
November 2005

ELECTRONIC WASTE

Strengthening the Role of the Federal Government in Encouraging Recycling and Reuse





Highlights of GAO-06-47, a report to congressional requesters

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Why GAO Did This Study

Advances in technology have led to rapidly increasing sales of new electronic devices. With this increase comes the dilemma of managing these products at the end of their useful lives. Some research suggests that the disposal of used electronics could cause a number of environmental problems. Research also suggests that such problems are often exacerbated by the export of used electronics to countries without protective environmental regulations.

Given that millions of used electronics become obsolete each year with only a fraction of them being recycled, GAO was asked to (1) summarize information on the volumes of, and problems associated with, used electronics; (2) examine the factors affecting their recycling and reuse; and (3) examine federal efforts to encourage recycling and reuse of these products.

What GAO Recommends

GAO recommends that EPA strengthen the federal role in encouraging recycling and reuse of used electronics by (1) proposing options to the Congress for overcoming the factors deterring recycling and reuse, (2) promoting wider federal agency participation in promising EPA programs, and (3) taking steps to ensure safe handling of these products if exported. EPA agreed with most of GAO's findings, but disagreed with the first and second recommendations.

www.gao.gov/cgi-bin/getrpt?GAO-06-47.

To view the full product, including the scope and methodology, click on the link above. For more information, contact John Stephenson at (202) 512-3841 or Stephensonj@gao.gov.

What GAO Found

Available estimates suggest that over 100 million computers, monitors, and televisions become obsolete each year, and this number is growing. If improperly managed, these used electronics can harm the environment and human health. Available data suggest that most used electronics are probably stored in garages, attics, or warehouses, with the potential to be recycled, reused, or disposed of in landfills, either in the United States or overseas. If disposed of in landfills, valuable resources, such as copper, gold, and aluminum, are lost for future use. Additionally, some research shows that toxic substances with known adverse health effects, such as lead, have the potential to leach from discarded electronics in landfills. Although one study suggests that this leaching does not occur in modern U.S. landfills, it appears that many used electronics are exported to countries without modern landfills or with regulations less protective of human health and the environment.

Economic factors inhibit the recycling and reuse of used electronics. Consumers generally have to pay fees and drop off their used electronics at often inconvenient locations to have them recycled or refurbished for reuse. Recyclers and refurbishers charge these fees because their costs exceed the revenue they receive from selling recycled commodities or refurbishing units. In addition to these economic factors, federal regulatory requirements provide little incentive for environmentally preferable management of used electronics. First, the governing statute, the Resource Conservation and Recovery Act, allows individuals and households to dispose of hazardous waste, including many used electronics, in landfills. Second, federal regulations do not provide a financing system to overcome the economic factors deterring recycling and reuse. Third, federal regulations do not prevent the exportation of used electronics to countries where disassembly takes place at far lower cost, but where disassembly practices may threaten human health and the environment. In the absence of federal actions to address these concerns, an emerging patchwork of state requirements to encourage recycling and reuse may place a substantial burden on manufacturers, retailers, and recyclers, who incur additional costs and face an uncertain regulatory landscape as a result.

In response to these challenges, EPA has spent about \$2 million on several promising programs to encourage recycling and reuse of used electronics. Participation in one program—the Federal Electronics Challenge—has already led the Bonneville Power Administration to substantial cost savings through the procurement of environmentally friendly and energy efficient electronic products. To date, however, federal participation in this and other EPA electronics recycling programs has been minimal because—unlike other successful federal procurement programs (such as EPA's and the Department of Energy's Energy Star program)—participation is not required.

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Abbreviations

ARF	advanced recycling fee
BPA	Bonneville Power Administration
CRT	cathode ray tube
DOE	Department of Energy
EPA	Environmental Protection Agency
EPEAT	Electronic Product Environmental Assessment Tool
EPR	extended producer responsibility
EU	European Union
FEC	Federal Electronics Challenge
NEPSI	National Electronic Product Stewardship Initiative
RCRA	Resource Conservation and Recovery Act

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**United States Government Accountability Office
Washington, D.C. 20548**

November 10, 2005

The Honorable James M. Jeffords
Ranking Minority Member
Committee on Environment and Public Works
United States Senate

The Honorable John Thune
Chairman
Subcommittee on Superfund and Waste Management
Committee on Environment and Public Works
United States Senate

The Honorable Barbara Boxer
Ranking Minority Member
Subcommittee on Superfund and Waste Management
Committee on Environment and Public Works
United States Senate

The Honorable Lincoln Chafee
The Honorable Olympia Snowe
The Honorable James Talent
The Honorable Ron Wyden
United States Senate

Rapid advances in technology have led to increasing sales of new electronic devices, particularly televisions, computers, and computer monitors. Approximately 62 percent of U.S. households had computers in 2003, compared with only 37 percent just 6 years earlier. With this increase comes the dilemma of how to manage these products when they reach the end of their useful lives. The National Safety Council forecast that in 2003 alone, about 70 million existing computers became obsolete, but it also forecast that only 7 million were recycled.

Disposal of used electronics poses a number of potential environmental problems.¹ For example, concerns have been raised because toxic substances such as lead, which have well-documented adverse health effects, can potentially leach from these products, especially if disposed

¹For the purposes of our study, used electronics includes computers, computer monitors, and televisions that have reached the end of their original useful life.

improperly. Concerns have also been raised over used electronics that are exported from the United States to countries with less stringent environmental regulations because disposal in these countries can more easily have adverse environmental and human health effects. In addition to toxic substances, computers contain precious metals, such as gold, silver, and platinum, which require substantial amounts of energy and land to extract. These metals can often be extracted with less environmental impact from used electronics than from the environment. The U.S. Geological Survey, for instance, reports that 1 metric ton of computer scrap contains more gold than 17 tons of ore and much lower levels of harmful elements common to ores, such as arsenic, mercury, and sulfur.

Under the Resource Conservation and Recovery Act (RCRA), the Environmental Protection Agency's (EPA) Office of Solid Waste provides regulatory oversight of the disposal of certain hazardous used electronic products. The office tightly regulates hazardous waste from generation to disposal; but also under RCRA, for other solid wastes, it promotes waste reduction, recycling, and responsible disposal through national voluntary and educational programs. Individual states must meet minimum national standards for the management of municipal solid waste in landfills, but they operate their own waste management programs, develop their own recycling and reuse programs, and are free to implement more stringent waste management policies.

Given the growing number of computers and other electronic products becoming obsolete, you asked that we (1) summarize existing information on the volumes of, and problems associated with, used electronics; (2) examine the factors affecting the nation's ability to recycle and reuse these products; and (3) examine federal efforts to encourage recycling and reuse of used electronics and determine what, if anything, can be done to improve them.

To address these issues, we reviewed scientific studies and reports conducted by government agencies, nonprofits, trade organizations, and academics. We also interviewed federal, state, local, nonprofit, and industry officials, as well as academic and research organization experts. For studies that we cite in this report, we reviewed their methodology, assumptions, limitations, and conclusions to ensure that we properly represented the validity and reliability of their results and conclusions. To examine the factors that affect the nation's ability to recycle and reuse used electronics, we examined current federal laws, regulations, and guidance regarding solid and hazardous waste disposal as they relate to the disposal

of used electronics. We also reviewed pertinent state and local laws, regulations, and guidance. In particular, we reviewed the electronic waste legislation passed in California, Maine, Maryland, Massachusetts, and Minnesota. We visited states and localities that have implemented programs or passed legislation to responsibly manage used electronics, including California, Maine, Massachusetts, Oregon, and Washington. Further, we examined EPA-sponsored federal, state, and local pilot programs that attempt to encourage recycling of electronic products. In addition, to obtain the views of informed stakeholders regarding the factors that affect the nation's ability to recycle and reuse used electronics, we conducted a survey of participants in the National Electronics Product Stewardship Initiative (NEPSI) and other key stakeholders. We received 42 responses from our survey population of 49. For additional information on our scope and methodology, see appendix I. Our work was conducted in accordance with generally accepted government auditing standards, which include an assessment of data reliability and internal controls.

Results in Brief

Available research suggests that the volume of used electronics is large and growing and, if improperly managed, can harm the environment and human health. While data and research are limited, some data suggest that over 100 million computers, monitors, and televisions become obsolete each year and that this amount is growing. These obsolete products can be recycled, reused, disposed of in landfills, or stored by users in places such as basements, garages, and company warehouses. Data we reviewed suggest that most used electronics are probably stored, and therefore have the potential to be recycled or reused, disposed of in landfills, or exported overseas. If ultimately disposed in landfills, either in the United States or overseas, valuable resources, such as copper, gold, and aluminum, are lost for future use. In addition to concerns over losing valuable resources, some research shows that certain toxic substances with known adverse health effects, such as lead, have the potential to leach into landfills. Although one study suggests that leaching is not a concern in modern U.S. landfills, it appears that many of these products end up in countries without modern landfills or environmental regulations comparable to those in the United States. Finally, even with uncertainty surrounding the risks associated with toxic substances in used electronics, EPA has identified a number of these substances as priority toxic chemicals for reduction because they do not break down when released into the environment and can be dangerous even in small quantities.

Despite the large volume of used electronics and the valuable resources contained within them, economic and regulatory factors discourage these products' recycling and reuse. Specifically:

- Consumers generally have to pay fees and drop off their used electronics at often inconvenient locations to have them recycled or refurbished for reuse. Consumers in Snohomish County, Washington, for instance, may have to travel more than an hour to the nearest drop-off location, which then charges between \$10 and \$27 per unit, depending on the type and size of the product. Consumers in the Portland, Oregon area pay one local recycler 50 cents per pound to have their used computers recycled, which is about \$28 for an average-sized desktop computer. Recyclers and refurbishers charge these fees because costs associated with recycling and refurbishing outweigh the revenue received from recycled commodities or refurbished units. This point was underscored by the International Association of Electronics Recyclers, which reported that the value of commodities recovered from computer equipment (such as shredded plastic, copper, and aluminum) is only between \$1.50 and \$2.00 per unit. It was further underscored by our interviews with eight electronics recyclers, who were unanimous in emphasizing that they could not cover costs without charging fees.
- Federal regulatory requirements also provide little incentive for environmentally preferable management of used electronics. First, some used electronics are considered hazardous waste under RCRA, and RCRA bars entities that generate more than 220 pounds per month of hazardous waste (including some used electronics) from depositing it in landfills. However, RCRA does not bar households and entities that generate less than 220 pounds of hazardous waste per month from this practice. Consequently, since only four states currently ban disposal of used electronics in landfills, most consumers in the remaining 46 states (and the District of Columbia) are allowed to do so—and have little incentive to do otherwise. Not surprisingly, data we reviewed suggest that states and localities without landfill bans have dramatically lower levels of recycling than the four states that have enacted landfill bans. Second, federal law does not provide a financing system to recycle used electronics. Absent a consistent financing system to make recycling less costly and more convenient for consumers, a patchwork of potentially conflicting state requirements is emerging that may ultimately place a substantial burden on recyclers, retailers, and manufacturers. The lack of a national financing mechanism has also led to an array of legislative

proposals that take very different approaches to address the problem. Third, federal regulations do not provide adequate oversight of these products when exported. This is a particular problem in the case of some developing countries, where risks to the environment and human health may be more likely because less stringent environmental regulations often do not ensure that exported used electronics—supposedly destined for reuse—are not instead being disposed of improperly. Together, these factors hinder EPA's ability to reach its stated goal that within 10 years, it will be as convenient for consumers to take a discarded television or computer for recycling or reuse as it is to purchase a new product.

