
Benefits of recycling electronics in the US

Introduction

A product creates environmental impacts throughout its lifecycle, from raw material extraction and manufacture to use and disposal. This fact sheet references laws in Europe and the US that finance the collection and recycling of discarded electronics. These laws (1) reduce the amount of waste generated, (2) prevent the release of hazardous materials into our ecosystems, and (3) conserve the earth's limited resources by reducing raw material extraction and encouraging more sustainable approaches to manufacturing. This fact sheet also highlights products not included in US laws and identifies research that explains why they should be included in take-back programs.

Consumer electronics^a are the fastest growing segment of the municipal solid waste stream in the US, accounting for 2.63 million tons of waste in 2005 (or 1.1 percent of the waste stream), an increase of 7.8 percent over 2004. Of this 2.63 million tons, 87.5 percent was disposed of rather than recycled.² Toxic substances contained in electronic products can pose threats to human and environmental health after those products have been sent to landfill or burned in incinerators. For this reason, numerous products have been classified as hazardous waste. Recent lifecycle analyses^b show that recovering many of the materials contained in electronics, as opposed to extracting raw materials from the earth, makes environmental sense.

Table 1 lists numerous consumer electronics and identifies those with documented environmental gains from recycling, those covered by European and US recycling laws, ownership rates in the US, and hazardous waste determination.

Products covered under European Union Directives

The European Union (EU) Waste Electrical and Electronic Equipment (WEEE) Directive entered into force February 13, 2003. It required each member state to develop separate legislation to comply with its terms by August 13, 2004.⁴ The WEEE Directive applies the principle of extended producer responsibility (EPR), a policy approach that seeks to make manufacturers fiscally responsible for managing products that have reached the end of their useful life. The WEEE Directive covers electrical products (e.g., household appliances and tools) and electronics (e.g., TVs, computers, cell phones, etc.) (see the attached annex), and it requires manufacturers to fund the collection, recycling, or safe disposal of these products. The EU Battery Directive, which regulates the collection and recycling of batteries, entered into force September 26, 2006, and each member state must translate its provisions into law by September 26, 2008. The Battery Directive covers single-use and rechargeable batteries found in consumer electronics.⁵

Products covered under US state laws

Four states have enacted laws that require the collection and recycling of certain electronic devices: California (2003), Maine (2004), Maryland (2005), and Washington (2006). The laws in California and Maine cover similar products: laptop computers and video display devices such as TVs and computer monitors. In addition to these devices, Washington's law applies to desktop computers. Maryland's law covers only desktop personal computers, laptop computers, and computer monitors; it does not include TVs. Only California requires the collection and recycling of rechargeable batteries found in consumer electronics.

^a Products such as TVs, VCRs, DVD players, video cameras, stereo systems, telephones, and computer equipment.

^b Lifecycle assessment is a process that quantifies the environmental impacts of a product during its "lifetime," which includes raw material extraction, production, use, and disposal.

Table 1: Selected consumer electronic products by US household saturation rate

Product	Documented environmental gains from recycling	Household saturation rate ⁶ in US* (%)	Covered in WEEE Directive	Classified as hazardous waste ⁷	Financed (F) or not financed [†] (NF) under US state law
Televisions (all technologies)	✓ ¹	95	•	•	F (CA, ME, WA)
VCR player	✓ ¹	87	•	•	NF (CA)
Cordless telephones	✓ ¹	85	•	•	NF (CA)
DVD player	✓ ¹	81	•		
Wireless phone	✓ ^{1,8}	78	•	•	NF (CA)
Personal computer		73	•	•	F (WA), NF (CA)
CRT-based PC monitor	✓ ¹	—	•	•	F (CA, ME, WA)
Color printer	✓ ⁹	71	•	•	NF (CA)
In-dash CD player		62	•		
Digital camera		57	•		
Portable boom box CD	✓ ¹	54	•	•	NF (CA)
Portable headset CD	✓ ¹	50	•		
Video game system		42	•		
Vehicle security system		39			
Notebook PC		35	•	•	F (CA, ME, WA)
Home theater package	✓ ¹	31	•		
Car CD changer		29	•		
Flat panel PC monitor	✓ ¹	28	•	•	F (CA, ME, WA)
AV receiver	✓ ¹	28	•		
Portable digital music player		25	•		
Digital camcorder		25	•		
Two-way radio		22	•		
Digital video recorder	✓ ¹	15	•		
Mobile video system		15	•	•	F (CA)
Satellite radio		10	•		
Mobile navigation system		9	•		
Fax machine	✓ ¹	—	•		
LCD projector	✓ ¹	—	•		
Microwave oven		—	•	•	NF (CA)

