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Recycling Computers and Electronic Equipment: Legislative and Regulatory Approaches for "E-Waste"

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Summary

Rapid growth in the use of computers and the incorporation of electronic features in a wide array of consumer products have been among the most important driving forces of the nation's economy in recent years; but they also pose potential environmental problems. In addition to producing better products, the improvements in technology have created growing volumes of obsolete products to be managed as waste. According to the National Safety Council, which undertook the first major effort to gather quantitative information on e-waste, 500 million personal computers will become obsolete in the United States between 1997 and 2007. At an average weight of 60 pounds, obsolete PCs weighing 15 million tons will become waste needing management in that period. EPA, using a broader definition, estimates that 2.8 million tons of consumer electronics were generated as waste in 2003.

Management of these products as waste is of concern in part because of their volume, but more importantly because they contain large amounts of heavy metals and other toxic substances. A computer monitor or television set, for example, generally contains 4-8 pounds of lead. Mercury, cadmium, and other heavy metals are also commonly used in such equipment. In an incinerator or landfill, these metals can be released to the environment, contaminating air, ash, and ground water. As a result, many argue that electronic equipment should be managed separately from the municipal waste stream, and recycled whenever possible.

The United States has done little to address this problem. Unless disposed in large quantities, used computers and other electronic products are allowed to be managed as municipal solid waste (i.e., the same as ordinary household trash) in most states. In some locations, used computers have been collected for recycling on special voluntary collection days, but few jurisdictions offer frequent, comprehensive recycling opportunities for electronic waste. The exceptions are three states in which disposal of cathode ray tubes (i.e., television sets and computer monitors) has been banned — essentially requiring their separate collection for recycling. Collection for recycling does not guarantee environmentally responsible management, however; reports suggest that large volumes of electronic waste separated for recycling have been shipped to China and other developing countries, where primitive recycling methods threaten human health and the environment.

Numerous interested parties, including environmental groups, solid waste management officials, electronics manufacturers, and retailers, have begun to develop alternative approaches on a voluntary basis; in Japan, the European Union, California, Maine, and Maryland, regulations are being implemented that will force manufacturers and importers to take back end of life products for recycling and waste management separate from the municipal waste stream, or provide funds to cover the cost of recycling programs.

This report provides background on the management of discarded computers, discusses some of the initiatives undertaken in the United States and abroad, and identifies options that Congress might consider if it were to address this issue.

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The Nature of the Problem

Rapid improvements in technology and software have made the use of computers and other electronic products nearly ubiquitous in the United States and other developed countries; but disposal of these products, when they become "e-waste" at the end of their useful lives poses potential environmental problems.

The improvements in technology and software have stimulated new applications, simplified computer use, and lowered cost, bringing computers within reach of more and more consumers. In addition, electronic controls have been incorporated in a growing list of products, from autos to audio equipment to microwave ovens. On balance, particularly in the 1990s, the effect of these developments has been to stimulate productivity and contribute to what was the nation's longest sustained period of economic growth.

As computers and electronic equipment have improved, however, there has been a more rapid turnover of such equipment, with growing volumes of obsolete products to be managed as waste. The National Safety Council, which undertook the first major effort to gather quantitative information on electronic product recycling, estimated the average lifespan of personal computers to be 3.2 years in 1998, declining to 2.0 years in 2005; the council projected that 499.8 million PCs will become obsolete in the period 1997-2007.[1] At an average weight of 60 pounds, obsolete PCs weighing 15 million tons will be added to the supply of waste needing to be managed.

The Environmental Protection Agency (EPA), using a broader definition of "selected consumer electronics," estimates that 2.79 million tons of such waste was generated in 2003, a 32% increase since 2000.[2]

Not all of the obsolete products will actually *be* disposed, however. In fact, the amount disposed may be substantially smaller. Replacing an obsolete computer generally has more to do with the consumer's or business's desire for a new or

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[1] National Safety Council, *Electronic Product Recovery and Recycling Baseline Report*, May 1999, p. 29.

[2] See U.S. EPA, Office of Solid Waste and Emergency Response, *Municipal Solid Waste in the United States, 2003 Facts and Figures*, Table 12, available at [http://www.epa.gov/epaoswer/non-hw/muncpl/pubs/03data.pdf]. EPA's category includes audio, video, and information (computer, phone, and fax) products.

improved feature of the replacement model — additional speed or memory, for example — or, in some cases, the failure of a single component of a larger system. Obsolete computers that are still in working order are often consigned to spare offices or basements, where they may occasionally be used, but more likely will sit unused for months or years. Computers needing repair of a component may suffer a similar fate, often piled in storage rooms or basements until the owner decides what to do with them. In part, this storage is motivated by a lack of information on how end-of-life computers should be disposed. Uncertain what to do, the owners let them sit. Waste analysts refer to this method of managing used computers as "hoarding." There is little hard information regarding the number of computers being hoarded, but it is widely assumed that hoarding is a common practice.

PCs are only one part of the electronics waste stream. Mainframe computers, printers and other peripheral equipment, laptops, video gaming systems, televisions, VCRs, and telecommunications equipment are also changing and being replaced at a rapid rate.

This equipment and the rechargeable batteries that power increasing numbers of computers, telephones, and other portable devices pose challenges to the waste management system. At the end of their useful life, many of these devices are disposed in municipal waste systems poorly designed to handle them. Electronic equipment can be bulky and not easily compacted. It is largely composed of glass and metals (materials that don't burn or decompose) and that, in some cases, are hazardous: a computer monitor or television set with a cathode ray tube (CRT), for example, generally contains 4-8 pounds of lead. Mercury, cadmium, and other heavy metals are also commonly used in such equipment. In an incinerator or landfill, these metals can be released to the environment, contaminating air, ash, and ground water. The presence of such materials suggests to many that electronic equipment should be managed separately from the municipal waste stream and recycled whenever possible.

Regulatory Structure for E-Waste

The United States has done little to address this problem. Under EPA regulations, much of the waste could qualify as hazardous. When disposed in sufficient quantities, it would be subject to regulations requiring generators and transporters to ship wastes to permitted hazardous waste management facilities. These facilities must comply with stringent standards governing treatment, storage, and disposal of the waste.[3]

But federal law exempts households and other small-quantity-generators from hazardous waste management requirements. Generators of up to 220 pounds per month of electronic waste may dispose of it with ordinary trash or at municipal waste management facilities in most states without any special requirements. Larger generators often escape regulation, too, by donating used equipment to educational or charitable groups for reuse. Such donations are not considered disposal from a regulatory perspective.