EPA has spent about \$2 million on several voluntary programs to help overcome some of the factors discouraging recycling and reuse of used electronics. For example, the “Plug-In To eCycling” campaign sponsors partnerships with industry and state and local governments to make recycling used electronics less expensive and more convenient for consumers. In 2004, Plug-In To eCycling sponsored four pilot projects involving collection events at retailers such as Best Buy, Good Guys, Office Depot, and Staples, in which over 11 million pounds of used electronics were collected. Another program—the Federal Electronics Challenge—leverages U.S. government purchasing power to promote environmentally preferable management of used electronics throughout their life cycle: procurement, operation and maintenance, and end-of-life management. Through its participation in this program, the Bonneville Power Administration has already documented cost savings associated with longer life spans for the agency’s computers and through purchases of computer monitors that contain less toxic substances and are therefore cheaper to recycle. To date, however, only 61 out of thousands of federal facilities participate in the Federal Electronics Challenge. A major reason for the limited federal participation in this and other EPA electronics recycling programs is that, unlike other successful federal procurement programs (such as EPA’s and the Department of Energy’s Energy Star program), participation is not required.

We are recommending that the Administrator of EPA develop a legislative proposal that addresses some of the economic and regulatory factors discouraging recycling and reuse of used electronics. In addition, we are recommending that the agency take several administrative steps to (1) increase federal agency participation in promising EPA electronics recycling programs and (2) help ensure that used electronics exported

overseas are destined for reuse, as intended, and not disposed of improperly.

In responding to a draft of this report, EPA generally agreed with our findings but disagreed with our recommendations that it develop a legislative proposal, and that it take additional steps to engender wider federal agency participation in promising EPA electronics recycling programs. Regarding the first of these two recommendations, EPA commented that it does not believe it is appropriate for the agency to propose options for a nationwide financing system to overcome the barriers to recycling and reuse because there is no consensus among manufacturers as to the optimal solution. We disagree that this lack of consensus provides a compelling reason for EPA to abstain from acting because there are ample precedents for EPA's involvement in addressing complex financing issues affecting solutions to key environmental problems. Furthermore, our survey results show that there is overwhelming agreement that legislation will be needed to deal with used electronics and a national financing system must be a part of it.

In commenting on the recommendation to engender wider federal agency participation in its electronics recycling programs, EPA disagreed with our view that participation in the Federal Electronics Challenge is limited, noting that the 12 federal agencies participating in the program to date "represent over 80 percent of the Information Technology purchasing in the government." The figure, however, overstates federal agency adherence to the goals of the program. Participation simply means these agencies have identified their current practices for managing electronic products and set goals to improve them. However, the participating agencies and facilities are not required to meet their goals. As a practical matter, 61 out of thousands of federal facilities participate in the program, and only 5 of these are meeting electronic product management criteria that the program's steering committee has asked them to attain. We continue to believe this track record falls short of EPA's own goal that the federal government "lead by example" in promoting recycling, reducing the use of toxic chemicals, and conserving energy and materials in its lifecycle management of electronic products.

Background

Few people are aware of recycling options for their old televisions and personal computers. Because of the perceived value of used electronics, some pass their used equipment to family members or friends before eventually storing these units in their attics, basements, or garages.

Eventually, though, consumers need to dispose of these units in some manner. By choosing to have these products recycled, consumers ensure the recovery of resources like copper, iron, aluminum, and gold, which would otherwise be procured through less environmentally friendly practices such as mining. Likewise, consumers who choose to recycle also reduce the amount of waste entering the nation's landfills and incinerators. Since used electronics typically contain toxic substances like lead, mercury, and cadmium, recycling or refurbishing will prevent or delay such toxic substances from entering landfills.

The Congress affirmed its commitment to reducing waste and encouraging recycling, first through enactment of the Resource Conservation and Recovery Act (RCRA) of 1976, and then again with passage of the Pollution Prevention Act of 1990. Both RCRA and the Pollution Prevention Act address alternatives to waste disposal. RCRA promotes the use of resource recovery, either through facilities that convert waste to energy or through recycling. To promote recycling, RCRA required EPA to develop guidelines for identifying products that are or can be produced with recovered materials. RCRA also required federal agencies to procure items that are, to the maximum extent practicable, produced with recovered materials.

The Pollution Prevention Act provided that pollution that cannot be prevented should be recycled or treated in a safe manner, and disposal or other releases should be used only as a last resort. The act specified that pollution prevention can include such practices as modifying equipment, technology, and processes; redesigning products; and substituting less-toxic raw materials. Executive Order 13101, issued September 14, 1998, also affirmed the federal government's commitment to encourage recycling by directing federal agencies to consider procuring products that, among other things, use recovered materials, can be reused, facilitate recycling, and include fewer toxic substances. The Federal Environmental Executive, who is appointed by and reports to the President, is responsible for recommending initiatives for government-wide procurement preference programs for environmentally preferable products.

EPA's Office of Solid Waste regulates hazardous waste and nonhazardous waste, including discarded used electronics, under RCRA. RCRA established explicit hazardous waste management requirements overseen by the Office of Solid Waste, but for nonhazardous waste management, also under RCRA, the Office's policies rely heavily on national voluntary and education programs for waste reduction that emphasize materials recycling

and reuse, toxic chemical reduction, and resource conservation.² Several of these voluntary programs are tailored specifically for environmentally preferable management of used electronics. The Office of Solid Waste also collaborates with EPA's Office of Pollution Prevention and Toxics to conserve valuable resources and reduce wastes—particularly toxic wastes—before they are generated. These efforts are administered under the Resource Conservation Challenge, which is an institutional strategy combining the strengths of the two offices to ultimately minimize waste and toxic substances and conserve energy and resources. According to EPA, the overarching goal of the Resource Conservation Challenge is to move the nation from a waste-oriented to a life-cycle management way of thinking about resources.

Growing Volume of Used Electronics May Pose Environmental and Health Problems If Not Managed Properly

The information we reviewed suggests strongly that the volume of used electronics is large and growing. For example, in a 1999 study, the National Safety Council forecast that almost 100 million computers and monitors (70 million of which would be computers) would become obsolete in 2003—a three-fold increase over the 33 million obsolete computers and monitors in 1997.³ Additionally, a 2003 International Association of Electronics Recyclers report estimated that 20 million televisions become obsolete each year—a number that is expected to increase as cathode ray tube (CRT) technology⁴ is replaced by new technologies such as plasma screens.⁵

Thus far, it appears that relatively few used electronics have found their way into either landfills or recycling centers. Available EPA data indicate that less than 4 million monitors and 8 million televisions are disposed of

²States are subject to minimum national standards for the management of municipal solid waste in landfills, but they are free to implement more stringent policies as well.

³National Safety Council, *Electronic Product Recovery and Recycling Baseline Report*, May 1999. These estimates are based on major assumptions, as well as responses from only 38 percent of sampled companies. Although the study supports the existence of a large and growing problem, the precise estimates should be used with caution.

⁴CRTs are the technology used in most televisions and computer display screens.

⁵International Association of Electronics Recyclers, *IAER Electronics Recycling Industry Report*, 2003. These estimates are based on major assumptions, as well as responses from only 20 percent of sampled companies. Although the study supports the existence of a large and growing problem, the precise estimates should be used with caution.

annually in U.S. landfills—only a fraction of the amount estimated to become obsolete annually, according to EPA.⁶ Additionally, the 1999 National Safety Council report forecast that only 19 million computers, monitors, and televisions would be recycled in 2005. Hence, the gap between the enormous quantity of used electronics that are obsolete (or becoming obsolete), and the quantity either in landfills or sent to recycling centers, suggests that most are still in storage—such as attics, basements, and garages, and that their ultimate fate is still uncertain—or have been exported for recycling and reuse overseas.

Conventional disposal of used electronics in landfills raises two primary concerns, according to research we reviewed: the loss of natural resources and the potential release of toxic substances in the environment. By disposing of these products in landfills or incinerators, valuable resources are lost for future use. For example, computers typically contain precious metals, such as gold, silver, palladium, and platinum, as well as other useful metals like aluminum and copper. The U.S. Geological Survey reports that one metric ton of computer circuit boards contains between 40 and 800 times the concentration of gold contained in gold ore and 30 to 40 times the concentration of copper, while containing much lower levels of harmful elements common to ores, such as arsenic, mercury, and sulfur.⁷ The research we reviewed also suggests that the energy saved by recycling and reusing used electronics is significant. The author of one report by the United Nations University states that perhaps as much as 80 percent of the energy used in the life cycle of a computer, which includes manufacturing, can be saved through refurbishment and reuse instead of producing a new unit from raw materials.⁸

Regarding the issue of toxicity, the research we reviewed is unclear on the extent to which toxic substances may leach from used electronics in

⁶“Flow and Capacity Analysis of Cathode Ray Tube Management for Households and Conditionally Exempt Small Quantity Generators,” prepared for EPA by ICF, June 2004. Because we were unable to review the methodology of this study, these data should be used with caution.

⁷Bleiwas, Donald and Kelly, Thomas, *Obsolete Computers, “Gold Mines,” or High-Tech Trash? Resource Recovery from Recycling* (Washington, D.C.: U.S. Geological Survey, 2001). Because we were unable to review the methodology of this study, these data should be used with caution.

⁸The United Nations University is a think tank for the United Nations and is not a degree granting university.

landfills. According to a standard regulatory test RCRA requires to determine whether a solid waste is subject to federal hazardous waste regulations, lead (a substance with known adverse health affects) leaches from some used electronics under laboratory conditions. Some tests conducted at the University of Florida indicate that lead leachate from color computer monitors and televisions with CRTs exceeds the regulatory limit and, as a result could, according to EPA, be considered hazardous waste under RCRA.⁹ On the other hand, the author of this study told us that these findings are not necessarily predictive of what could occur in a modern landfill. A report by the Solid Waste Association of North America also suggests that while the amount of lead from used electronics appears to be increasing in municipal solid waste landfills, these landfills provide safe management of used electronics without exceeding toxicity limits that have been established to protect human health and the environment.¹⁰

Nonetheless, regardless of uncertainty surrounding the environmental risks associated with toxic substances commonly found in used electronics, EPA has identified lead, mercury, and cadmium (which are typically found in computers or monitors), as priority toxic chemicals for reduction under the agency's Resource Conservation Challenge. According to EPA, these toxic substances do not break down when released into the environment and can be dangerous, even in small quantities.

