

EarthTrends Featured Topic: Toxic Trade: The Real Cost of Electronics Waste Exports from the United States

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Electronic waste, or "e-waste", is a broad term that refers to end-of-life consumer electronics, including televisions, computers and monitors, audio/stereo equipment, VCRs, DVD players, video cameras, telephones, fax and copy machines, mobile phones, wireless devices, and video game consoles. In 2003, the United States alone generated 2.8 million tons of electronic waste and only recovered (re-used or recycled) 290 thousand tons, leaving the rest to enter into the municipal waste stream (EPA 2003).

One of the largest obstacles in recycling e-waste is the lack of proper domestic facilities to sort and handle the various materials, many of which are hazardous. In the United States, waste is frequently exported to developing countries, allowing producers and consumers to take advantage of very low labor costs (as low as \$1.50 per worker per day in China) and less stringent environmental and occupational regulations (Puckett et al. 2002: 10). However, the dismantling of e-waste, particularly in parts of Asia and Africa, poses a significant health risk to workers and their communities (Puckett et al. 2002: 11). The promotion of responsible federal regulation, legitimate recycling programs, and corporately sponsored take-back agreements would work towards preventing the export of tons of e-waste and ultimately protect these overseas communities from the environmental and health impacts of the hazardous materials.

E-Waste Toxins

E-waste contains a number of toxic substances, including plastics and heavy metals such as lead, cadmium, and mercury, which can cause serious adverse health effects.

Lead can be found in circuit boards and monitor cathode ray tubes (CRTs). Lead is particularly dangerous to the environment because of its ability to accumulate and persist in plants, animals, and microorganisms (Puckett et al. 2002: 11). The bioaccumulation of lead in the human body is particularly harmful because its primary target is the central nervous system. Lead can cause permanent damage to the brain and nervous system, causing retardation and behavioral changes. Infants and young children are particularly susceptible because of the impairment of cognitive and behavioral development it can cause (Ryan et al. 2004: 19A).

Cadmium can be found in SMD (surface mount device) chip resistors, infrared detectors and semiconductors (Puckett et al. 2002: 11). Like lead, cadmium is particularly toxic to humans because it accumulates in the human body and poses an environmental danger due to both acute and chronic toxicity (Puckett et al. 2002: 11). Renal damage is the most common effect of cadmium toxicity. Cadmium that enters the system through the gastrointestinal tract resides in human kidneys with a half-life of 10-20 years (Nordberg et al. 1985).

Mercury is the most prevalent toxic metal found in e-waste. It is in circuit boards, switches, medical equipment, lamps, mobile phones, and batteries. Mercury transforms into methylmercury in water, where it can accumulate in living organisms, typically via fish, concentrating in large fish and humans at the top of the food chain (Puckett et al. 2002: 11). Mercury is readily absorbed by the human body, ultimately inhibiting enzymatic activity and leading to cell damage (Boyer et al. 1959).

The most abundant component of e-waste is plastics. Plastics comprise almost twenty-three percent of a typical desktop computer (Microelectronics 1995). They are used for insulation, cables and housing for all electronic devices; the variety of products available for recovery complicates the de-manufacturing process. Due to the complex recovery process, large amounts of plastic e-waste are disposed of through landfills, incinerators and open burning, allowing toxic substances to leach into the environment.

Case Study: Guiyu, China

The town of Guiyu is located in the Chaozhou region of the greater Guangdong Province in southeast China. "Since 1995, Guiyu has been transformed from a poor, rural, rice-growing community to a booming e-waste processing center. While rice is still growing in the fields, virtually all of the available building space has given way to providing many hundreds of small and often specialized e-

waste recycling shelters and yards" (Puckett et al. 2002: 17).

Along with this new e-waste recycling comes serious environmental and occupational health hazards. Hazardous recycling operations include toner sweeping, the open burning of dismantled computers, CRT cracking and dumping, circuit board recycling, acid stripping of chips, and plastic chipping and melting (Puckett et al. 2002: 20). The workers are at risk of inhaling the toxic fumes from the burning of the materials and ingesting contaminated water and food. They may also be exposed to toxins through dermal contact due to the lack of sufficient protective equipment.

Please see the Basel Action Network website (<http://www.ban.org/photogallery/index.html>) to view a photo gallery of e-waste in Guiyu, China.

Large amounts of imported e-waste material and process residues never get recycled and are simply dumped in open fields; along riverbanks, ponds, and wetlands; in rivers; and in irrigation ditches (Puckett et al. 2002: 23-24). This indiscriminate dumping has exacerbated contamination of drinking water sources and sediments. Water samples from the Liangjiang River outside of Guiyu, China show cadmium and lead levels to be well above World Health Guidelines and EPA Drinking Water Standards (*Table 1*).

Table 1. Guiyu Sample Results and Water Quality Comparison. Adapted from Puckett et al., 2002.

Metal	Liangjiang River, Guiyu (mg/L)	World Health Guideline (mg/L)	EPA Drinking Water Standard (mg/L)
Cadmium	0.01	0.003	0.005
Mercury	< 0.001	0.001	0.002
Lead	1.9	0.01	0.015

International, National, and Local Efforts to Eliminate E-waste

The Basel Convention is the leading international authority on regulating the reduction of e-waste. On March 22, 1989 the Basel Convention was established to control "transboundary movements of hazardous wastes and their disposal" between countries (UNEP 1989). Signatories to the Convention are not allowed to import or export any electronic components that may contain toxic chemicals. Currently, there are 167 participants of the Basel Convention. Afghanistan, Haiti, and the United States have not yet ratified the document (UNEP 2006).