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[3] The regulations are found at 40 CFR Parts 260-265.

When electronic goods are ready for disposal, recycling can keep them out of the waste management regulatory scheme. Often, the equipment is shipped outside the United States, where U.S. regulatory authorities may have little information concerning the environmental performance of the recycling facility.

Under the federal waste management laws, states remain free to establish more stringent requirements. At least three states (California, Maine, and Massachusetts) have done so, banning disposal of cathode ray tubes (i.e., most television sets and computer monitors) in municipal landfills and incinerators.[4] California and Maine have established recycling requirements for TVs and computer monitors, and, in California's case, for cell phones. California will also ban the use of certain heavy metals in video devices after January 1, 2007.[5] Disposal of other electronic waste is not regulated in any state, however.

Even the materials collected for recycling (about 14% of total discards, according to the National Safety Council,[6] or 10.4%, according to EPA[7]) pose environmental and regulatory questions. According to one report, "Currently the cheapest e-waste recycling option in the U.S. is to send e-waste overseas: how it is used or disposed of there is largely unknown."[8]

Although there is little current regulation governing disposal of e-waste, a growing movement among environmental groups, regulatory officials, manufacturers, and retailers, both in the United States and abroad, has begun to develop alternative approaches. This report discusses some of the initiatives undertaken by these groups and identifies approaches that Congress might consider if it were to address this issue.

Voluntary Initiatives

Local waste management officials, manufacturers, and retailers in the United States have developed a number of voluntary programs to collect electronic products for reuse or recycling. These initiatives are motivated by a mix of reasons, including the desire to protect the environment from the effects of disposal, an interest in demonstrating the feasibility of separate collection and recycling, a sense that it is good business and good public relations to do so, the wish to provide a stimulus for companies pioneering "demanufacturing" and recycling technologies, and in response

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[4] In an earlier version of this report, Minnesota was reported to have banned disposal also. The Minnesota ban, scheduled to go into effect July 1, 2005, was postponed until July 1, 2006, apparently out of concern that sufficient recycling alternatives were not in place.

[5] A more complete description of California's new e-waste law, S.B. 20, is provided below, in the section on "State Regulations."

[6] National Safety Council, previously cited, p. viii. These machines are largely collected from businesses, rather than households.

[7] U.S. EPA, previously cited, Table 13.

[8] Global Futures Foundation, *Computers, E-Waste, and Product Stewardship: Is California Ready for the Challenge?*, Report for U.S. EPA Region IX, June 25, 2001, Executive Summary, available at [http://www.globalff.org/].

to the increasing discussion of regulatory approaches under development in Europe and Japan.

State and Local Government Collection Efforts. Over the past several years, many local governments have undertaken recycling collection events for computer equipment. According to the Electronic Industries Alliance, there were 990 local collection programs for e-waste (mostly computers and monitors) in the United States as of July 2005.[9] While the number is substantial, these programs are not evenly distributed across the country: nearly half the programs are found in two states, Massachusetts (266 programs) and California (214). Eight states have no collection programs at all.

Many of the programs follow the model of household hazardous waste collection. Since the early 1980s, hundreds of local governments have organized occasional collection of hazardous waste (paints, used oil, batteries, pesticides, etc.), generally by establishing a one-day event, or a series of such events, at central locations. These events are geared toward households (rather than businesses), allowing citizens of the jurisdiction to bring such wastes to a collection point where the wastes are separated by type for recycling or hazardous waste disposal. The objective is to keep hazardous wastes out of the ordinary municipal waste stream, protecting sanitation workers and the environment. In the past several years, a number of jurisdictions have added computer equipment to the list of items that they will accept at such events. Other jurisdictions have staged similar events focused on computers alone. The response has indicated that many consumers will participate in separate collection programs.

Manufacturers' Take Back Programs. A number of computer manufacturers (including Dell, Hewlett-Packard, and IBM) have also begun programs in which they take back old equipment for recycling. Some charge a fee; others provide free recycling to purchasers of new products or coupons that can be used on equipment purchases. Most require the consumer to box and mail the used equipment to a company location. A list of these programs is also available at the Electronic Industries Alliance website.[10]

Retailer Programs. Retailers have also become interested in promoting recycling of electronic equipment, although thus far, their efforts appear limited. In April 2001, Best Buy announced that it would begin periodic collections to allow consumers to drop off used electronic items for recycling. Under Phase I of their program, the company held special recycling collection events at 11 sites in 8 states across the country in the summer and fall of 2001. In 2002, another 9 events were held in 8 states. In 2005, the company plans another 16 events at locations scattered across the country. The company originally said that it expected to expand the service "to ensure that consumers in every Best Buy community will be close to a

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[9] For comprehensive state-by-state information on these programs and on national reuse and recycling opportunities, see the website of the Electronic Industries Alliance at [http://www.eiae.org/].

[10] Ibid. Click on "View National Programs."

special electronics recycling event at least once a year,"[11] but this idea appears now to have been abandoned.

On July 14, 2005, EPA and the Product Stewardship Institute (PSI) released a report regarding a pilot program that EPA's New England regional office undertook with PSI and the office supply retailer Staples. According to PSI, Staples collected and recycled used computers, computer "peripherals" (keyboards, mice, and speakers), printers, scanners, fax machines, and desktop copiers from its customers at 27 retail stores and 14 businesses in five states: Maine, New Hampshire, Massachusetts, Connecticut, and Rhode Island. The pilot project ran for a six-week period, May 29 through July 11, 2004. Through reverse distribution, Staples transported the materials from multiple collection points to its distribution centers and on to a recycler.[12]

Data concerning the results of voluntary programs (whether run by municipalities, manufacturers, or retailers) indicate that there is substantial interest in electronics recycling. In addition, the programs have demonstrated a number of models for how larger (possibly mandatory) programs might be organized. Overall, however, the availability and use of such programs has only scratched the surface of what is available to be recycled, with little impact on overall recycling rates.

State Regulations

Several states have enacted laws or adopted regulations to address some of the issues posed by growing e-waste volumes. In general, the state approaches have fallen into seven categories: (1) the creation of task forces to study the issue or develop a state program; (2) bans on the disposal of CRTs in landfills and incinerators; (3) funding for recycling collection and infrastructure; (4) consumer education campaigns; (5) advanced recycling fees, imposed at point of sale to finance recycling programs; (6) manufacturer take-back requirements; and (7) phase-out of hazardous materials.[13] While more than a dozen states have taken some legislative or regulatory action, three of them (Massachusetts, California, and Maine) have developed the most extensive requirements.