Cost and Regulatory Factors Deter Recycling and Reuse of Used Electronics

The costs associated with recycling and reuse, along with limited regulatory requirements or incentives, discourage environmentally preferable management of used electronics. Generally, consumers have to pay fees and take their used electronics to locations that are often inconvenient to have them recycled or refurbished for reuse. Recyclers and refurbishers charge fees to cover the costs of their operations. In most states, consumers have an easier and cheaper alternative—they can take

⁹Townsend, Timothy, et al, *Characterization of Lead Leachability from Cathode Ray Tubes Using the Toxicity Characteristic Leaching Procedure*. (University of Florida, Department of Environmental Engineering Sciences: 2000). Because this study did not test a representative sample of each type of electronic device, the results cannot be generalized to the population. However, the results do indicate that color monitors and televisions with CRTs have the potential to be toxicity characteristic hazardous wastes.

¹⁰Solid Waste Association of North America, *The Effectiveness of Municipal Solid Waste Landfills in Controlling Releases of Heavy Metals to the Environment* (2004). We did not independently evaluate and validate the reliability of the information from the studies reviewed in this report.

them to the local landfill. This easy and inexpensive alternative helps, in part, explain why so little recycling of used electronics has thus far taken place in the United States. Moreover, this economic reality, together with federal regulations that do little to preclude disposal of used electronics along with other wastes, have led a growing number of states to enact their own laws to encourage environmentally preferable management of these products.

Cost and Consumer Inconvenience Discourage Recycling and Reuse of Used Electronics

Consumers who seek to recycle or donate their used electronics for reuse generally pay a fee and face inconvenient drop-off locations. Unlike their efforts for other solid waste management and recycling programs, most local governments do not provide curbside collection for recycling of used electronics because it is too expensive. Instead, some localities offer used electronics collection services, for a fee, at local waste transfer stations. These localities send consumers' used electronics to recyclers for processing.¹¹ For example, transfer stations in Snohomish County, Washington, charge consumers between \$10 and \$27 per unit for collecting and transporting used electronics to recyclers and, ultimately, paying the recycler to responsibly handle the products.

Moreover, such transfer stations are generally not conveniently located, and rural residents, such as those in parts of Snohomish County, may need to drive more than an hour to get to the nearest drop-off station. Our survey respondents recognize this challenge for the recycling infrastructure—over 70 percent believe that existing collection options for recycling used electronics are inconvenient for households. However, in some localities, consumers can also take their used electronics directly to a recycler, where they are typically charged a fee. In the Portland, Oregon area, for instance, one recycler charges consumers 50 cents per pound to recycle computers, monitors, and televisions, which means it costs consumers about \$28 to recycle an average-sized desktop computer system.

Recyclers charge these fees to cover the costs they incur when disassembling used electronics, processing the components, and refining the commodities for resale. As noted in a 2003 report by the International Association of Electronics Recyclers, most recyclers and refurbishers in

¹¹Data from recent EPA-sponsored pilot projects show that the costs of collecting and transporting used electronics can be as much as two-thirds of the total cost associated with recycling.

the United States cannot recoup their expenses from the resale of recycled commodities or refurbished units. The report, which compiled data from more than 60 recyclers in North America, stated that the costs associated with recycling are greater than the revenue received from reselling recycled commodities and that fees are needed to cover the difference. Furthermore, the report states that the value of commodities recovered from computer equipment, such as shredded plastic, copper, and aluminum, is only between \$1.50 and \$2.00 per unit. This point is further underscored by our interviews with eight electronics recyclers, who were unanimous in emphasizing that they could not cover costs without charging fees.

The costs associated with recycling make it unprofitable (without charging fees) for several reasons. First, recycling used electronics is labor intensive—the equipment must be separated into its component parts, including the plastic housing, copper wires, metals (e.g., gold, silver, and aluminum), and circuit boards, as well as parts that can be easily reused or resold, like hard drives and CD-ROM drives. Officials with Noranda Recycling Inc., which recycles used electronics for Hewlett-Packard, told us that over 50 percent of their total costs for recycling are labor costs involved in disassembly, even though they operate some of the most technologically advanced equipment available. Labor costs are high, in part, because electronic products are not always designed to facilitate recycling at end of life. For instance, a Hewlett-Packard official told us 30 different screws must be removed to take out one lithium battery when disassembling a Hewlett-Packard computer for recycling. According to this official, if Hewlett-Packard spent \$1 in added design costs to reduce the number of different screws in each computer, it would save Noranda approximately \$4 in its disassembly costs.¹² A substantial majority of respondents to our survey agreed that the complexities of taking apart used electronics is a major hindrance that impedes the recycling of these products—over 60 percent said that recycling is discouraged because of the difficulty of disassembly.¹³

¹²Hewlett-Packard officials said they are currently modifying their computers to reduce Noranda's recycling costs.

¹³The percentages used in this report reflect those survey respondents who provided an answer for the question being examined and does not include non-responses to the question.

Second, to obtain sellable commodities, the resulting metal and plastic “scrap” must be further processed to obtain shredded plastic, aluminum, copper, gold, and other recyclable materials. Processing in this fashion typically involves multimillion-dollar machinery. According to officials with one international electronics recycling company, processing costs are high, in part, because this sophisticated and expensive machinery is being used to process the relatively limited supply of used electronics being recycled in the United States. Company officials noted that, by contrast, in some European countries where manufacturers are required to take financial responsibility for recycling their products, the increased supply of recyclable electronics has decreased the company’s per-unit processing costs and increased the net revenue associated with recycling used electronics.

Finally, recyclers incur additional expenses when handling and disposing of toxic components (such as batteries) and toxic substances (such as lead), which are commonly found in used electronics. These expenses include removing the toxic components and substances from the product, as well as handling and processing them as hazardous material.¹⁴ Once separated from the product, these wastes may be regulated as hazardous wastes and, thus, subject to more stringent RCRA requirements governing their transportation, storage, and disposal. CRTs from computer monitors and televisions are particularly expensive to dispose of because they contain large volumes of leaded glass, which must be handled and disposed of as a hazardous waste. Some recyclers, for example, send their CRT glass to a lead smelter in Missouri that charges 6.5 cents per pound. A study on the economics of recycling personal computers found that the cost associated with disposing of CRT monitors substantially reduces a recycler’s net revenue.¹⁵

Refurbishers charge similar fees to cover the costs involved in guaranteeing data security by “wiping” hard drives, upgrading systems, installing software, and testing equipment. A program manager for a nonprofit technology assistance provider told us that it generally costs

¹⁴EPA does not regulate whole circuit boards that contain batteries and minimal quantities of mercury. However, once these materials are removed from the circuit boards, EPA may consider them to be hazardous wastes.

¹⁵Boon, J.E., Isaacs, J.A., and Gupta, S.M. “Economic Sensitivity for End of Life Planning and Processing of Personal Computers.” *Journal of Electronics Manufacturing* (Vol. 11, 81-93, 2002).

about \$100 to refurbish a Pentium III computer system, plus an additional licensing fee of about \$80 for an operating system.

To help minimize the cost and inconvenience of recycling used electronics, Office Depot and Hewlett-Packard partnered to provide free take-back of used electronics at Office Depot retail stores in 2004. Office Depot collected used electronics at their retail stores, and then sent them to Hewlett-Packard facilities for recycling. Over a 3-month period, nearly 215,000 computers, monitors, and televisions were collected and recycled. EPA officials told us that the pilot program showed the extent to which recycling can be encouraged by making it inexpensive and convenient to the consumer.

Federal Regulatory Framework Governing Used Electronics Provides Little Incentive for Recycling or Reuse

The lack of economic incentives promoting recycling and reuse of electronics is compounded by the absence of federal provisions that either encourage recycling, or preclude their disposal in landfills. Specifically, current federal laws and regulations (1) allow hazardous used electronics in municipal landfills, (2) do not provide for a financing system to support recycling, and (3) do not preclude electronic products generated in the United States from being exported and subsequently threatening human health and the environment overseas.

Hazardous Used Electronics Are Allowed in Municipal Landfills

Regulation at the federal level of used electronics identified as hazardous waste and disposed in landfills falls under RCRA Subtitle C, which was established to ensure that hazardous waste is managed in a manner that is protective of human health and the environment. Many computer monitors and televisions are considered hazardous waste under RCRA, and some materials from circuit boards might be hazardous waste as well. Federal regulations bar entities that generate more than 220 pounds of hazardous waste per month from sending hazardous waste to municipal solid waste landfills. However, households and entities that generate more than 220 pounds of hazardous waste per month are exempt from many RCRA regulations, thus allowing them to deposit their used electronics in municipal solid waste landfills—even though CRTs in computer monitors and televisions, and potentially circuit boards in computers, exhibit characteristics of hazardous waste. EPA's Office of Solid Waste regulates hazardous waste under RCRA, but its regulations do not require households and other entities that generate small quantities of hazardous waste to recycle or reuse used electronics, nor do its regulations require the office to establish a mandatory national approach, such as a disposal ban.

In response to the RCRA regulatory exemption for household hazardous waste and the growing volume of obsolete electronics within their boundaries, four states—California, Maine, Massachusetts, and Minnesota—recently banned some used electronics from landfills.¹⁶ Such bans appear to have contributed to a higher degree of recycling than in states where disposal in solid waste landfills is allowed. In San Ramon, California, for instance, a 1-day collection event for television monitors yielded 24,000 units. In contrast, in Richmond, Virginia, a metropolitan area 4 times the size of San Ramon but without a landfill ban, a similar collection event (organized by the same electronics recycler as in San Ramon) only yielded about 6,000 monitors. This difference in yield is consistent with assessments of California and Massachusetts officials, who all said that their states have seen substantial increases in used electronics recycling. One international electronics recycler, for instance, set up recycling facilities in the San Francisco area in 2003 because of the large volume of used electronics that was no longer being disposed of in landfills. In Massachusetts, an official with the Department of Environmental Protection said that six businesses dedicated to electronics recycling were created following the enactment of a landfill ban. Finally, over 95 percent (all but one) of survey respondents said that a national disposal ban should be enacted to overcome the factors that discourage recycling and reuse of used electronics.

Recyclers we interviewed in California and Massachusetts said that a positive side effect of a ban is increased public awareness. In Massachusetts, for example, the Department of Environmental Protection conducted a survey in which over 60 percent of the respondents were aware that electronic products were banned from landfills. Of note, only 25 percent of survey respondents believe that the public is aware of recycling options for used electronics on a national scale, and over 85 percent believe that the overall lack of awareness of recycling options discourages recycling of these products.

Experts Believe a National Financing System Is Needed to Support Recycling

Given the inherent economic disincentives to recycling used electronics in the United States, we also found widespread agreement among our survey respondents and others we contacted that establishing some type of financing system is critical to making recycling and reuse sufficiently inexpensive and convenient for consumers to attract their participation. Of particular note, over 90 percent of survey respondents support one of the

¹⁶The landfill bans in Maine and Minnesota take full effect in 2006.

two major proposals being discussed—an advanced recovery fee (ARF) or extended producer responsibility (EPR)—or, a hybrid of the two.¹⁷ Yet despite broad agreement in principle, participants in the EPA-sponsored NEPSI process, particularly those in the computer and television industries, did not reach agreement on a uniform, nationwide financing system after several years of meetings.

