Recycle to Poor Students”

Knight Ridder Tribune Business News 31 Jul. 2003: p 1. ProQuest. ProQuest Direct.

10 Mar. 2004 <<http://www.proquest.com>>.

Lead and Cadmium. 23 Mar. 2004

<<http://www.hc-sc.gc.ca/english/media/releases/1998/lead.htm>>

Lorek, L.A.. “Austin, Texas, Company Keeps Unwanted Computers out of the Dump”

Knight Ridder Tribune Business News 18 Oct. 2003: p 1. ProQuest. ProQuest Direct.

10 Mar. 2004 <<http://www.proquest.com>>.

Maguire, James. “PC Sales Surging, Profits Iffy” News Factor. 12 Sept. 2003

<<http://www.newsfactor.com/perl/story/22854.html> >.

Matthews, H. Scott, et al.. Disposal and End-of-Life Options for Personal Computers. 05

Mar. 2004 <<http://gdi.ce.cmu.edu/comprec/NEWREPORT.PDF>>.

Moore’s Law. 14 Mar. 2004. 16 Mar. 2004 <http://en.wikipedia.org/wiki/Moore's_Law>.

News: VIA Announces Lead-Free Motherboard. 23 Apr. 2004

<<http://www.overclockersclub.com/?read=8266105>>

Swett, Clint. "Silicon Valley Green Group Applauds Hewlett-Packard's Recycling Efforts" Knight Ridder Tribune Business News 27 Jun. 2003: p 1. ProQuest. ProQuest Direct.

10 Mar. 2004 <<http://www.proquest.com>>.

"Toxic Legacy" Computer World 2 Feb. 2004: vol 36 iss 5 pg 19-21. ProQuest. ProQuest Direct. 10 Mar. 2004 <<http://www.proquest.com>>.

United States. Dept. of Energy. Computers : Energy Star. 10 Mar. 2004 <http://www.energystar.gov/index.cfm?c=computers.pr_computers>.