Massachusetts. Massachusetts banned the disposal of cathode ray tubes (CRTs) in landfills and incinerators as of April 1, 2000, and established a grant program that helped develop an infrastructure for recycling them. CRTs are the picture tubes that form the bulk of most older (i.e., non-flat-screen) televisions and computer monitors. According to the Massachusetts Department of Environmental Protection (DEP), a wide array of organizations, including the University of

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[11] "Best Buy Electronics Recycling Program," program introduction, undated, originally available at [http://www.e4partners.com]. Click on "Best Buy Consumer Electronics Program" for additional information.

[12] See [http://www.productstewardship.us/pilot_takeback_staples.html].

[13] These programs were identified by the EPA Office of Inspector General in its *Evaluation Report: Multiple Actions Taken to Address Electronic Waste, But EPA Needs to Provide Clear National Direction*, Report No. 2004-P-00028, September 1, 2004.

Massachusetts, non-profits (such as the Salvation Army and Goodwill Industries), for-profit companies, and municipalities established an infrastructure to collect, repair, reuse, and recycle CRTs as Massachusetts implemented its ban on disposal. The state encouraged the development of the collection and recycling infrastructure through grants. Measured by the number of collection programs, this effort appears to have been wildly successful. Of the nationwide total of 330 electronics collection programs identified by the Electronic Industries Alliance in early 2002, 255 (77%) were in Massachusetts. In July 2005, Massachusetts still accounted for 27% of all programs nationally (266 of the national total of 990).

The collected monitors and televisions have multiple uses. A high percentage (perhaps 4 in 10, according to a DEP official) are still useable or repairable, and can be resold. In other cases, the face plate of the picture tube is removed from the CRT for reuse. In still others, the CRT is crushed and the glass is sent to a smelter for recycling.

One problem Massachusetts had in implementing its program was obtaining approval from EPA. Under the Resource Conservation and Recovery Act (RCRA), EPA is given authority to regulate hazardous waste, but may authorize states to run the program if the state can demonstrate that its regulations are equivalent to and consistent with EPA's. As discussed earlier, CRTs are considered hazardous waste under EPA regulations, because of the high amount of lead they contain. Massachusetts wanted to exempt CRTs from hazardous waste management regulations in order to avoid regulatory requirements that would increase the cost of its program to entities handling the CRTs. After prolonged negotiations with EPA, Massachusetts rewrote its hazardous waste regulations to provide a conditional exemption from the hazardous waste program provided that the CRTs are managed according to specific regulations that, among other things, prohibit disposal. EPA granted the state only an interim, three-year authorization to run the CRT program, but the state received an additional three years from EPA in October 2002.

In part because of the experience with Massachusetts, and in part because of a desire to stimulate recycling throughout the United States, EPA later proposed a set of special exemptions from the hazardous waste rules for computer recycling. The proposed changes were published in the *Federal Register* on June 12, 2002, but have not been finalized.[14]

California. In California, "the disposal of waste CRTs in municipal landfills has always been prohibited," according to Peggy Harris, Chief of the State Regulatory Programs Division, Hazardous Waste Management Program.[15] Unlike federal law, California law does not contain exemptions for household or small quantity generators of hazardous waste. Therefore, in California, persons who generate hazardous waste at their home, or who are small generators, must transport

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[14] 67 Federal Register 40508, June 12, 2002.

[15] Letter of Peggy Harris to Sheila Davis, Materials for the Future Foundation, April 3, 2001. This letter was originally available at the foundation's website, at http://www.materials4future.org/ELECTRONICS/DTSCresponse3-20.html. The website appears to be no longer active.

their hazardous waste (including CRTs) to a household hazardous waste collection facility for disposal.[16]

In September 2003, California became the first state to pass legislation designed to provide free and convenient recycling of CRTs, phase out the use of hazardous materials, and restrict exports of e-waste to developing countries. As subsequently amended, the legislation (S.B. 20/S.B. 50) imposes fees of $6 to $10 per unit (depending on screen size) on the sale of computer monitors, televisions, and other video devices containing toxic materials, beginning January 1, 2005. The fees are to be used to reimburse recyclers for the cost of collecting and recycling the covered video devices. The amounts are to be adjusted after July 1, 2005, to reflect the actual cost of recycling. Beginning January 1, 2007 (or later, if implementation of European Union regulations occurs later), S.B. 20 will prohibit the sale of video devices to the extent that the European Union prohibits their sale due to the presence of heavy metals. The law also prohibits the export of covered e-waste to foreign destinations unless the exporter notifies the California Department of Toxic Substances Control at least 60 days prior to export, demonstrates that the import of the waste is not prohibited by the receiving country, forwards required import and operating licenses to the Department, and demonstrates that the exported waste will be managed within the country of destination only at facilities whose operations meet or exceed the binding decisions and implementing guidelines of the Organization for Economic Cooperation and Development.

California has also enacted legislation to require retailers of cell phones to collect used products for reuse, recycling, or proper disposal, beginning July 1, 2006. Under the legislation (the Cell Phone Recycling Act of 2004), retailers must take back at no cost to consumers cell phones that they previously sold. Retailers must also accept at no charge a used cell phone from a consumer who is purchasing a new cell phone, regardless of whether the used phone was purchased from that retailer.

Maine. Maine's law, enacted in April 2004, is different from California's in that it makes manufacturers of televisions and computer monitors individually responsible for recycling their products. The law envisions, but does not mandate, municipal collection of televisions and monitors. The collected items are to be delivered to consolidation facilities for counting and for transport to certified recycling and dismantling facilities. The state is to provide guidelines for environmentally sound management.

Manufacturers will play key roles in Maine's system. Effective January 1, 2006, they will be responsible for paying the costs of the handling, transportation, and recycling of their own products plus a pro rata share of the costs for "orphan" waste. They must also ensure that consolidation facilities are geographically located to conveniently serve all areas of the state.

Like the California law, Maine's is intended to facilitate recycling of televisions and computer monitors with a screen size greater than 4 inches (measured diagonally) generated by households. The law addresses cathode ray tubes (CRTs) as well as flat

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[16] Ibid.

screens, but, as in California, excludes video displays contained in motor vehicles, industrial, commercial, or medical equipment, and household appliances. Maine also requires that vendors of covered devices sold to the state provide take-back services for their products at the end of their useful life.