In the absence of a national system, several states have enacted their own financing systems through legislation to help ensure environmentally preferable management of used electronics. For example, in 2005, California implemented an ARF on all new video display devices, such as televisions and computer monitors, sold within the state. The fee is charged to consumers at the time and location of purchase and can range between \$6 and \$10. According to an official with the California Department of Toxic Substance Control, the revenues generated from the fee are intended to deal with a key concern—used electronics in storage, or “legacy waste.” The officials explained that while California’s recycling industry had sufficient capacity to recycle large volumes of used electronics, consumers and businesses had little incentive to take products out of their basements or warehouses to have them recycled. The state uses revenues from the fees to reimburse electronics recyclers at the rate of 48 cents per pound of used electronics recycled. The recyclers, in turn, pass on to collectors 20 cents per pound of used electronics, thereby providing an incentive for entities to make collection free and convenient for households.

The state is still in the preliminary stages of program implementation, and state officials acknowledge that they face a number of challenges. Some of these challenges underscore the difficulty of dealing with the electronic waste problem on a state-by-state basis. The officials noted, for instance, that the ARF applies only to electronics purchased in California, and that the fees are intended only for used electronics originating in the state. Implementing the program within the state’s boundaries, however, may prove difficult because the payout may attract units originating in other states. Preventing this problem, they say, requires substantial documentation for each unit, and may require a substantial enforcement effort.

¹⁷An ARF involves placing an additional fee on a product at the point of sale. EPR involves the manufacturers of a product having financial or physical responsibility for taking back their products for recycling or reuse at end of life.

While California's ARF focuses on consumers of electronics, Maine's approach focuses on producers through an EPR-like system. In 2004, the state passed legislation requiring computer and television manufacturers who sell products in Maine to pay for the take back and recycling of their products at end of life. Under this plan, consumers are to take their used electronics to a consolidation point, such as a transfer station, where they are sorted by original manufacturer. Each manufacturer is physically or financially responsible for transporting and recycling its products, along with a share of the products whose original manufacturer no longer exists. According to one official with Maine's State Planning Office, a key challenge of its EPR system is the lack of a financial incentive for consumers to take their used electronics out of storage. Additionally, consumers will still likely have to pay a fee at consolidation points.

Several other states have implemented or are considering implementing financing systems for used electronics. Earlier this year, Maryland passed legislation requiring all computer manufacturers that sell computers in the state to pay \$5,000 into a fund to help implement local recycling programs.¹⁸ For manufacturers that implement a computer take-back program in the prior year, the fee is only \$500. Other states, such as Arkansas, Colorado, Florida, and Massachusetts, have allocated grants to help pay for the recycling of used electronics, and New York, Rhode Island, and Vermont are considering enacting EPR-like programs.

The differing financing systems of California and Maine, as well as those being considered by other states, suggest that in the absence of a national approach, a patchwork of potentially conflicting state requirements is developing. Further, this patchwork may be placing a substantial burden on manufacturers, retailers, and recyclers. A manufacturer in one state, for example, may have an advance recovery fee placed on its products; whereas in another state, the same manufacturer may have to take back its products and pay for recycling. Hewlett-Packard serves as one example: in Maine, officials estimate they will spend almost \$90,000 per year paying for the take-back and recycling of their products under the state's EPR system. In California, Hewlett-Packard incurred over \$3 million in start-up costs and will spend an additional \$250,000 per year because the state's ARF

¹⁸An official with the Maryland Department of Environment estimated that anywhere from 40 to 200 computer manufacturers might be required to pay the fee. He cited one estimate that the fee will provide the state with about \$400,000 to use toward recycling used electronics.

system requires them to track their products that have been distributed to various retailers, who then add a fee. A Hewlett-Packard official said implementing one financing system on a national scale would be more preferable than implementing numerous financing systems on a state-by-state basis that have different requirements and, thus, require additional costs. A Hewlett-Packard official also told us that these conflicting systems involve start-up costs, which could cost over \$2 million dollars per state if a new state system differs from those currently in place.

Similarly, a Seattle area recycler told us that because of the differing state requirements and the lack of a national approach, recyclers find it difficult to invest in developing a recycling infrastructure. Specifically, he noted that without certainty about the regulatory landscape, larger recyclers will not enter the industry and invest in technologies that can reduce costs, such as has been done in some European countries where recycling used electronics is more profitable. He added that until this problem is addressed, recycling will continue to be conducted primarily by small, niche companies.

Not surprisingly, three major computer manufacturers we contacted said that while they have individual preferences for one financing mechanism or another (usually an ARF or EPR system), their main preference is to operate within a uniform national system that mandates a financing system preempting varying state requirements. Recyclers and state and local government officials generally agreed, noting that having a system in place that covers costs and is national in scope is more important to them than their preferences for a particular system. Our survey results substantiate these views, with over 95 percent of survey respondents indicating that national legislation should be enacted, and over 90 percent of that group stating that one of the major proposals being discussed (or a hybrid of the two) should be included, such as an ARF or EPR system.

Because of these challenges, EPA sponsored a major effort in this regard by providing the initial funding for the multistakeholder National Electronic Product Stewardship Initiative (NEPSI) process. NEPSI stakeholders met between 2001 and 2004, in part, to develop a financing system to facilitate

recycling and reuse of used electronics. The process ultimately dissolved in 2005, however, in large part because EPA withdrew its participation and funding.¹⁹

Notwithstanding EPA's withdrawal of its sponsorship of the NEPSI process, the agency still generally advocates financing systems for resource conservation that involve all stakeholders—consumers, manufacturers, and retailers—who benefit from resource use. Under the Resource Conservation Challenge, EPA seeks to have products designed with reuse and recycling in mind, the costs of reuse and recycling included in the price of the product, and improved mechanisms for collecting products for recovery. Further, in the Resource Conservation Challenge's strategic plan, EPA recognizes that for some products, such as electronics, recycling is not economically sustainable. For these products, EPA supports the consideration of financing approaches that have been implemented in Japan and some European nations, in which the cost of recovering products is incorporated into the cost of buying the product; and in which incentives are provided for environmentally preferable design.

For example, Japan enacted the Home Appliances Recycling Law in 1998, which requires that retailers collect—and manufacturers and importers recycle—four types of household appliances, in which televisions are included. The law's inclusion of televisions has encouraged the development of a television and CRT recycling industry in Japan, where substantial research has gone into the development of television dismantling and recycling technologies. Since enactment of this law, Sony, for example, has cooperated with other companies to establish 190 take-back sites and 15 recycling plants in Japan.

In Europe, the European Union (EU) enacted the Waste Electrical and Electronic Equipment Directive, which established comprehensive take-back and recycling requirements for retailers, manufacturers, and importers of electrical and electronic products, including televisions, computers, and monitors. The directive requires that producers and

¹⁹EPA provided funding for NEPSI through a cooperative agreement with the University of Tennessee. EPA's Office of General Counsel recommended that EPA withdraw from NEPSI because discussions had, by late 2003, evolved to the point where some stakeholders were discussing jointly lobbying for federal legislation. The Office of General Counsel was concerned that EPA's continued involvement in this dialogue (and continued funding of a grant to facilitate the dialogue) could raise questions relating to anti-lobbying restrictions applicable to EPA staff and EPA grantees.

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. Ninety-three percent of our survey respondents believe that this directive will facilitate collection and recycling of used electronics in the EU. The EU also addressed the issue of hazardous substances in discarded used electronics by requiring that six hazardous substances, including substances such as lead, mercury, and cadmium, commonly found in used electronics, be replaced by other substances by July 1, 2006.

Oversight of Exported Used Electronics Is Limited

The lack of oversight over some exported used electronics also appears to be discouraging environmentally preferable management of such products and inhibiting the development of a domestic recycling infrastructure. Companies export used electronics because the largest markets for reused computers and televisions are overseas. One EPA official told us that consumers in developing countries are more willing to purchase older computer and television models than consumers in developed countries.

Likewise, the largest markets are also overseas for commodities commonly found in used electronics, such as copper, aluminum, and shredded plastic. In many developing countries, commodities such as these can be obtained more cheaply by disassembling whole units, such as CRT televisions and monitors, under less stringent environmental requirements. As a result of this demand, many businesses, schools, government agencies, and recyclers in the United States receive e-mails from foreign brokers willing to pay them for their obsolete computers and televisions, even if the products cannot be reused. For example, we observed that at one e-commerce Web site, a broker sought to purchase 50,000 used monitors per month and did not require the monitors to be tested to determine whether they could be reused. Another broker in Pakistan sought to purchase 1 million nonworking monitors annually at a price of \$2 to \$3 per monitor. In another instance, another broker specifically requested nonworking monitors and wanted to fill at least 10 containers, which amounts to anywhere from 6,000 to 11,000 units overall (depending on their size).

Five electronics recyclers we interviewed, including two who export nonworking whole computers and televisions, agreed that brokers such as these are probably not handling nonworking units responsibly once the units reach their final overseas destination. According to these recyclers, it costs money to disassemble and recycle used electronics in such a way that protects human health and the environment from exposure to toxic substances. In many importing countries, they note, labor costs are far

lower, in part because the regulatory standards needed to protect workers' health and the environment are far more lenient. One EPA official agreed, noting that it is safer and more protective of the environment if used electronics are disassembled (and their materials subsequently separated) in the United States under sound environmental standards before exporting recycled commodities. Even so, two Seattle area recyclers told us they regularly receive e-mails requesting these types of products, and they are aware of many other organizations, such as school districts, that sell their obsolete computers and televisions to foreign brokers because it costs too much to have them disassembled in the United States in a manner protective of human health and the environment.

As the export of nonworking whole units continues, a growing body of evidence suggests that it is cause for concern in developing countries. Instances have been documented recently to confirm the assertions of some recyclers and environmental groups that human health and environmental threats have resulted from the less-regulated disassembly and disposal of many of these U.S.-generated used electronics overseas—products that were allegedly destined for reuse (See fig. 1.). A 2002 documentary by the Basel Action Network and Silicon Valley Toxics Coalition videotaped egregious disassembly practices in China that involved open burning of wire to recover copper, open acid baths for separating precious metals, and human exposure to lead and other hazardous materials.²⁰ According to a report by these groups, most of the used electronics being handled in this manner were of North American origin.

²⁰The Basel Action Network is an environmental group that works to prevent the trade of toxic wastes from developed countries to developing countries. The Silicon Valley Toxics Coalition is an environmental group that works to prevent environmental and human health problems caused by the electronics industry.

Figure 1: A Woman in Guiyu, China, Disassembling a CRT Monitor



Source: Basel Action Network.