* Household saturation rates are for 2005 except bold figures that are for 2006.

† Although collection and recycling of these products is not financed, they are banned from disposal in municipal solid waste.

Testing for toxicity characteristics

When products are burned in incinerators and disposed in landfills, hazardous substances contained in them can enter the environment. A method called the Toxicity Characteristic Leaching Procedure (TCLP) is used to classify a solid as a hazardous waste. A required regulatory test, TCLP determines if hazardous substances such as lead, antimony, copper, chromium, mercury, and nickel leach from a solid waste. To date, 14 types of products have exceeded at least one of the hazardous waste criterion identified under TCLP: CRT-, LCD-, and plasma-based televisions; CRT- and LCD-based computer monitors; CPUs; cell phones; cordless phones; laptops; microwaves; printers; portable DVD players; radios; and VCRs.

Environmental gains from recycling

Researchers have concluded that from a lifecycle perspective, collecting many types of electronics is environmentally beneficial,^{1,10} and they have focused on determining which recycling options provide the most the environmental gain per dollar invested. Researchers are also suggesting specific product design changes to improve treatment at end-of-life, e.g., making disassembly easier and plastic recycling more efficient.

Lifecycle studies have shown that many consumer electronics, such as those identified in table 1, generate an environmental gain when recycled under specific conditions. Hischer¹⁰ finds that from an environmental perspective, collecting and recycling of a variety of products in Switzerland, such as office equipment, large household appliances, cooling equipment, consumer electronics, and small household appliances, provides a clear advantage over incineration.

Huisman¹ suggests the following policy strategies:

1. Increase the collection and treatment of products with high precious metal content, e.g., higher than 250 ppm gold and 150 ppm palladium. This strategy would cover cell phones and cordless phones. Depending on the actual concentrations, recycling high precious metal content products that have less than the specified parts per million concentrations will still have an environmental return.
As an example, PC motherboards contain 310 ppm of gold.¹¹ Although studies that examine the benefits of recycling personal computers and notebook PCs were not found, the collection of these products should be encouraged, as this strategy suggests.
2. Increase the collection and treatment of predominantly metal products that have a relatively high content of precious metals and a low plastic content, e.g., VCRs, DVD players, and LCD projectors.
3. Increase the recycling of plastics contained in predominantly plastic products that are already being disassembled, e.g., large CRT and LCD housings. Portable audio devices, fax machines, and audio systems can be considered to be predominantly plastic.
4. Increase the recycling of glass contained in TVs and monitors.

Recommendations

The WEEE Directive covers more than 100 types of products, but the end-of-life recycling options for many of them have not been analyzed. Decision-making for different recycling methods should be based on environmental gain per dollar invested. Policymakers should consider expanding the types of products covered by US state laws, establishing statutes to finance the recycling of products, and following the strategies described above when deciding what additional products to cover. Once products have been classified by their hazardous characteristics according to the TCLP, if they exist, the next step is to use a specific product composition, along with a lifecycle methodology, to accurately represent the environmental gain from recycling each product and to determine the optimum recycling methods.