Maryland. Maryland has also enacted computer recycling legislation (in May 2005). While it has received considerable attention in the press, the law is substantially less stringent than those in California and Maine. It would require that manufacturers of more than 1,000 computers per year register with the state, paying a fee of $5,000. Beginning January 1, 2006, these manufacturers must either implement a computer takeback program or pay an annual fee of $5,000 to the State Recycling Trust Fund. The term "computer takeback program" is not defined in the law, but the requirements of such a program may be specified in regulations. It could include the type of program currently being run by Dell, IBM, HP, and others, in which consumers mail computers to the manufacturer for recycling. More importantly, however, it would appear that manufacturers who wish to avoid operating such a program need only pay an annual fee of $5,000.[17]

International Regulatory Developments

Computers and consumer electronics have long been among the most international of industries. Japanese, Korean, Taiwanese, European, and American companies sell products worldwide, with production facilities and component manufacturing plants in many different countries. As a result, developments in Europe and the Pacific Rim — where numerous countries are developing legislation and regulations that would reduce the volume of electronic waste, shift the burden for its management from the public sector to industry, and reduce the toxicity of materials used in production — are being closely watched by executives in this country. This section discusses developments in several major countries, including Switzerland, the Netherlands, Japan, and the European Union.

Switzerland. Switzerland was the first country to enact broad legislation: on January 14, 1998, the Swiss enacted an ordinance on separate collection and recycling of electronic waste.[18] The ordinance, which went into effect on July 1, 1998, requires separate collection and recycling of electronic waste, including electronic equipment used at home as well as office equipment, computer equipment, communications equipment, and household appliances. According to the ordinance, consumers are required to take used equipment back to a manufacturer, an importer, or a retailer. Retailers are required to take back old equipment if they offer the same sort of product for sale. Wholesalers and intermediaries likewise have an obligation

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[17] For additional information on the Maryland law, see [http://www.mde.state.md.us/Programs/LandPrograms/Recycling/SpecialProjects/ecycling.asp].

[18] This section is based on the Ordonnance sur la Restitution, la Reprise et l'Elimination des Appareils Electriques et Electroniques of January 14, 1998, available in French on the Swiss Federal Government website at [http://www.admin.ch/ch/f/rs/c814_620.html]. According to the Swiss Embassy, the ordinance has not been translated into English, although information on the recycling requirements is available in English on the government's website.

to accept returns, although they can arrange for waste equipment to be delivered directly to a waste-handling facility.

Manufacturers and importers are only required to take back equipment of their own brand (or, in the case of importers, of brands that they import). This reinforces one of the ordinance's primary objectives, which is to serve as an incentive to manufacturers to consider the question of waste management during the design of a product. Manufacturers who produce equipment that is easily disassembled and made of materials easily recycled and causing little pollution can thus reduce their costs vis-a-vis their competitors.

The ordinance leaves most details of the recycling and management of returned items to industry or to state-level (canton) governments. Regulations on the recycling and management of the returned items and permitting or authorizing the necessary facilities, for example, are left to the cantons. The ordinance contains no requirements on financing; determining how to finance and structure the return system is left to industry and the markets to decide. The Swiss federal government does have one other role, however: the regulation of exports, in order to insure that disposal in other countries is in accord with those countries' regulations and is respectful of the environment.

In many respects, such as the required take-back provisions and the flexibility given industry to devise its own collection and recycling schemes, the Swiss system is similar to regulations established elsewhere in Europe to encourage recovery and recycling of packaging waste. These regulatory systems have the same general objective: by imposing responsibility for waste management on producers and importers, they aim to affect manufacturer decisions regarding product (or packaging) design, reuse, and recyclability.

Netherlands. Shortly after the Swiss enacted their ordinance, the Dutch government issued a Decree on the Removal of Electric and Electronic Appliances (also referred to as the Disposal of White and Brown Goods Decree), April 21, 1998.[19] The decree requires retailers, manufacturers, and importers of electric and electronic appliances to finance the collection and to take back end-of-life equipment, including computers, from consumers. It prohibits incineration and landfilling of the products.

The decree applied to large appliances (televisions, video and sound equipment, computers, printers, and telecommunications equipment, as well as refrigerators, freezers, washers, dryers, and stoves) as of January 1, 1999. Smaller appliances were covered as of January 1, 2000. The decree requires retailers to accept used appliances in trade, and requires local authorities to provide separate collection of such appliances from households, as well as a place to which retailers may take equipment traded in. Manufacturers and importers must take back products of their brand from retailers and local authorities and must reimburse retailers, repair companies, and local authorities for the cost of collecting their products.

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[19] A fact sheet can be found on the Netherlands Ministry of Housing, Spatial Planning and Environment website at [http://international.vrom.nl/pagina.html?id=7387].

The Dutch system, which is the only one for which we have been able to obtain data, "works well after two years of operation," according to a Dutch source; it has "recycling rates higher than anticipated" and "costs lower than anticipated."[20] The system captured 76% of end-of-life televisions in its first two years, for example, and processing costs for TVs were lower than budgeted, allowing the recycling fees charged on new televisions to be lowered from $10 to $7.[21]

In general, electrical and electronic products are sorted and processed by an industry-funded recycling organization (known by its Dutch initials, NVMP), rather than being taken back by individual manufacturers and importers. NVMP is funded by fixed recycling fees imposed on the sale of new products. These range as high as $15 for refrigerators, freezers, and air conditioners; small items like radios and CD players initially had fees of $2.00, but as of July 2001 are not subject to fees.

Dutch computers are collected through a separate system, not through NVMP. There are no recycling fees paid directly by consumers in this system; rather, producers and importers are paying the costs of computer recycling, in proportion to each company's share of the products returned. About 25% of the products returned are orphans (i.e., the manufacturer is no longer doing business in the Netherlands). The cost for managing these products is split among companies still in business according to each company's share of the recycled products. One potential inequity of this system is that it places a heavier burden on companies that had a large market share in the past, irrespective of their current sales. New entrants to the market, by contrast, do not pay for the management of historic or orphan waste, even if they have a significant share of current sales.[22]

Another criticism of the Dutch system is that, as currently structured, it provides little incentive for companies to design their products for recycling, since all products of a given type are charged the same recycling fee.