Since the inception of the Basel Convention, European communities have presented a detailed document that specifies methods for regulating e-waste. The Directive on Waste Electrical and Electronic Equipment, or WEEE Directive, was presented and accepted by the European Parliament on January 27, 2003. The directive's purpose was to prevent e-waste from becoming a problem by reusing or recycling recoverable electrical parts (European Parliament 2003a). An amendment to the original directive forced producers to internalize external costs, such as recycling and proper disposal, instead of burdening the consumer with costs for proper disposal (European Parliament 2003b).

In 2001, Japan implemented their Specified Home Appliance Recycling Law, which requires manufacturers to take back their electronic products and home appliances (Ministry of the Environment 2005). The national law also makes it illegal to dump any electronic waste or home appliance in municipal landfills or roadsides (Ministry of the Environment 2005).

In 2003, the Organization for Economic Co-operation and Development (OECD) completed the Environmentally Sound Management of Waste report, which advises countries on collecting, disposing, storing, and recovering their hazardous electronic waste (OECD 2003). This report, however, can only make recommendations to waste facilities about environmental management systems; auditing environment, health and safety measures; and monitoring and recording emissions and waste generation (OECD 2003). The report cannot force countries to implement these measures.

In North America, The Commission for Environmental Cooperation created a proposal in 2004 similar to the WEEE Directive that was introduced in Europe. The proposal was not well-received by electronics-related industries (EPA 2004). Adoption of the proposal to the Commission did not take place (EPA 2004), meaning that it is still legal to allow U.S. export of hazardous e-waste (Puckett et al. 2002: 6).

The U.S. stance on the Basel Convention has not stopped private organizations and local governments within U.S. national boundaries from introducing local policies to regulate electronic equipment. Some corporations have played a proactive role in the e-waste debate by providing electronic recycling programs: Dell, Hewlett-Packard (HP), NEC, Toshiba Gateway, eMachines, IBM, and Lexmark for individual

Participating Countries	Governing Body	Initiative	Date Adopted	Reference
167 countries of the UN (excluding Afghanistan, Haiti, and the US)	United Nations Environment Programme	<i>Basel Convention</i> : No transboundary movement of hazardous waste	1989	(UNEP, 1989)
The European Union	European Parliament	<i>WEEE Directive</i> : Reuse/recycle electronic parts; manufacturers internalize take back/recycling costs	2003	(European Parliament, 2003)
Japan	Ministry of the Environment, Government of Japan	<i>Home Appliance Recycling Law</i> : Home appliance manufacturers must take back and recycle end-use products	2001	(EPA, 2004)
Intended for OECD countries	Organization for Economic Co-operation and Development (OECD)	<i>Environmentally Sound Management of Waste</i> : Redaim e-waste	2003	(OECD, 2003)

Table 2. International Efforts in Reducing E-Waste.

consumers, and Xerox and Pitney Bowes for large-scale office equipment customers (SVTC 2004a,b). The following states have initiatives in place: California passed the 2003 Electronic Waste Recycling Act; in 2000, Massachusetts banned CRTs from landfills; in 2003, Minnesota passed a bill that banned CRT disposal in mixed solid waste; and in 2006, Maine became the first state to force television and computer monitor manufacturers pay for recycling and proper disposal (Associated Press 2005).

The strictest regulations so far in the U.S. have been passed in Washington state. As of October 1, 2005, it was illegal to dump any used electronics in Seattle or in King County, Washington (Priorities 2006). The King County Solid Waste Division will not accept any electronics in municipal landfills; instead, their Waste Acceptance Rule directs consumers to drop off used electronics to participating Take it Back Network Electronics Recyclers (King County 2005a,b). Priorities for a Healthy

Washington is a state-organized campaign supported by a variety of businesses and public interest groups who are in favor of Senate Bill 6428: Washington State's Electronic Waste Recycling Bill (Priorities 2006). SB 6428 passed on March 6, 2006. Instead of putting the burden on consumers to pay for recycling, this bill expects manufacturers to include electronic recycling fees as part of their own business costs.

Recommendations

While a few U.S. states have taken the initiative to manage their e-waste, there is no guarantee that the trend will encourage all states to do the same. A national commitment to e-waste regulation should include the ratification of the Basel convention by the United States, and expand on existing regulations in federal laws such as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA) by banning hazardous waste exports entirely. Adequate resources need to be allocated for both the implementation and

enforcement of e-waste policies. Like the WEEE Directive, there should be a formal document not only banning e-waste creation and trade within U.S. borders, but Canada, Mexico, and the U.S. should also coordinate a formal document that bans e-waste creation and trade within North America.

In addition to government action, private industry can expand its role in managing e-waste. Recycling is one of many solutions, but it can only play a limited role when hazardous inputs are involved. Product substitutions can be implemented wherever possible in order to reduce the amount of poisons in the manufacturing of electronics (SVTC 2004b). Producers can also take the initiative of managing their products over their entire life-cycle. If manufactures and distributors assumed the responsibility for the costs of collecting, managing, and disposing of discarded electronics, they could be reflected in product prices. The cost of "life-cycle responsibility" could be offset by market incentives for manufacturers of electronics to reduce such costs by designing products that are clean, safe,

durable, reusable, repairable, upgradeable, and easy to disassemble and recycle (Puckett et al. 2002: 37).

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