Additionally, it appears that *nonworking whole electronic products* are more frequently handled in an irresponsible manner. Specifically, seven recyclers we interviewed, along with a majority of survey respondents, told us that nonworking whole products (CRT televisions and computer monitors in particular) are much more likely to pose environmental and human health risks if they are not disassembled in the United States prior

to being exported. Accordingly, one survey respondent told us that the export of such products should be regulated more closely than the export of specific commodities, such as copper, because they still contain toxic substances likely to be handled improperly in countries without regulations to protect human health and the environment. Our survey respondents generally supported these views: while more than 75 percent believe that exports of *working* units should be allowed to help developing countries advance technologically, only about 20 percent said that export of nonworking whole products should be allowed.²¹

Despite the additional risks posed by the export of nonworking whole CRT televisions and monitors, few legal safeguards are in place to ensure that these units are managed responsibly or indeed destined for reuse overseas, and one proposed rule by EPA aims to reduce the few safeguards that currently exist.²² Under U.S. law, hazardous electronic products that will be disassembled in another country are subject to a number of export regulations. Such products may only be exported with the consent of the government of the receiving country, and the Department of State must forward to that government a description of the federal regulations that would apply to the waste if it remained in the United States. The receiving government may specify the terms of its consent and, under U.S. law, the exporter must comply with these terms. In addition, the exporter must know the final destination of the wastes and must obtain verification that it reached the destination. The exporter must also make yearly reports to EPA detailing the type, quantity, frequency, and ultimate destination of exported hazardous waste.

In practice, however, U.S. legal restrictions on the export of hazardous waste have had little apparent effect on exporters of used electronics, even if the units will be disassembled when they reach their final destination overseas. One reason for this is that EPA has long interpreted the definition of “waste” (and, thus, “hazardous waste”) to exclude products that will be reused “as is” or after minor repairs. Therefore, although U.S. export regulations on hazardous waste apply to products that will not be reused at

²¹Also of note, about 65 percent said that export of commodities like copper and shredded plastic should be allowed once disassembled domestically.

²²The following are generally not classified as solid wastes under RCRA, which means they cannot be regulated as hazardous waste: Used electronics for reuse, whole circuit boards, shredded circuit boards, if free of certain hazardous materials, metal from used electronics, and scrap metal.

their destination, the regulations do not apply to products that are bound for reuse. Moreover, nothing in RCRA or its regulations requires exporters to demonstrate that their products will be reused. Exporters can simply assert that their exported used electronics are bound for reuse, even if the exports instead are completely disassembled when they reach their destination.

Of additional concern is EPA's June 2002 proposed rule, which would, under most circumstances, exclude hazardous CRT televisions and computer monitors from RCRA's existing notification and consent regulations for hazardous waste exports. The purpose of the rule, as outlined in the *Federal Register*, is to encourage greater reuse and recycling of these products in the United States by streamlining the management requirements for used CRTs, while maintaining necessary environmental protection.²³ Many stakeholders support this rule, including recyclers and manufacturers, because it helps reduce the costs of recycling CRT televisions and computer monitors. However, under the proposed rule, EPA also proposed that CRT televisions and computer monitors, including broken units, be excluded from RCRA's export notification and consent laws and regulations. Thus, exporters would be excluded from having to obtain the consent of the receiving country before exporting the waste and from having to make yearly reports to EPA detailing the quantity and destination of used CRT exports. This provision is in stark contrast to recommendations developed by EPA's Common Sense Initiative between 1994 and 1998, which recommended that entities exporting CRTs be subject to the same export regulations as other generators of hazardous waste.²⁴

According to one EPA official closely involved in this proposed rulemaking effort, EPA received numerous comments from individuals and organizations concerned that the rule would increase the export of eventual hazardous wastes to countries ill-equipped to manage them in a manner protective of human health and the environment. As a result, this and another EPA official told us that EPA is making changes to the final rule that address these stakeholders' concerns while, at the same time,

²³Hazardous Waste Management System; Modification of the Hazardous Waste Program; Cathode Ray Tubes and Mercury-Containing Equipment, 67 Fed. Reg. 40507 (proposed June 12, 2002).

²⁴EPA's Common Sense Initiative was an advisory committee formed under the Federal Advisory Committee Act.

helping the domestic recycling infrastructure. Currently, the rule—along with language addressing oversight of hazardous exports—is being reviewed by the Office of Management and Budget.

In addition to the added health and environmental risks posed by nonworking whole electronic products, several recyclers who disassemble domestically told us they cannot compete with exporters of nonworking whole products because these exporters do not bear the costs of adherence to U.S. environmental regulations. In support of this view, 75 percent of survey respondents said that exports such as these reduce the viability of the U.S. recycling infrastructure. Additionally, concerned about potential environmental and human health risks resulting from U.S.-generated used electronics, over 70 percent of survey respondents said the U.S. government should place some restrictions on used electronics exports.

Federal Efforts to Increase Recycling and Reuse of Used Electronics Can Be Strengthened

EPA has implemented several promising voluntary programs to encourage recycling and reuse of used electronics. Without EPA authority to require recycling of these products or to require other federal agencies to participate, however, these programs' successes have been and will continue to be limited.

Voluntary EPA Programs Show Promise

In 2002, EPA organized its voluntary efforts for environmentally preferable management of used electronics under a broadly scoped program called the Resource Conservation Challenge. This program focuses EPA resource conservation efforts on four critical areas, two of which are directly related to used electronics: (1) promoting environmentally preferable management of used electronics, such as recycling, and (2) reducing toxic substances potentially entering the waste stream. This program also challenges the federal government to lead by example. Since 2000, EPA has spent about \$2 million on voluntary pilot programs, projects, and grants related to recycling used electronics. Three particularly promising projects under this program include (1) the Federal Electronics Challenge (FEC); (2) the Electronic Product Environmental Assessment Tool (EPEAT), both of which leverage U.S. government purchasing power to promote environmentally preferable management of electronic products from procurement through end of life; and (3) the “Plug-In To eCycling”

campaign, which aims to minimize the economic factors that deter recycling.

The FEC program challenges federal agencies and facilities to procure environmentally preferable electronic products, extend the lifespan of these products, and expand markets for recycling and recovered materials by recycling them at end of life. The FEC provides guidance on environmentally preferable attributes of electronic products, information on operating and maintaining them in an energy-efficient manner, and on options for recycling or reusing them at end of life. Currently, 12 federal agencies and 61 individual federal facilities participate in the FEC to some extent. Of note, the Bonneville Power Administration (BPA) recently documented cost savings associated with its FEC participation. BPA noted, for example, that through the program, it extended the lifespan of its personal computers from 3 to 4 years. With over 500 computers procured each year at an annual cost of more than \$500,000, a BPA official said that extending computer life spans could generate substantial savings. Additionally, BPA decided to procure new flat-screen monitors instead of CRT monitors, reducing both hazardous waste tonnage and end of life recycling costs. According to BPA, it expects to save at least \$153 per monitor over the life of each monitor.

Relatedly, the EPEAT program promotes environmentally preferable management of electronics by helping large purchasers, such as government agencies, compare and select laptop computers, desktop computers, and monitors with environmentally preferable attributes. For example, using EPEAT, purchasers can evaluate the design of an electronic product for energy conservation, reduced toxicity, extended lifespan, and end of life recycling, among other things. EPEAT's three-tier system—bronze, silver, and gold—provides purchasers with the flexibility to select equipment that meets the minimum performance criteria, or to give preference to products with more environmental attributes. For manufacturers, EPEAT provides flexibility to choose which optional criteria they would like to meet to achieve higher levels of EPEAT qualification. EPEAT was developed along the lines of EPA and DOE's Energy Star program, in which the federal government rewards manufacturers that offer businesses and consumers energy-efficient products that ultimately save money and protect the environment by providing them with the Energy Star label for their products. In fact, specific EPEAT procurement criteria are drawn heavily from Energy Star standards. EPA expects EPEAT to be instituted in 2006.

Another promising program, the Plug-In To eCycling campaign, has led to the collection and recycling of over 45 million pounds of used consumer electronics in the United States, including computers, monitors, and televisions, since 2003. The “Plug-In To eCycling” campaign is partnering with over 20 industry affiliates and 27 state and local governments to provide the public with information about recycling and to establish pilot projects to test innovative approaches to collect and manage used electronics. In the pilot projects funded through Plug-In To eCycling, partnering organizations have reduced the cost and inconvenience of recycling used electronics. For example, manufacturers have helped pay the cost of recycling used electronics; retailers have helped provide collection opportunities; recyclers have helped provide lower costs for larger quantity, longer-term contracts that meet environmentally safe management guidelines; and consumers have taken their used electronics from storage to designated locations. In 2004, Plug-In To eCycling sponsored four pilot projects, which all involved holding collections events at retailers such as Best Buy, Good Guys, Office Depot, Staples, and Target. These pilot collection events lasted from a few weeks to a few months and collected over 11 million pounds of used electronics.

Lack of EPA Authority for Requiring Federal Agency Participation Limits Programs’ Successes

While the voluntary EPA programs outlined above have produced tangible results, their ultimate potential is constrained by the lack of EPA authority to require broader participation. Currently, for example, only 61 out of thousands of federal facilities are participating in the FEC. Requiring participation by private parties and state and local governments in these programs may be neither realistic nor desirable. However, as discussed below, there is ample precedent for actions that would engender greater federal participation in these types of programs. Wider federal participation would likely benefit both the environment and the development of the electronics recycling industry—federal agencies were expected to spend over \$60 billion on televisions, computers, monitors, and other information technology products and services in fiscal year 2005 alone.

Perhaps the best precedent for requiring broader federal participation in electronics recycling is the Energy Star program, co-sponsored by EPA and the Department of Energy. According to EPA, in 2004 alone, Energy Star products helped save approximately \$10 billion in energy costs and reduced greenhouse gas emissions by an amount equivalent to that produced by 20 million automobiles. Also, in 2005, public awareness of Energy Star reached over 60 percent. Because of Energy Star’s high profile, EPA officials told us that although manufacturers do not have to design

their products to meet Energy Star criteria, many manufacturers view Energy Star as a de facto requirement for design of their products—suggesting that if their products do not have the Energy Star label then they are at a competitive disadvantage in the marketplace.

According to an EPA official who has worked on the Energy Star program since its inception, part of Energy Star's success can be attributed to two executive orders that required federal agencies to purchase products equipped with Energy Star features. Specifically, Executive Order 12845, issued in 1993, required federal agencies to procure computers and monitors that meet Energy Star requirements for energy efficiency. This EPA official told us that the early success of Energy Star was enhanced by this executive order. Executive Order 13123, issued in 1999, directs federal agencies to select Energy Star products when procuring *any* energy-using product. For product groups where Energy Star labels are not yet available, agencies are directed to select products that are in the upper 25 percent of energy efficiency, as designated by the Federal Energy Management Program.

