



Electronic Waste

GECAP of the Georgia Tech Research Institute is a voluntary, non-regulatory environmental compliance program funded by the Georgia Legislature through the University System of Georgia.

What is 'electronic waste'?

Electronic waste is defined as anything with a circuit board or a Cathode Ray Tube (CRT). **Table 1** gives a list of some of the more common types of electronic waste, or e-waste, that are often accepted during recycling events.

Table 1: Common E-waste

Mini-towers	Routers	Stereo equipment
Desktop computers	Laptop computers	Digital cameras
Scanners	Digital projectors	Fax machines
Monitors	UPS units	Television sets
Servers	Main frames	VCRs
Cell phones	Component parts	DVD players
Keyboards	Cables	Calculators
Mice	Telephones	Remote controls
Joystick game controllers	Telephony equipment	Answering machines
Printers	Adding machines	Radios
Cable converter boxes	Portable game players	Portable CD players
Speakers	Typewriters	Zip drives
PDAs	Hubs	GPS receivers
Pagers	Copiers	Smoke detectors

There are at least 4.4 million Personal Computers (PCs) and 8 million TVs in the 3 million households in the state. With an average weight of 54 pounds this e-scrap will eventually become 334,800 tons of waste. The picture tubes (CRTs) in monitors and TVs each contain about 5 pounds of lead oxide embedded in the glass. Thus, the 12.4 million CRTs contain about 31,000 tons of lead, known to be a highly toxic hazardous waste.¹

Recycling of electronic wastes has the benefit of recovering high value materials such as metals, glass and plastics, keeping toxic materials out of our environment and reducing regulatory burden on businesses.

How do you determine whether or not a particular item is hazardous?

Electronic waste is not always hazardous, but determining which products are not hazardous may prove to be difficult. It is the responsibility of the business that wants to dispose/recycle e-waste to make that determination. Unless you want to get all your equipment tested it is best to follow the precautionary principle and manage all e-waste assuming that it is hazardous.

Why is electronic waste a problem?

Electronic equipment contains many different toxic materials, such as: lead, tin, cadmium, PBDEs (polybrominated diphenyl ethers), mercury and flame retardants. The presence of these materials does not make the equipment dangerous during its use period but if electronic equipment is landfilled or incinerated these hazardous materials can be released into the environment. See **Table 2** for a list of hazardous materials found in electronics and their associated health risks.

¹ Computer Equipment Disposal and Recycling Council. (2005). Electronics Recycling: An Economic Development Opportunity for the New Georgia, June 2005. Available online at <http://sisfur.coa.gatech.edu/download/CEDRC%20FINAL%20REPORT.pdf>.

Table 2: What are the contaminants of concern in old electronics and what are their exposure pathways?

Electronic equipment contains metals and other materials that can be hazardous to human health and the environment if they are not properly managed:

- **Cadmium** - found in chip resistors, infrared detectors, and semiconductors. Cadmium can affect the kidneys. Cadmium is persistent, bioaccumulative, and toxic. The principal exposure pathway is through respiration and through our food.
- **Lead** - found in glass panels in computer monitors and in lead soldering of printed circuit boards. Printed circuit boards are used in computers, televisions, radios, cell phones, dvd players, cameras etc. Lead can cause damage to the central and peripheral nervous systems, blood systems, and kidneys in humans. Lead has also been shown to have negative effects on the development of children's brains. Lead can accumulate in the environment and have a detrimental effect on plants, animals, and humans. Consumer electronics may be responsible for 40% of the lead found in landfills. The principal pathway of concern is lead leaching from landfills and contaminating drinking water supplies.
- **Mercury** - found in thermostats, position sensors, relays and switches (e.g., on printed circuit boards), discharge lamps, and batteries. It is also used in medical equipment, data transmission, telecommunications, and cell phones. When mercury makes its way into waterways, it is transformed into methylated mercury in the sediments. Methylated mercury accumulates in living organisms and travels up the food chain. Methylated mercury can cause brain damage. The principal exposure pathway is through our food.
- **Hexavalent Chromium or Chromium VI** - can be used to protect against corrosion of untreated and galvanized steel plates. Chromium VI can damage DNA and has been linked to asthmatic bronchitis. The major pathways are through landfill leachate or from fly ash generated when materials containing Chromium VI are incinerated.
- **Brominated Flame Retardants (BFR)** - found on printed circuit boards, components such as plastic covers and cables as well as plastic covers of televisions and cell phones. Research has shown that one of these flame retardants, Polybrominated Diphenylethers (PDBE) might act as an endocrine disrupter. Flame retardant Polybrominated Biphenyls (PBB) may increase cancer risk to the of the digestive and lymph systems. Once released into the environment through landfill leachate and incineration they are concentrated in the food chain.

Adapted from EPA's e-Cycling website <http://www.epa.gov/e-Cycling/faq.htm>.

If you have a large quantity of identical models that you feel are not hazardous it may be worthwhile to have a hazardous waste determination analytical test run called the Toxicity Characteristic Leaching Procedure (TCLP).