Japan. In Japan, a Law for Recycling Specified Kinds of Home Appliance (also referred to as the Home Appliances Recycling Law) was enacted in June 1998. The law requires that retailers collect — and that manufacturers and importers recycle — four types of household appliances: televisions, refrigerators, washing machines, and air conditioners. The law's inclusion of televisions has encouraged the development of a TV and CRT recycling industry in Japan, where substantial research has gone into the development of TV dismantling and recycling technologies since the early 1990s. On its web-site, for example, Sony has reported that it has developed automated recycling lines that open the television cabinet, remove the CRT, separate the front panel from the rear funnel, and pulverize the glass for recycling. As of 2002, Sony had cooperated with other companies to

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[20] Ab Stevels. "Experiences with the Take-Back of White and Brown Goods in The Netherlands," *Sustainable Development International*. The author is affiliated with Delft University of Technology and Phillips Consumer Electronics.

[21] Ibid., p. 3.

[22] Personal communication, Alan Phipps, Product Stewardship Initiative, University of Massachusetts (Lowell). Mr. Phipps researched the Dutch electronics recycling program for the National Electronics Product Stewardship Initiative.

establish 190 take-back sites and 15 recycling plants in Japan since enactment of this law.

Japan began compulsory recycling of business computers in April 2001, and expanded the requirement to PCs on October 1, 2003. In anticipation of this requirement, the Japanese PC manufacturing industry and the Ministry of Economy, Trade, and Industry agreed to add recycling fees to the price of new computers when the requirement went into effect. The fees are $63 for computers with CRT monitors, $27 for notebooks/laptops.[23]

European Union. While the above countries have already implemented take-back and recycling requirements for electronic products, the efforts of the 25-nation European Union (EU), whose regulatory program is still under development, has aroused far greater interest. The size and importance of the European Union (457 million consumers in some of the world's wealthiest economies) and the broad sweep of the requirements under discussion have made EU developments the principal focus of discussion among participants and observers of the electronics industry.

The European Union Directive on Waste Electrical and Electronic Equipment (WEEE),[24] which was agreed to October 10, 2002, will establish comprehensive take-back and recycling requirements for retailers, manufacturers, and importers of electrical and electronic products. The directive contains a five-and-a-half-page list of covered products (Annex 1B), including household appliances, computer and telecommunication equipment, consumer electronics (TVs, radios, VCRs, etc.), lighting equipment, tools, toys, medical equipment, monitors and controls, and vending and ATM machines.

EU directives are somewhat different from federal law in the United States. Unlike U.S. federal laws, which can bind individuals and corporations directly, EU directives are implemented and enforced indirectly, by requiring that the member states of the Union enact legislation meeting the directive's requirements. In this case, the member states were required to have a legal and regulatory framework in place by July 27, 2004, 18 months after the entry into force of the directive. As of May 2005, lees than half the member states had met this obligation.

The directive on WEEE provides, among other requirements, that Member States shall (1) ensure that systems are set up so that consumers can return WEEE for reuse, recycling, or disposal free of charge; (2) ensure that retailers (termed "distributors" in the directive) offer to take WEEE back free of charge when they supply a new, similar product; (3) ensure that producers and importers provide for collection of WEEE from holders other than households; (4) regulate collection and treatment of WEEE to ensure its suitability for reuse and recycling; and (5) meet a separate collection target from households of at least 4 kilograms (8.8 pounds) per person per year by the end of 2006.

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[23] "Japan to Require Computer Recycling Starting in Summer 2003, Agency Says" *Daily Environment Report*, March 6, 2002, p. A-6. The fees were reported in *E-Scrap News*, Vol. 3, No. 10, October 2003, p. 1.

[24] Available at [http://register.consilium.eu.int/pdf/en/02/st03/st03663-re02en02.pdf].

In Article 7, the directive sets targets for collection and recycling of the various categories of products. For computer and telecommunications equipment (category 3) and consumer electronics, including televisions, VCRs, and audio equipment (Category 4), the target rates of recovery would be a minimum of 75% by weight, with reuse and recycling of the components, materials, and substances collected to be 65% by weight. Additional targets are to be set for the years beyond 2008, but are not specified in the directive.

The directive requires that producers and importers finance the separate collection of waste electronics either on their own or through collective systems financed by themselves and other members of the industry. The cost of managing household waste from products put on the market before the directive's entry into force (historical waste) is to be shared by all existing producers based on their market share. Producers will be able to recoup this cost through a "visible fee" on new products for 8 - 10 years. Users other than private households may be made partly or totally responsible for financing the costs of management of their historic waste.

The directive provides for labeling and consumer information, and for submission of annual reports on quantities placed on the market, as well as collection and recycling.

The EU also has addressed the issue of hazardous substances in electronic waste. In Annex II of the WEEE draft, the directive requires that certain hazardous substances (including PCBs, mercury, batteries, printed circuit boards, toner cartridges, plastic containing brominated flame retardants, asbestos, CRTs, CFCs, liquid crystal displays, and components containing radioactive substances) be removed from waste electrical and electronic equipment and treated separately. There is also a separate directive on the Regulation of Hazardous Substances (RoHS),[25] under which the EU will require that 6 hazardous substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls [PBBs], and polybrominated diphenyl ether [PBDE]) be replaced by other substances in electrical and electronic equipment by July 1, 2006. The directive provides a list of exemptions, however, including use of lead in the glass of cathode ray tubes and in solder, mercury in fluorescent lighting, and lead as radiation protection. In addition, the prohibited substances may continue to be used in spare parts for equipment that was placed on the market before July 1, 2006.

As noted previously, the EU directives are broad in scope, setting aggressive collection, reuse, and recycling targets for dozens of products and industries. But the basic principles — producer responsibility for take-back and for financing collection and recovery systems, fees on new products to cover the cost of managing historical waste, recycling targets, and controls on hazardous substances — appear common to many European and Japanese recycling programs.

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[25] Available at [http://register.consilium.eu.int/pdf/en/02/st03/st03662-re02en02.pdf].

Legislative Approaches

With any environmental issue, growing interest among individuals and interest groups in what appears to be a national or international problem, frequent attention to the issue in the press, and consideration of a diverse array of legislative and regulatory options among the states are often precursors of congressional interest. Thus, although there has been little activity in Congress to date,[26] many assume Congress is likely to take up this issue given the increasing interest by other stakeholders.