In contrast, the potential success of the FEC and EPEAT programs is presently limited because, unlike the Energy Star program, federal agencies' participation is not required. The potential benefits from broader federal participation were illustrated by BPA's experience, which, as noted earlier, demonstrated significant cost and energy savings and greater environmental protection. They were also underscored by the results of our survey—almost 90 percent of respondents said that federal government procurement criteria along the lines of FEC and EPEAT should be required, and over 95 percent said that such procurement criteria would encourage environmentally preferable product design, and greater recycling and reuse.

Conclusions

Despite the significant environmental benefits of recycling and reusing used electronics, these environmentally preferable practices will likely remain underutilized unless concerted actions are taken. Two overarching factors contribute to this problem. First, consumers have the cheaper and more convenient option of simply throwing these products away in most states. Without a fundamental change in the incentive structure affecting their decisions, such as through the implementation of a consistent nationwide financing system, consumers will continue to choose disposal as the preferable option of dealing with used electronics in the overwhelming number of states where disposal is allowed. Also in the

absence of federal action, states are taking measures to address their unique recycling challenges. This state-by-state approach, however, has the unintended consequence of increasing costs for manufacturers, retailers, and consumers, while discouraging recyclers from investing in a domestic recycling infrastructure. It has also led to an array of legislative proposals that take very different approaches to address the problem.

Second, rather than paying for proper disassembly in the United States, some organizations discarding used electronics (and some recyclers) sell these units to overseas buyers with no guarantee that they will be properly handled. The problem is particularly serious in the case of nonworking whole products, such as CRT televisions and computer monitors, which are often handled in a manner that causes adverse environmental and human health effects in receiving countries. Current RCRA regulations require EPA to oversee the export of many used CRT televisions and computer monitors if such products will not be reused at their final destination. In practice, however, there has been little oversight over the export of these products because neither RCRA nor its regulations require exporters to demonstrate that exported electronic products will actually be reused. In addition to posing health and environmental risks in developing countries, this practice undermines the domestic recycling industry by providing a cheap alternative to domestic recycling, which is more protective of human health and the environment. Importantly, EPA's proposed CRT rule would further exacerbate the problem if adopted as presently worded because it would restrict EPA's regulatory authority to oversee the exportation of most used CRT televisions and computer monitors.

These factors have prevented much recycling from occurring to date and, if not addressed, will continue to stymie recycling and reuse efforts. EPA has implemented several promising voluntary programs to encourage recycling and reuse of used electronics, but without the authority to require recycling of these products or to require other federal agencies to participate, the success of these programs is and will continue to be limited. In the past, the federal government has taken steps to encourage environmentally preferable choices by leveraging its substantial market power, but these actions required the participation of all federal agencies. Using the success of the Energy Star program as a precedent, the federal government has the opportunity to lead by example by building on existing EPA programs to (1) enhance the domestic recycling infrastructure for used electronics by ensuring a steady and substantial supply of used electronics; (2) stimulate markets for environmentally preferable electronic products by purchasing energy efficient, easily recyclable products with high recycled content and

less toxic substances; and (3) save energy by extending the lifespan of used electronics.

Recommendations

Given the numerous and varying legislative proposals for nationwide financing systems, we recommend that the Administrator, EPA, direct the Offices of Solid Waste and Pollution Prevention and Toxics to bring its expertise to bear on the issue by drafting a legislative proposal including, but not limited to, recommendations for a consistent, nationwide financing system that addresses the barriers to recycling and reuse.

As EPA finalizes its proposed rule regarding CRTs, we also recommend that the Administrator ensure that the final rule reflects the concerns of numerous commenters that it will not constrict EPA's regulatory authority to oversee the exportation of CRT televisions and monitors (many of which exhibit the traits of hazardous wastes currently regulated by EPA) to countries that do not have the environmental protections in place to ensure their safe disassembly.

In addition, to establish a national recycling infrastructure and encourage environmentally preferable management of used electronics throughout their life-cycle, we also recommend that the Administrator direct the Office of Solid Waste to take necessary action (in collaboration with the Office of the Federal Environmental Executive) to require federal agencies to participate in the Federal Electronics Challenge and to procure electronic products that meet or exceed the minimum performance criteria set by the Electronic Product Environmental Assessment Tool.

Agency Comments and Our Evaluation

We provided a draft of this report to the Administrator of the Environmental Protection Agency for review and comment. In its October 14, 2005 letter, EPA expressed agreement with most of the report's findings, noting further that agency reviewers found the report "to be very well written, carefully researched, and clearly argued." EPA disagreed, however, with our recommendations that the agency play a more active role in promoting electronic waste recycling and reuse by (1) developing a legislative proposal that would address key barriers to recycling and reuse and (2) taking additional steps to ensure broader implementation by federal agencies of EPA's initiatives to promote wider use of electronics recycling and reuse across the federal government.

EPA commented that it does not believe it is appropriate for the agency to develop a proposal for establishing a nationwide financing system that addresses the barriers to recycling and reusing used electronics. EPA explained that since there is no consensus among manufacturers regarding the optimal financing solution to meet these ends, the agency is “not in the best position to choose between competing financing solutions, given that this decision is one that is fundamentally a business and economic issue, rather than an environmental issue.” We acknowledge the lack of consensus among manufacturers cited by EPA, but disagree that this lack of consensus provides a compelling reason for EPA to abstain from acting on this recommendation.

First, for the reasons cited in this report and those of other organizations, electronic waste is becoming an increasingly important environmental issue. As such, the fact that a key barrier involves disagreement over competing financing solutions should not preclude EPA from helping to resolve the problem. There are also ample precedents for EPA’s active involvement in addressing complex financial issues affecting solutions to key environmental problems. EPA played a central role, for example, in developing the Clean Water State Revolving Fund and Drinking Water State Revolving Fund programs. These programs have become instrumental in helping communities address their water infrastructure needs efficiently and at lower cost to the federal government.

Second, our survey results show that while there is disagreement on precisely what financing mechanism should be used to resolve the problem, there is an overwhelming consensus that (1) legislation will be needed to deal with the problem and (2) a uniform nationwide financing solution would be preferable to none at all. As we noted above, the manufacturers we contacted said that while they have individual preferences for one financing mechanism or another, their overriding goal is to operate within a uniform national system that mandates a financing system preempting varying state requirements. Our survey results substantiated these views, with over 95 percent of survey respondents indicating that some type of national legislation is needed to move electronics recycling forward. Additionally, over 90 percent of these respondents believe that a financing system should be included in national legislation. In essence, inaction itself is the choice that has the least support among stakeholders in dealing with electronics waste at the national level.

Third, an active EPA role in proposing options to Congress for a nationwide financing system is consistent with the goals EPA has set forth in its own strategic plan for electronics recycling.²⁵ In this plan, EPA commits to removing barriers to recycling and identifying opportunities to reduce wastes. The plan also says that sustainable funding systems must be available for recycling, particularly for products in which recycling is not economically viable. As noted earlier in our report, such is the case for used electronics. Finally, EPA's plan notes that within 5 years, the agency aims for "it to be as easy for consumers to recycle or find a re-user for their television or computer as it is for them to buy one."

EPA's letter also disagreed with our recommendation that EPA take steps aimed at requiring federal agencies to participate in the Federal Electronics Challenge and Electronic Product Environmental Assessment Tool program. In particular, citing its specific technical comments provided to us under separate cover, EPA disagreed with our view that participation in the FEC is limited. Among other things, EPA's technical comments echoed often-cited data showing that the 12 federal agencies participating in the program to date "represent over 80 percent of the Information Technology purchasing in the government." The figure, however, overstates federal agency adherence to the goals of the FEC. Participation by these 12 agencies, for example, does not mean that 80 percent of all Information Technology products are procured, operated, and recycled or reused at end of life in an environmentally preferable fashion. Instead, participation simply means these agencies have identified their current practices for managing electronic products and set goals to improve them. However, participating agencies and facilities are not required to meet these goals. As a practical matter, 61 out of thousands of federal facilities participate in the Federal Electronics Challenge, and only 5 are meeting electronic product management criteria that the Federal Electronics Challenge steering committee has asked them to attain.

We believe this track record falls short of the goals of EPA's Resource Conservation Challenge, which asks the federal government to "lead by example" in promoting recycling, reducing the use of toxic chemicals, and conserving energy and materials in its life-cycle management of electronic products. Past experience with similar programs (such as the Energy Star program), together with EPA's experience to date with the FEC, suggests

²⁵Environmental Protection Agency, *Resource Conservation Challenge Strategic Plan, What Can You Save Tomorrow? Five Year Plan*.

that merely encouraging participation in these programs will not meet these goals. Because the federal government will spend about \$65 billion on information technology in fiscal year 2006 while discarding approximately 10,000 computers per week, we continue to believe that our recommendation on this matter is both practical and appropriate. Specifically, either through an executive order, changes to the *Federal Acquisition Regulations*, or through some other means, federal participation in the FEC and EPEAT programs should be required to help ensure environmentally preferable management of used electronics by the federal government.

EPA also provided technical clarifications on the text of our draft report, which we have incorporated into the final report as appropriate.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies of this report to interested congressional committees; the Administrator of the Environmental Protection Agency; and other interested parties. We will make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-3841 or stephensonj@gao.gov. Contact points for our Office of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors to this report are listed in appendix IV.

A handwritten signature in black ink, appearing to read "John B. Stephenson".

John B. Stephenson
Director, Natural Resources and Environment

Scope and Methodology

To summarize existing research on the quantity of end-of-life electronics and the problems they may pose, we reviewed scientific studies and reports conducted by government agencies, nonprofits, trade organizations, and academics. We also consulted with federal, state, local, nonprofit, and industry officials, as well as academic and research organization experts. For studies estimating the volume of used electronics, we focused on those that generated original data analyses rather than summaries of existing literature. In addition, we limited our review to studies that provided nationwide estimates.¹ For studies that we cited in this report, we reviewed their methodology, assumptions, limitations, and conclusions to ensure that we properly represented the validity and reliability of their results and conclusions. We also interviewed experts and study authors from government, industry, and academia to obtain their views on the quantity of used electronics and problems they may pose.

To examine the factors that affect the nation's ability to recycle and reuse electronics, we examined current federal laws, regulations, and guidance regarding solid and hazardous waste disposal as they relate to the disposal of used electronics. We also reviewed pertinent state and local laws, regulations, and guidance. In particular, we reviewed the electronic waste legislation passed in Massachusetts, California, Maine, Minnesota, and Maryland. We visited states and localities that have implemented programs or passed legislation to responsibly manage used electronics, including California, Maine, Massachusetts, Oregon, and Washington. In addition we interviewed federal, state, local, government officials. We also interviewed officials from original equipment manufacturers, recyclers, trade organizations, nonprofit organizations, and environmental advocacy groups, as well as academic and research organization experts. Further, we examined EPA-sponsored federal, state, and local pilot programs that attempt to encourage recycling of electronic products. Finally, we also examined regulations that manage used electronics in Japan and the European Union.