In a 2004 study conducted by researchers at the University of Florida, every type of electronic equipment that they tested failed the TCLP standard of 5 mg/L for lead.² The electronic devices that

² Townsend, T.G. et al. (2004). RCRA Toxicity Characterization of Computer CPUs and Other Discarded Electronic Devices. Department of Environmental Engineering Sciences, University of Florida, Gainesville, Florida. Sponsored by: United States Environmental Protection Agency, Region 4 and Region 5. Available online at http://www.epa.gov/region5/waste/solidwaste/ecycling/pdfs/uf_ewaste_final.pdf

they tested are: CPUs (computer processing units), computer monitors, flat panel monitors, laptop computers, printers, color televisions, VCRs, cellular telephones, keyboards, computer mice, remote controls and smoke detectors. The researchers concluded that equipment with a color CRT or with printed wiring boards should be assumed to be hazardous due to lead unless testing can demonstrate otherwise. In a similar study, the State of California tested seven electronic product types (microwave ovens, VCRs, printers, CPUs, cell phones, telephones, and radios) and concluded that all the product types tested clearly exceeded at least one hazardous waste criterion. Lead was the most common element exceeding its limits.³ As a result under California law CRTs, LCD and plasma screens that are greater than 4 inches when measured diagonally, are all assumed to be hazardous unless the manufacturer can demonstrate that their product is not hazardous.⁴ A list of items found to have hazardous characteristics through testing is in Table 3.

Table 3: Items testing positive for hazardous characteristics

CPUs	Color televisions	Computer mice
Computer monitors	Flat panel monitors	Laptop computers
Telephones	VCRs	Smoke detectors
Remote controls	Cell phones	Microwave ovens
Printers	Keyboards	Radios

One way to avoid having to test equipment is to evaluate equipment before you make a purchase decision so that you buy the product without any hazardous elements, if possible. Unfortunately it is not always possible to get this information from suppliers or manufacturers. There is one available resource which rates computers, monitors and laptops on a number of environmental issues including their use of hazardous metals, the Electronic Product Environmental Assessment Tool (see <http://www.epeat.net>).

What regulations apply to businesses?

Any business that generates less than 100 kilograms (about 220 lb.) of hazardous waste, including hazardous electronic equipment, per month is exempted from RCRA hazardous waste regulations. While these businesses do not have to follow RCRA procedures, their electronic waste must still be disposed of properly, either through reuse, donation or being sent to a facility authorized to receive solid waste.

³ Hazardous Material Laboratory, California Department of Toxic Substances Control (2004). E-waste Report: Determination of regulated elements in seven types of discarded consumer electronic products. Available online at http://www.dtsc.ca.gov/Hazardous-Waste/EWaste/upload/Consumer_Electronic_Products.pdf.

⁴ http://www.dtsc.ca.gov/HazardousWaste/EWaste/#How_do_I_Know_if_my_E-Waste_is_Hazardous

Small and Large Quantity Generators (businesses producing more than 100 kilograms of hazardous waste a month) must include the weight of any hazardous e-waste that they generate in their calculations to determine generator status. These generators are regulated under federal law and hazardous e-waste sent for disposal from such facilities must be manifested as “hazardous waste” and sent to a permitted licensed hazardous waste disposal facility. There are however more attractive solutions that can turn your e-waste into a valuable commodity avoiding the need to treat it as a hazardous waste.

Used electronic equipment is not considered solid waste if you resale, donate or recycle the equipment, and thus would not count toward generator status. Another way to avoid the disposal headache is to establish an agreement with the equipment manufacturer to take it back at the end of its useful life, or better yet lease the equipment, which enables you to update your electronics to the latest technology more frequently.

Businesses that decide to resale, donate or recycle their used electronic equipment do need to take some precautions. In order to protect your business’ intellectual property and data that may be regulated under federal privacy laws, companies are advised to over-write their hard drives to erase all data. It is also a good idea to perform due diligence on the recipient of your e-waste to ensure that they will handle it properly. Paying to have your equipment recycled does not guarantee that the company will follow through with their promise. If the recycler mishandles your e-waste you could still be considered liable. The last two websites listed at the end of this document provide guidance on selecting a good recycling company.

Special Ruling for CRTs

The EPA released the final rule for Cathode Ray Tubes (CRT) on July 28, 2006 to become effective on January 29, 2007. A CRT is the glass video display component of an electronic device (usually a computer or television monitor). The new rule conditionally excludes CRTs from the definition as solid waste as long as they are recycled and handled properly. There are specific rules related to the handling and recycling of CRTs depending on their condition, in order to qualify for the exemption. These include:

Used, intact CRTs

- Cannot be disposed or stored in hope that they can be recycled later, called “speculative accumulation.” To avoid this charge you must be able to demonstrate that at least 75% of all electronic material collected is recycled within a calendar year

- Exports for recycling are permitted with 60 days notice to EPA and consent of the receiving country – see [part 261, subpart E section 261.39\(a\)\(5\)](#) for specific requirements of the notice
- Exports for reuse require a one-time notification to the Regional EPA office including your name, address, EPA ID number and designating a contact person.

Used, broken CRTs

- Must be stored in a building or container
- Must be labeled as follows: “Used cathode ray tube(s) – contains leaded glass” or “Leaded glass from televisions or computers.” Additionally it must be labeled “Do not mix with other glass materials.”
- Both the labeling and containing requirements must be maintained during transportation

If CRTs are not recycled and are disposed or speculatively accumulated you must follow requirements for Recyclable Materials Used in a Manner Constituting Disposal found in [part 266, subpart C](#).

Where can you get more information?

- List of e-waste recyclers in Georgia updated March 2006 by Georgia’s Sustainability Division at http://www.gecap.org/pdf/ga_sustdiv_electronics_recyclers.pdf
- Georgia Department of Community Affairs maintains a searchable database of recyclers in Georgia at <http://www.dca.state.ga.us/development/EnvironmentalManagement/programs/recycling/default.asp>
- Guidance from Georgia’s former Pollution Prevention Assistance Division (now the Sustainability Division) “What You Should Know About Your E-Scrap Vendor” at <http://www.gecap.org/pdf/e-scrappendor.pdf>
- Checklist for how to select a recycling company at <http://www2.epa.gov/sites/production/files/documents/select.pdf>

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Georgia Tech Research Institute
Atlanta, Georgia 30332-0837
404-407-8082 <http://www.gecap.org>

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