When Congress decides to address the subject, there are at least nine options that might arise during discussions: (1) a report to Congress on e-waste issues; (2) grants or tax credits for the development of recycling infrastructure; (3) legislation establishing exemptions from the hazardous waste program to facilitate recycling of computers or other e-waste; (4) labeling to encourage recycling or provide environmental information to consumers; (5) bans on disposal and/or export of e-waste; (6) regulation of the use of hazardous substances in computer equipment; (7) requiring reuse or recycled content in computer manufacture; (8) an "extended producer responsibility" system, requiring manufacturers and importers to take back computers for recycling, either as individual companies responsible for their own brands, or collectively through an industry consortium; and (9) a fee-based system for the management of "historic" waste.

An additional question that presents itself is what to include in the definition of computers (or electronic waste) that might be the subject of legislation. This question is addressed in a separate section at the conclusion of this report.

1. Report to Congress. At present, there is a dearth of information on the U.S. electronics waste stream. Such basic facts as current and projected amounts of electronic waste, the amounts and types of heavy metals and other toxic substances contained in such products, how such waste is managed, and the impact of its disposal on the environment are all essentially unknown. Many, including the authors of this report, have relied on a baseline study published by the National Safety Council in 1999 — data that are now seven years old. EPA produced estimates of consumer electronic waste (a broader category encompassing audio, video, and information products) in its 2001 and 2003 Municipal Solid Waste Facts and Figures reports. Its estimates were substantially different from those of the Safety Council.[27]

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[26] As of July 2005, several bills have been introduced on the subject, and the first congressional hearing has been scheduled by a House Energy and Commerce subcommittee for July 20. In addition, the Senate version of comprehensive energy legislation (H.R. 6), in Section 1545, would provide a tax credit for the purchase or lease of equipment that is used for sorting or processing certain commercial or residential "qualified recyclable materials." Electronic waste, including any CRT, flat panel screen, or video display device with a screen size greater than 4 inches measured diagonally, or a CPU, is included in the definition of qualified recyclable materials.

[27] For example, the 2001 EPA study estimated the life of PCs at three to six years, and PC
(continued...)

Few states regulate such waste separately from the municipal waste stream, which means that it can be disposed in municipal landfills or incinerators. Under EPA's hazardous waste regulations, disposal of more than 100 kilograms (220 pounds) of such waste per month is likely to qualify as hazardous waste disposal, subject to strict regulatory requirements. It is not clear how stringently this requirement is enforced.

A report to Congress, defining e-waste, providing basic information on the quantities and types of such waste, describing how it is currently managed, and outlining options for management of electronic products at the end of their useful lives could be a useful starting point. (At or around the time of the House hearing on e-waste scheduled for July 20, 2005, the U.S. Commerce Department's Technology Administration is expected to release a report to the Administration and Congress outlining a "national roadmap" for addressing e-waste. The report may provide some of the basic information that has been lacking.)

2. Grants or Tax Credits for Recycling Infrastructure. If one wanted to establish universal requirements for recycling electronic waste, implementation of such requirements would likely be thwarted initially by the absence of a national infrastructure to collect and manage the products being returned. E-waste recycling is in its infancy. Most local governments have no separate collection program for computers or other electronic products, and few facilities are equipped to process the materials that are collected. Much of the processing/recycling that is done occurs overseas.

Thus, the development of a recycling infrastructure through a grant or loan program or through tax credits may merit consideration. A model for this effort could be the program in Massachusetts. As noted earlier, Massachusetts implemented a ban on the disposal of computer monitors and televisions containing cathode ray tubes (CRTs) in April 2000. Prior to implementation of the ban, the University of Massachusetts, a variety of non-profits (such as the Salvation Army and Goodwill Industries), for-profit companies, and municipalities established an infrastructure to collect, repair, reuse, and recycle CRTs. The State encouraged the development of the collection and recycling infrastructure through a municipal grant program. The program was not large: according to the Massachusetts Department of Environmental Protection (DEP), the state spent $800,000 combined in FY1999 -

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[27] (...continued)
monitors at six to seven years, about double the estimates of the Safety Council. As a result of longer estimated life, information product (computer, phone, and fax) waste generation was estimated at 1,076,300 tons in 2001, substantially less than the Safety Council estimate. An additional 806,200 tons of video products (including TVs) were generated, according to EPA. See U.S. EPA, Office of Solid Waste and Emergency Response, *Municipal Solid Waste in the United States, 2001 Facts and Figures*, Appendix C, available at [http://www.epa.gov/epaoswer/non-hw/muncpl/pubs/msw2001.pdf]. EPA produced estimates of selected consumer electronics waste for 2002 and 2003 in its 2003 report, but did not provide the detailed information that it had in 2001.

FY2002.[28] The grants covered the cost of processing collected materials for each of the state's 351 cities and towns for the first year in which they collected e-waste. During that year, the local governments developed programs for collection and were able to determine the amounts they would need to budget to continue the programs in succeeding years. Extrapolating these amounts on the basis of population, a comparable program for all 50 states might cost about $10 million annually.

Another means of stimulating the development of e-waste recycling infrastructure might be the provision of tax credits for recycling equipment. As noted earlier, Section 1545 of the Senate version of the comprehensive energy bill (H.R. 6), passed June 28, 2005, would provide a tax credit for the purchase or lease of equipment that is used for sorting or processing electronic waste. E-waste is defined to include any CRT, flat panel screen, or video display device with a screen size greater than 4 inches measured diagonally, or a CPU.

3. Exemptions from RCRA. A third approach, used by Congress and EPA to encourage recycling of batteries in 1996, would be to amend the Solid Waste Disposal Act (generally referred to as "RCRA"[29]) to exempt e-waste from portions of the hazardous waste management rules, *provided that the material is reused or recycled*. One model for this is EPA's "universal waste" rule, which exempts waste batteries, pesticides, and thermostats from portions of the hazardous waste management regulations in order to encourage their recycling. When a waste is listed as a universal waste, handlers can accumulate a greater quantity of the waste and hold it for a longer time without requiring a hazardous waste storage permit. Universal wastes are also exempt from the requirement that transporters carry a manifest with detailed information when handling hazardous waste, thus permitting transport by common carriers in many cases. Adding computers and/or other electronics to the universal waste stream would provide clarification as to what type of waste these items are considered to be.