In addition, to obtain the views of informed stakeholders regarding the factors that affect the nation's ability to recycle and reuse used electronics, we conducted a survey of a nonprobability sample of participants in the National Electronics Product Stewardship Initiative (NEPSI) and other key

¹For the purposes of our study, used electronics includes computers, computer monitors, and televisions that have reached the end of their original useful life.

stakeholders.² The NEPSI stakeholders met in a series of meetings between 2001 and 2004 in an attempt to develop solutions to the issue of managing used electronics. NEPSI was comprised of 48 stakeholders, with 15 representing federal, state, and local governments; 16 representing equipment manufacturers; and 17 other stakeholders from environmental organizations, recyclers, retailers, and academics. We attempted to contact all the NEPSI stakeholders listed on NEPSI's Web site, but we could not obtain current contact information for 4 of the 48 stakeholders or their alternates. We also sent surveys to 3 alternate NEPSI stakeholders because we were told by other stakeholders that they were active participants in NEPSI deliberations and did not work in the same agency as the primary stakeholder. We sent another 7 surveys to non-NEPSI participants to provide more balance in our survey population. These 7 stakeholders included two retailers, two recyclers (one for profit and one nonprofit), a recycling trade organization, a retail trade organization, and an EPA consultant who is an expert on recycling issues. Finally, we excluded from our survey population 4 stakeholders that did not respond to our survey who the coordinator of NEPSI characterized as "inactive" during the NEPSI deliberations, and 1 stakeholder who now works for the same organization as another stakeholder. In total, our survey population comprised of 49 individuals, 42 of which completed surveys and submitted them to us, yielding an 86 percent response rate.

To develop the questions for our survey, we identified key information to gain a general understanding of recycling and reuse issues for used electronics. In particular, the survey focused on areas such as public awareness, collections, exports, costs, historic and orphan waste, and hypothetical provisions in potential federal legislation. After initially developing, reviewing, and modifying the survey questions, we conducted a total of six pretests, two with GAO employees who were not associated with this review, and four non-GAO employees who were chosen on the basis of having characteristics similar to the NEPSI stakeholders. The final changes to the survey were made on the basis of the combined observations from the six pretests.

²Results from nonprobability samples cannot be used to make inferences about a population, because in a nonprobability sample some elements of the population being studied have no chance or an unknown chance of being selected as part of the sample.

Appendix I
Scope and Methodology

We conducted our review from October 2004 to September 2005 in accordance with generally accepted government auditing standards, which include an assessment of data reliability and internal controls.

Survey of Selected Stakeholders on Recycling Used Electronics

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United States Government Accountability Office



Survey of Selected Stakeholders on Recycling Used Electronics

Introduction

The U.S. Government Accountability Office (GAO) is an agency that assists the U.S. Congress in evaluating federal programs. GAO has been asked by members of the U.S. Senate to identify (1) the amount of used electronics and the problems they may pose, (2) practices that encourage recycling of used electronics, and (3) factors that discourage the recycling of these products. The electronic products in the scope of our analysis include televisions, computer monitors, and computer central processing units (CPUs), including laptops.

To obtain stakeholder perspectives on recycling used electronics, we are sending this survey to participants in the NEPSI dialogue. Please note that we will not publish individual responses to this survey. We intend to use the information gained through this survey in a report that we will ultimately provide to the Congress.

Instructions

This questionnaire can be filled out using MS-Word and returned via e-mail to EWasteSurvey@gao.gov. If you prefer, you may print copies of the questionnaire and complete them by hand. If you complete the survey by hand, fax your completed questionnaire to GAO at (202) 512-2514 or (202) 512-2502.

- Please use your mouse to navigate by clicking on the field or check box you wish to answer.
- To select a check box or button, simply click on the center of the box.
- To change or deselect a check box response, simply click on the check box and the 'X' will disappear.
- To answer a question that requires that you write a comment, click on the answer box _____ and begin typing. The box will expand to accommodate your answer.

If you have any questions about the content of this questionnaire, please e-mail or call Nathan Anderson at AndersonN@gao.gov or (206) 287-4804 or Arvin Wu at WuA@gao.gov or (206) 287-4793. If you experience any technical difficulties with the questionnaire, please call Jenny Chanley at ChanleyV@gao.gov or (202) 512-4801 or Monica Wolford at WolfordM@gao.gov or (202) 512-2625.

We recommend reading through the survey once before answering the questions so you have a clear idea of the broad range of questions you will be asked.

Thank you for your cooperation.

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Survey of Selected Stakeholders on Recycling
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Contact information

Please provide the following contact information in the event we need to clarify a response.

Name: _____

Title: _____

Organization: _____

Phone Number: _____

Address: _____

Email Address: _____

Preferred means of contact: _____

Background

1. Which of the following type of organization are you primarily affiliated with? (*Select one.*)

- | | |
|---------------------------------------|--|
| Federal government | <input type="checkbox"/> |
| State government | <input type="checkbox"/> |
| Local government | <input type="checkbox"/> |
| Trade organization | <input type="checkbox"/> |
| Environmental organization | <input type="checkbox"/> |
| Electronics recycler | <input type="checkbox"/> |
| Retailer | <input type="checkbox"/> |
| Original equipment manufacturer | <input type="checkbox"/> |
| Other | <input type="checkbox"/> ➤ Please specify: _____ |

2. Briefly, what is your organization's interest and role in managing used electronics?

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Factors that may affect recycling

We would like to know, in your professional opinion, the extent to which the following factors may affect domestic recycling of used electronics.

Public awareness

3. In general, how aware do you feel the public is of recycling options for used electronics (such as whether a product is recyclable or how to get it to a recycler)?

Extremely aware
Very aware
Moderately aware
Slightly aware
Not at all aware

Don't know

4. To what extent, if at all, does the current level of public awareness of recycling options for used electronics discourage recycling?

Very great extent
Great extent
Moderate extent
Little extent
No extent

Don't know or no opinion

If you wish, describe the basis for your answer:

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Collection

5. In general, for households across the nation, do you feel that the existing waste collection infrastructure, such as municipal curbside collection programs, is adequate to facilitate recycling of used electronics?

Yes
No

Don't know

6. In your professional opinion, to what extent, if at all, are existing collection options for recycling used electronics convenient for households?

Very great extent
Great extent
Moderate extent
Little extent
No extent

Don't know or no opinion

7. What are the most important challenges to facilitating the recycling of used electronics facing the existing waste collections infrastructure?

Exports and Prison Labor

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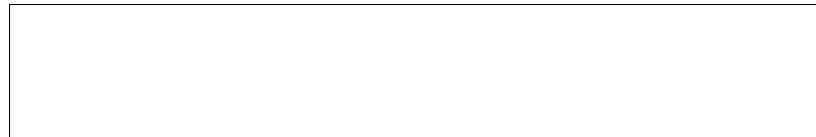
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8. In your professional opinion, to what extent, if at all, does the option to export used electronics reduce the viability of the private domestic recycling infrastructure?

Very great extent
Great extent
Moderate extent
Little extent
No extent

Don't know or no opinion

If you wish, describe the basis for your answer:



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9. In your professional opinion, would restricting exports of used electronics to certified processors overseas encourage greater recycling in the U.S.?

Yes

No

Don't know or no opinion

If you wish, describe the basis for your answer:

10. What types of used electronics should be allowed to be exported to non-OECD developing nations?

Working units

Non-working whole units

Circuit boards

CRT glass cullet

Hazardous commodities (e.g., hazardous metals)

Non hazardous commodities (e.g., non hazardous plastics)

None at all

Don't know or no opinion

If you wish, describe the basis for your answer:

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11. To what extent, if at all, does the option to use prison labor diminish the viability of the private domestic recycling infrastructure?

Very great extent
Great extent
Moderate extent
Little extent
No extent

Don't know or no opinion

If you wish, describe the basis for your answer:

12. Should prison industries, as currently operated, be allowed to compete with the private sector for non-government business in the area of used electronics recycling?

Yes
No

Don't know or no opinion

If you wish, describe the basis for your answer:

13. Are there any other issues regarding exports and prison labor that diminish the viability of the domestic recycling infrastructure?

Yes Please describe these other issues :
 ➔
No

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Recycling/processing

14. To what extent, if at all, does the way in which electronic products are currently designed discourage recycling?

- Very great extent
Great extent
Moderate extent
Little extent
No extent

Don't know

15. Some electronic products contain toxic materials that require special handling and processing when recycled. Does this discourage recycling of used electronics?

- Yes
No

Don't know or no opinion

16. We have been told that some used electronics are difficult to manually disassemble. Does this discourage recycling?

- Yes
No

Don't know or no opinion

If you wish, describe the basis for your answer:

17. Are there other issues regarding product design that discourage recycling?

- Yes → Please describe these other issues :
- No

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Other issues

18. In your professional opinion, to what extent, if at all, do unacceptable or potentially illegal activities occur in the recycling industry? (By unacceptable or potentially illegal activities, we mean activities such as recyclers “dumping” the used electronics they collect or “disposing” of them in ways other than advertised.)

Very great extent
Great extent
Moderate extent
Little extent
No extent

Don't know

19. Other than the issues discussed above (i.e., product design, exporting and prison labor options, collection, and public awareness), are you aware of any other factors that affect the recycling of used electronics domestically?

Yes
 ➔
No

Please describe these other issues :

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Historic, Orphan, and Future Waste

20. In your professional opinion, who should pay for recycling historic waste? (By historic waste, we mean used electronics that are in storage and have not yet been disposed of or recycled.) (*Select one.*)

Producers
Users/consumers
Taxpayers
Other → Please identify: _____

Don't know or no opinion

If you wish, describe the basis for your answer:

21. In your professional opinion, who should pay for recycling orphan waste? (By orphan waste, we mean used electronics whose manufacturers no longer exist.) (*Select one.*)

Producers
Users/consumers
Taxpayers
Other → Please identify: _____

Don't know or no opinion

If you wish, describe the basis for your answer:

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22. In your professional opinion, which financing system will be most effective at recycling historic and orphan waste? (By ARF, we mean a fee imposed on consumers when they purchase a product that is used to recycle other used electronics. By extended producer responsibility, we mean that a manufacturer charges an invisible fee, and the price of the product covers all the costs involved in taking back and recycling their product at its end-of-life.)

Advanced recovery fee (ARF)
Extended producer responsibility ...
General tax base funding
Other → Please identify: _____

Don't know or no opinion

If you wish, describe the basis for your answer:

23. In your opinion, what financing system would be most effective at recycling future wastes? (By future wastes, we mean products that are being sold, or will be sold, but will someday become wastes.)