References

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Annex

Categories of electrical and electronic equipment in ANNEX IA of the WEEE Directive:

1. Large household appliances
2. Small household appliances
3. IT and telecommunications equipment
4. Consumer equipment
5. Lighting equipment
6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools)
7. Toys, leisure and sports equipment
8. Medical devices (with the exception of all implanted and infected products)
9. Monitoring and control instruments
10. Automatic dispensers

Detailed list in Annex IB, which fall under the categories of Annex IA:

1. Large household appliances

- Large cooling appliances: Refrigerators; Freezers; Other large appliances used for refrigeration, conservation and storage of food
- Washing machines
- Clothes dryers
- Dish washing machines
- Cooking: Electric stoves, Electric hot plates; Microwaves; Other large appliances used for cooking and other processing of food
- Electric heating appliances: Electric radiators; Other large appliances for heating rooms, beds, seating furniture
- Electric fans
- Air conditioner appliances
- Other fanning, exhaust ventilation and conditioning equipment

2. Small household appliances

- Vacuum cleaners
- Carpet sweepers
- Other appliances for cleaning
- Appliances used for sewing, knitting, weaving and other processing for textiles
- Irons and other appliances for ironing, mangling and other care of clothing
- Toasters
- Fryers
- Grinders, coffee machines and equipment for opening or sealing containers or packages
- Electric knives
- Appliances for hair-cutting, hair drying, tooth brushing, shaving, massage and other body care appliances

- Clocks, watches and equipment for the purpose of measuring, indicating or registering time
- Scales

3. IT and telecommunications equipment

- Centralized data processing: Mainframes, Minicomputers, Printer units
- Personal computing: Personal computers (CPU, mouse, screen and keyboard included), Laptop computers (CPU, mouse, screen and keyboard included), Notebook computers, Notepad computers
- Printers
- Copying equipment
- Electrical and electronic typewriters
- Pocket and desk calculators and other products and equipment for the collection, storage, processing, presentation or communication of information by electronic means
- User terminals and systems
- Facsimile
- Telex
- Telephones
- Pay telephones
- Cordless telephones
- Cellular telephones
- Answering systems and other products or equipment of transmitting sound, images or other information by telecommunications

4. Consumer equipment

- Radio sets
- Television sets

- Video cameras
- Video recorders
- Hi-fi recorders
- Audio amplifiers
- Musical instruments
- And other products or equipment for the purpose of recording or reproducing sound or images, including signals or other technologies for the distribution of sound and image than by telecommunications

5. Lighting equipment

- Luminaires for fluorescent lamps with the exception of luminaires in households
- Straight fluorescent lamps
- Compact fluorescent lamps
- High intensity discharge lamps, including pressure sodium lamps and metal halide lamps
- Low pressure sodium lamps
- Other lighting or equipment for the purpose of spreading or controlling light with the exception of filament bulbs

6. Electrical and electronic tools (with the exception of large scale stationary industrial tools)

- Drills
- Saws
- Sewing machines
- Equipment for turning, milling, sanding, grinding, sawing, cutting, shearing, drilling, making holes, punching, folding, bending or similar processing of wood, metal and other materials
- Tools for riveting, nailing or screwing or removing rivets, nails, screws or similar uses
- Tools for welding, soldering or similar use
- Equipment for spraying, spreading, dispersing or other treatment of liquid or gaseous substances by other means
- Tools for mowing or other gardening activities

7. Toys, leisure and sports equipment

- Electric trains or car racing sets
- Hand-held video game consoles
- Video games
- Computers for biking, diving, running, rowing, etc.
- Sports equipment with electric or electronic components
- Coin slot machines

8. Medical devices (with the exception of all implanted and infected products)

- Radiotherapy equipment
- Cardiology
- Dialysis
- Pulmonary ventilators
- Nuclear medicine
- Laboratory equipment for in-vitro diagnosis
- Analyzers
- Freezers
- Fertilization tests
- Other appliances for detecting, preventing, monitoring, treating, alleviating illness, injury or disability

9. Monitoring and control instruments

- Smoke detector
- Heating regulators
- Thermostats
- Measuring, weighing or adjusting appliances for household or as laboratory equipment
- Other monitoring and control instruments used in industrial installations (e.g. in control panels)

10. Automatic dispensers

- Automatic dispensers for hot drinks
- Automatic dispensers for hot or cold bottles or cans
- Automatic dispensers for solid products
- Automatic dispensers for money
- All appliances which deliver automatically all kind of products