One drawback of the universal waste approach is that states are not required to adopt the universal waste designations: under the hazardous waste program, states are allowed to have regulations that are more stringent than the federal requirements. If not all states adopt the designation of e-waste as universal waste, transporting end-of-life computers and other waste electronic products through states with differing regulations may become burdensome for handlers. To address this issue as regards rechargeable batteries, Congress enacted the Mercury Containing and Rechargeable Battery Management Act in 1996 (P.L. 104-142). This act established the universal waste rule for rechargeable batteries as law in all 50 states and preempted state and local laws that conflicted with or were more stringent than its requirements.

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[28] Personal communications, Peggy Harlowe, Massachusetts DEP, June 12 and October 17, 2002.

[29] RCRA refers to the title of a comprehensive set of amendments to the Solid Waste Disposal Act. These amendments, the Resource Conservation and Recovery Act (P.L. 94-580), were enacted in 1976. The statute has since been amended seven more times, however, including comprehensive amendments in 1984.

Without new legislation, EPA has moved slowly on proposals to exempt CRTs from hazardous waste requirements. On June 12, 2002, the agency proposed a rule that would exempt cathode ray tubes and glass removed from them from being considered solid or hazardous waste when sent for recycling. While the intention of this exemption was to streamline the reuse and recycling process for CRTs, critics fear that "less than ethical business owners will collect the computers for fees, store them in large warehouses and disappear."[30] As of early July 2005, three years after proposal, the agency had not yet finalized these regulations.

4. Labeling. A fourth option would be to require labeling of computers to encourage recycling or to provide environmental information to consumers. The content of such labels would be determined by the other components of the legislation. For example, the European Union intends to require labels that will identify electronic equipment subject to its requirements that manufacturers and importers take equipment back for reuse or recycling. Similarly, Maine will require labeling to facilitate the identification of the party responsible for the cost of collection, transportation, and recycling of computer monitors. Other types of labels might identify the percentage of recycled materials used in the product, indicate compliance with prohibitions on the use of hazardous substances, identify materials used in order to facilitate their recycling, or communicate to consumers if disposal of certain components is to be prohibited.

5. Bans on Disposal and/or Export of E-Waste. As noted earlier, because of the increasing volume of CRTs and the toxicity of some CRT components, California, Massachusetts, and Maine have prohibited disposal of these products in landfills and incinerators. Although we have little information concerning the overall effectiveness of these disposal bans, the prohibitions (combined with other policies) have apparently served as a stimulus to the development of recycling and reuse options in these states. Similarly, a federal prohibition might serve as a stimulus at the national level, provided it gave the waste management and recycling industries sufficient time to develop alternatives to disposal.

An important issue related to this option, would be whether to regulate exports of CRTs and other e-waste, as well as prohibiting their disposal in the United States. *Exporting Harm*, a 2002 report by the Basel Action Network and the Silicon Valley Toxics Coalition, concluded that such exports (often identified as being for the purpose of recycling) have served as a means of escaping from U.S. regulation, and in many cases pose serious health and environmental threats in the receiving countries. According to the report, "Informed recycling industry sources estimate that between 50 to 80 percent of the wastes collected for recycling are not recycled domestically at all, but very quickly placed on container ships bound for destinations like China."[31] Thus, restrictions on disposal without accompanying controls on

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[30] "Proposed Rule to Streamline Requirements for Handling CRTs Signed by Whitman," *Daily Environment Report*, May 28, 2002, p. A-10.

[31] Basel Action Network and Silicon Valley Toxics Coalition, *Exporting Harm*, February 25, 2002, p. 2.

exports might simply transfer a greater share of the problems associated with management of the waste overseas.

On the other hand, a prohibition on the export of materials collected for recycling would cut recyclers off from many of the markets able to reuse the materials. A significant portion of the manufacture and assembly of CRTs and computers occurs in Asian countries. If recovered materials cannot be shipped there, recycling and reuse will be difficult to achieve.

A possible solution might involve regulation rather than prohibition of exports, with specific record-keeping and reporting requirements, and shipment allowed only to facilities that have been certified to meet high standards for recycling, worker protection, and waste management. This option might require further development to identify the exact nature of feasible controls or prohibitions and to identify a certifying authority, before legislation along these lines could be drafted.[32] As noted above, California adopted a regulatory approach to e-waste exports in S.B. 20, which was enacted in September 2003.

6. Regulating the Use of Hazardous Substances in Computers. A sixth option is suggested by the European Union (EU) directive on the Regulation of Hazardous Substances (RoHS). This directive will — with some important exceptions — ban lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ether (PBDE) from electrical and electronic equipment put on the market after a specific date. A number of items, including lead in CRT glass, will be exempt from the ban because of the lack of substitutes.

Such a ban, it is argued, will limit hazardous substances in electronics and therefore reduce the hazards of exposure to employees, recyclers and waste managers (risks of exposure to users are thought to be negligible). Consultation with industry and recyclers would be helpful to determine what non-hazardous substitutes exist for the substances to be regulated and whether the benefits of such substitution outweigh the costs.

One possible problem with this approach is that banning hazardous substances could depress the market for reuse. If hazardous materials are banned, then spare parts from older computers would no longer be able to be reused to make new computers. The European Union directive gets around this problem by exempting reused equipment and spare parts from the ban.[33]

7. Recycled Content. A seventh option would be to stimulate the markets for reuse and recycling of computer components by requiring recycled content in new computer equipment. Most recycling and waste management experts would agree that collecting material for recycling is an incomplete exercise unless markets for

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[32] The International Association of Electronics Recyclers began a certification program early in 2002. For information, see [http://www.iaer.org].

[33] Article 2, Paragraph 3 of the RoHS directive, available at [http://register.consilium.eu.int/pdf/en/02/st03/st03662-re02en02.pdf].

reuse of the material are assured; but mandating the reuse of such material poses a number of logistical problems. Computer components are manufactured in numerous locations and often assembled in locations far from the places of manufacture. The parts are made of at least 36 different materials, according to one recent analysis,[34] many of them combined in ways that may be difficult to separate for recycling or reuse.

On the other hand, according to the same analysis, six components — silica (much of it used in glass), plastics, iron, aluminum, copper, and lead — account for 95.8% of the weight of a typical desktop computer. Many of the parts containing these materials can be recycled. The key might be to set recycled content or reuse requirements for some or all of the specific computer components, such as the CRT, plastic casing, or specific metals.

8. Extended Producer Responsibility. Under "extended producer responsibility" (EPR), which is at the heart of the Asian and European proposals for regulation of e-waste, manufacturers and importers of electronic products would be held responsible for the management of those products at the end of their useful life.