Advanced recovery fee (ARF)
Extended producer responsibility ...
General tax base funding
Other → Please identify: _____

Don't know or no opinion

If you wish, describe the basis for your answer:

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Potential federal legislation

24. Should national legislation be enacted to overcome the factors that discourage recycling?

Yes
No

Don't know

25. In the absence of national legislation, which sector(s) should take the lead in the voluntary efforts to encourage recycling of used electronics? (*Select all that apply.*)

Private sector/industry
Public sector/government
Non-profit sector/environmental organizations
Other sector(s) ➔ Please specify: _____
None of the above

If you wish, describe the basis for your answer:

26. If enacted, which of the following provisions should national legislation include? (*Select one in each row.*)

	Yes ▼	No ▼	No opinion ▼
a. Disposal bans.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Export restrictions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Toxic constituent restrictions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Universal waste designation under RCRA for used electronics (to aid in collection and transportation).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Tax credits or subsidies for recyclers/processors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Tax credits or subsidies for manufacturers who used recycled materials.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Certification requirements for recyclers/processors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Requirement that federal agencies purchase environmentally friendly electronics...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Consumer education programs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Other – Specify:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

27. If enacted, which, if any, of the following financing mechanisms should national legislation include?
(*Select one*)

Advanced recycling fee (ARF)

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Extended producer responsibility (EPR).....
ARF/EPR hybrid.....
End-of-life fees,
General tax base funding.....

28. How effective would the following implementation scenarios be for funding recycling of historic and orphan used electronics and future used electronics? (Select one answer in each row.)

	Very effectiv e ▼	Somewha t effectiv e ▼	Neither effectiv e nor ineffectiv e ▼	Somewha t ineffectiv e ▼	Not at all effectiv e ▼	No opinion ▼
a. ARF collected at retail level and managed by the federal government (covering collection, transportation, and recycling)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. ARF collected at retail level and managed by a third-party organization (covering collection, transportation, and recycling)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. ARF/EPR hybrid: ARF for historic waste with a transition to EPR after "X" years.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. ARF for collection/transportation of used electronics, and EPR for recycling/processing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. EPR with market share divisions for orphan waste.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. EPR with retroactive liability for historic waste.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. End of life fees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Local tax base funding for collection/transportation, and EPR for recycling/processing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Deposit/refund for collection/transportation, and EPR for recycling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Deposit/refund	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. Other – Specify:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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29. How willing would you (the organization or entity you represent) be to operate within the various financing scenarios? *(Select one answer in each row.)*

	Very willing ▼	Somewh at willing ▼	Neither willing nor unwillin g ▼	Somewh at unwillin g ▼	Not at all willing ▼	No opinion ▼
a. ARF collected at retail level and managed by the federal government (covering collection, transportation, and recycling).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. ARF collected at retail level and managed by a third-party organization (covering collection, transportation, and recycling).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. ARF/EPR hybrid: ARF for historic waste with a transition to EPR after "X" years	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. ARF for collection/transportation of used electronics, and EPR for recycling/processing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. EPR with market share divisions for orphan waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. EPR with retroactive liability for historic waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. End of life fees.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Local tax base funding for collection/transportation, and EPR for recycling/processing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Deposit/refund for collection/transportation, and EPR for recycling.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Deposit/refund	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. Other – Specify: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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EPA's management of used electronics

The Environmental Protection Agency's Office of Solid Waste (OSW) developed shared responsibility pilots, for example, under the "Plug-In to eCycling" campaign to help demonstrate the kinds of voluntary partnerships that can significantly increase recycling of used electronics in the United States. Additionally, EPA sponsored the Federal Electronics Challenge (FEC), which encourages federal agencies to procure environmentally responsible electronic products. The FEC aims to promote energy star features, extend the life span of electronic equipment, expand the recycling infrastructure for electronics, and reduce the volume and toxicity of used electronics.

30. In your opinion, to what extent, if at all, have EPA efforts (such as Plug-In to eCycling and its pilots) encouraged recycling of used electronics?

Very great extent
Great extent
Moderate extent
Little extent
No extent

Don't know or no opinion

31. Given that the federal government purchases nearly \$60 billion worth of electronics equipment annually, to what extent, if at all, would practices such as "green" product design and the recycling of used electronics be encouraged if federal agencies were required to procure electronic products that meet the goals of the Federal Electronics Challenge?

Very great extent
Great extent
Moderate extent
Little extent
No extent

Don't know or no opinion

32. In your opinion, to what extent, if at all, have the following factors hindered EPA's ability to encourage recycling of used electronics? (Select one answer in each row.)

	Very great extent ▼	Great extent ▼	Moderate extent ▼	Some extent ▼	No extent ▼	Don't know or no opinion ▼
a. Lack of program goals.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Lack of performance measures for pilot programs.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Lack of data on quantity of used electronics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Lack of legislative authority.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Other – Please identify: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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If you wish, describe the basis for your answer:

33. In your opinion, how can EPA improve its effectiveness in encouraging recycling of used electronics?

International efforts

34. In your opinion, to what extent, if at all, will the Waste Electrical and Electronic Equipment (WEEE) Directive facilitate collection, transportation, and processing of used electronics in the E.U.?

- Very great extent
Great extent
Moderate extent
Little extent
No extent

Don't know or no opinion

If you wish, describe the basis for your answer:

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35. In your opinion, to what extent, if at all, will the Restriction of Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive encourage “green” product design in the E.U.?

Very great extent
Great extent
Moderate extent
Little extent
No extent

Don't know or no opinion

If you wish, describe the basis for your answer:

Health and Environmental Problems

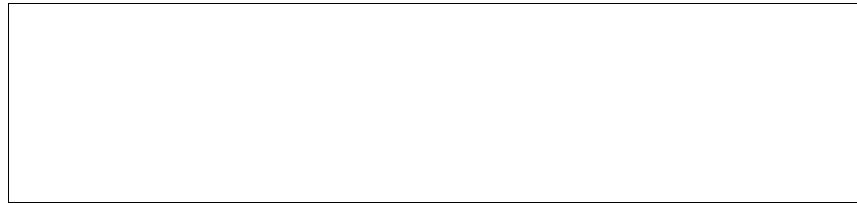
36. In your opinion, to what extent, if at all, are the following health and/or environmental problems associated with the disposal of used electronics in the U.S.? (Select one answer in each row.)

	Very great extent ▼	Great extent ▼	Moderate extent ▼	Some extent ▼	No extent ▼	Don't know or no opinion ▼
a. Leaching of toxic substances from a municipal landfill into groundwater or surface water.....	<input type="checkbox"/>					
b. Toxic emissions from incinerators.....	<input type="checkbox"/>					
c. Worker exposure to toxic substances at electronics disassembly facilities.....	<input type="checkbox"/>					
d. Volume of wastes in municipal landfills	<input type="checkbox"/>					
e. Loss of natural resources	<input type="checkbox"/>					
f. Other – Identify: _____	<input type="checkbox"/>					

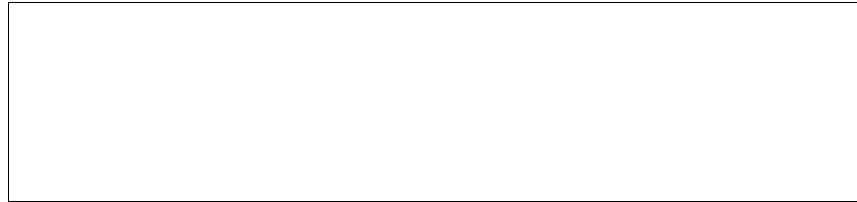
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DRAFT

37. Please indicate which problem from the prior question you think is the most significant problem associated with the disposal of used electronics in the U.S., and if you wish, describe why.



38. If you have any other comments that you would like to share with us concerning any issue related to the recycling of used electronics, please use the space below.



Thank you very much for your help.

Please save this file now and send an e-mail with your saved questionnaire file as an attachment to EWasteSurvey@gao.gov.

Comments from the Environmental Protection Agency



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
SOLID WASTE AND EMERGENCY
RESPONSE

October 14, 2005

Mr. John B. Stephenson
Director
Natural Resources and Environment
Government Accountability Office
Washington, DC 20548

Dear Mr. Stephenson:

This letter provides EPA's comments and responses to the draft report "Electronic Waste: Strengthening the Role of the Federal Government in Encouraging Recycling and Reuse."

We appreciate your report and the work that lies behind it. We have carefully reviewed the report and find it to be very well written, carefully researched and clearly argued. We had a number of technical and editorial suggestions which are provided in the attached document.

We agree with most of the findings made in this report. However, we take issue with your specific recommendations on development of legislation and on how to ensure broader implementation within the Federal Government of the Federal Electronics Challenge and the Electronic Products Environmental Assessment Tool. Our specific suggestions with regard to those recommendations follow.

On page 33 of the draft report, GAO recommends that EPA "draft a legislative proposal including, but not limited to, recommendations for a consistent, nationwide financing system that addresses the barriers to recycling and reuse." We do not believe it is appropriate for EPA (on behalf of the Administration) to develop such a proposal. As GAO knows, there is no consensus among manufacturers about what the best financing solution is to enable widespread electronics recycling, even though manufacturers and many other stakeholders have expressed the view that a national solution is better than a patchwork of state solutions. Manufacturers are sharply divided over whether it should be a visible fee at point of sale charged to the consumer or some kind of internalized fee charged to the manufacturers. Retailers appear to be strongly opposed to a visible fee at point of sale. While EPA has gained some expertise on the issues of financing electronics recycling through participation in the NEPSI dialogue and its observation of

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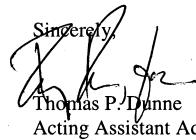
Appendix III
Comments from the Environmental
Protection Agency

development of state laws, EPA is not in the best position to choose between competing financing solutions, given that this decision is one that is fundamentally a business and economic issue, rather than an environmental issue. However, if the House Working Group on E-Waste or a yet to be formed House/Senate Working Group on E-Waste were to take up the task of developing a national financing bill modeled on some of the financing solutions discussed in NEPSI or being implemented at the state level, EPA could provide technical assistance, as requested.

GAO also calls on EPA to "take necessary action (in collaboration with the Office of the Federal Environmental Executive) to require federal agencies to participate in the Federal Electronics Challenge and to procure electronic products that meet or exceed the minimum performance criteria set by the Electronic Product Environmental Assessment Tool." As we explain in more detail in our specific comments, we disagree with GAO's view that participation in the FEC is limited, especially considering that this program was just launched in the past year. And we are not yet convinced that an Executive Order mandating participation is the best approach to ensuring broad and effective participation. However, we will explore this and other options with the Office of the Federal Environmental Executive and will continue to work with federal agencies and their facilities to encourage them to join FEC and use EPEAT.

Thank you for the opportunity to review the draft. Once again, we commend you on an excellent draft.

If you need additional information, you may contact Thea McManus, Associate Director of the Municipal and Industrial Solid Waste Division, Office of Solid Waste, at (703) 308-8738 or Clare Lindsay, Office of Solid Waste, at (703) 308-7266.

Sincerely,

Thomas P. Dunne
Acting Assistant Administrator

Enclosure

cc: Office of Pollution Prevention and Toxics
Office of Administration and Resources Management

GAO Contact and Staff Acknowledgments

GAO Contact

John B. Stephenson (202) 512-3841

Staff Acknowledgments

Individuals making key contributions to this report included Nathan Anderson, Charles Bausell, Virginia Chanley, Bernice Dawson, Steve Elstein, Omari Norman, Alison O'Neill, Judy Pagano, Carol Herrnstadt Shulman, Monica Wolford, and Arvin Wu.

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