EPR can be imposed on producers individually or collectively. In the individual approach, a producer or importer would be responsible for the take-back and management of its own products. By placing responsibility on individual companies, this approach creates incentives to design and manufacture the products in ways that simplify recycling and reuse. And, by allowing reuse of component parts, this approach could provide potentially large cost savings in the manufacture or remanufacture of products.

While it has potential advantages, individual producer responsibility also has potential drawbacks. The collection and sorting of e-waste in such a system could be costly and cumbersome, given that each manufacturer's products would need to be collected or sorted separately. One way to implement such a program would be by requiring retailers to accept returns of the brands of equipment that they offer for sale, and then simply to reverse the distribution process to get the products from retailers to manufacturers. Retailers might oppose such a requirement, however, because of the burden involved in storing the used equipment. In addition, many computers are sold directly by manufacturers or distributors to consumers without the use of retail locations.

An alternative to individual EPR is the use of a collective responsibility system. Under collective producer responsibility, manufacturers and importers create a third party organization which assumes responsibility for collection, recycling, and disposal of all the regulated products. The third party organization would be financed by producers and importers in proportion to the market share of each, or in proportion to the cost of recycling the products each contributes to the total collected.

While foreign governments have taken the leadership role in developing EPR legislation, legislation has been introduced in a number of states that would establish

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[34] Handy and Harmon Electronic Materials Corp., as cited in *Exporting Harm*, p. 44.

some form of EPR requirement for the management of CRTs or computer waste. As noted earlier, Maine has enacted a version of EPR legislation. Other states with EPR bills introduced include Massachusetts, Minnesota, and Vermont. Summaries of state legislation on e-waste can be found on the website of the National Caucus of Environmental Legislators.[35]

9. Management of "Historic" Waste. Electronic products that were sold prior to the date of enactment of any new regulatory scheme could contribute a substantial amount of waste. According to the National Safety Council study, 303 million personal computers are likely to become obsolete in the United States between 2002 and 2006.[36] While some of these will be disposed or recycled, a large number will simply be placed in long-term storage in basements or storerooms, until the owners decide what to do with them. Millions of old television sets have accumulated in the hands of consumers for similar reasons.

These "historic" products may have been manufactured by companies no longer in business, or, where the company is still in business, the amount of waste attributable to its brand may bear little correlation to the company's current market share.[37] Thus, many argue that a separate collection and recycling scheme needs to be adopted for historic waste.

Under S.B. 20, the California legislation enacted in September 2003, a fee of $6 - $10 is imposed on the sale of all CRT devices (televisions, video and computer monitors, and other devices), and on other video display devices that the state's Department of Toxic Substances Control determines contain toxic materials. The fees are to be used to reimburse recyclers for the cost of collecting and recycling the covered devices.[38] Under the Maine e-waste law, the cost of managing historic waste will be borne by the producer, with the cost of orphan waste to be shared by all current producers.

Defining E-Waste

What types of electronic products to include in any legislative consideration of e-waste is a key issue. There is a wide range of options. The most restrictive option would include only products containing cathode ray tubes (CRTs). CRTs are the

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[35] NCEL's website is at [http://www.ncel.net/base.cgim?template=bulletins_archive], click on April 20, 2004 Bulletin, E-Waste Update.

[36] National Safety Council, *Electronic Product Recovery and Recycling Baseline Report*, May 1999, p. 29.

[37] When Minnesota conducted a pilot e-waste recycling project in 1999, historic waste was a large percentage of what was collected: by weight, 69% of what they received was television sets. "Roughly half" of the televisions were manufactured before 1980, 15% by manufacturers who were no longer in business. See Minnesota Office of Environmental Assistance, *Recycling Used Electronics*, Report on Minnesota's Demonstration Project, July 2001, Background and Highlights, available at [http://www.moea.state.mn.us/plugin/report.cfm].

[38] S.B. 20 is available at [http://www.ciwmb.ca.gov/electronics/act2003/].

picture tubes used in most computer monitors and television sets. They are easily identified. They contain substantial amounts of lead and some other heavy metals that are considered hazardous when disposed in regulated quantities. They comprise a significant portion of the electronic waste stream, accounting for as much as half of the weight of a standard personal computer. And, as noted earlier, their disposal is already banned in four states. They also are costly to collect and recycle: most voluntary programs charge a fee of $5 - $15 to accept a television or monitor for recycling. Given this cost, it is unlikely that voluntary programs will ever handle a significant portion of the CRT waste stream.

A somewhat broader option would be to include flat panel displays and televisions as well as CRTs; in addition, one might include the other components of a personal computer, such as the CPU (the central processing unit that contains a system's memory, hard drive, disk drives, CD unit, etc.), keyboards, printers, speakers, scanners, modems, and any other peripheral equipment sold for use with a computer.

At the other end of the spectrum, the EU and other countries are taking a far broader approach. The WEEE directive contains 10 categories of equipment covered by its proposed requirements: large household appliances; small household appliances; IT and telecommunications equipment; consumer equipment; lighting equipment; electrical and electronic tools (with the exception of large-scale stationary industrial tools); toys, leisure and sports equipment; medical devices (with the exception of all implanted and infected products); monitoring and control instruments; and automatic dispensers. The directive includes a five-and-a-half page list of specific items that fall under these categories.

Those states that are considering legislation have focused primarily on CRTs and computers. The legislation enacted in California and Maine addresses primarily CRTs and LCD or other flat screen displays, or products containing them. Legislation introduced in Minnesota would address TVs, computer monitors, laptop computers, CPUs, and printers. A New York bill would direct the state's environmental agency to identify "electronic equipment"; the bill defines electronic equipment as "appliances that contain complex circuitry, circuit boards, or signal processing, as well as one or more hazardous components." An Oregon bill would regulate personal computers, defined as "a central processing unit that may or may not be combined with peripheral equipment such as hard drives, floppy drives, CD-ROM drives, internal or external modems, fans, keyboards, and monitors."

Given the rapidly changing nature of the computer and consumer electronics industries, new concerns may arise Flat screen TVs and monitors, for example, which are rapidly gaining market share, do not use CRTs; nor do laptop and handheld devices. Requiring only the older technology to be subject to regulatory requirements could provide an additional incentive for industry to phase out the technology's use. In contrast, covering a wide array of technologies, including new technologies as they are introduced, could encourage advance consideration of the environmental consequences of new technologies and the design of products for minimal environmental impact.