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ELECTRONIC WASTE

Observation on the Role of the Federal Government in Encouraging Recycling and Reuse

Statement of John B. Stephenson, Director
Natural Resources and Environment

July 26, 2005

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Highlights

Highlights of GAO-05-937T, a testimony before the Subcommittee on Superfund and Waste Management, Committee on Environment and Public Works, United States Senate

Why GAO Did This Study

Advances in technology have led to rapidly increasing sales of new electronic devices, particularly televisions, computers, and computer monitors. With this increase comes the dilemma of how to manage these products when they come to the end of their useful lives. Concerns have been increasingly expressed that while millions of existing computers become obsolete each year, only a fraction of them are being recycled.

Some have alleged that the disposal of used electronics causes a number of environmental problems. They note, for example, that toxic substances such as lead can leach from used electronics. They have also noted that computers and other electronic equipment contain precious metals that require substantial amounts of energy and land to extract. These metals, they say, can often be extracted with less environmental impact from used electronics than from the environment.

In this testimony, GAO summarizes existing information on the amounts of, and problems associated with, used electronics. GAO also examines the factors affecting the nation's ability to recycle and reuse electronics when such products have reached the end of their useful lives.

This testimony discusses preliminary results of GAO's work. GAO will report in full at a later date.

www.gao.gov/cgi-bin/getrpt?GAO-05-937T.

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 the amount of used electronics is large and growing, and that 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 are either recycled, reused, disposed of in landfills, or stored by users in places such as basements, garages, and company warehouses. Available data suggest that most used electronics are probably stored. The units still in storage have the potential to be recycled and reused, or disposed in landfills; or, they may be exported for recycling or reuse overseas. If disposed of in landfills, valuable resources, such as copper, gold, and aluminum, are lost for future use. Additionally, standard regulatory tests show that some toxic substances with known adverse health effects, such as lead, have the potential to leach from discarded electronics into landfills. Although one study suggests that this leaching does not occur in modern U.S. landfills, it appears that many used electronics end up in countries without either modern landfills or with considerably less protective environmental regulations.

Economic factors, such as cost, 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 their used electronics 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. Recyclers and refurbishers charge these fees because costs associated with their processes outweigh the revenue received from recycled commodities or refurbished units. In addition to the challenges posed by these economic factors, federal regulatory requirements provide little incentive for environmentally preferable management of used electronics. The governing statute, the Resource Conservation and Recovery Act, regulates the disposal practices of large generators of hazardous waste (including electronic waste) but exempts individuals and households from these requirements.

In the absence of a national framework for dealing with the problem, a patchwork of potentially conflicting state requirements appears to be emerging. Manufacturers in one state, for instance, may have an advance recovery fee placed on their products, but the same manufacturers may have to take back their products and pay for recycling in another. This patchwork may be placing a substantial burden on recyclers, refurbishers, and other stakeholders. As GAO concludes its work, it will examine the implications of these findings for the ongoing efforts among the states to deal with this growing problem, for the various legislative solutions that have been proposed to create a uniform national approach, and for options the federal government can pursue to encourage recycling and reuse of electronics.

Mr. Chairman and Members of the Subcommittee:

Thank you for the opportunity to discuss our work to date on the issues surrounding the growing volume of used electronics accumulating in the nation's basements, attics, and landfills. Rapid advancements 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 come to the end of their useful lives. The Environmental Protection Agency (EPA) has estimated that in 2003 alone, about 50 million existing computers became obsolete, but one estimate forecast that less than 6 million were recycled.

Disposal of used electronics creates potential problems that can be averted through recycling or reuse. For example, concerns have been raised because toxic substances such as lead, which have well-documented adverse health effects, can potentially leach from used electronics. Concerns have also been raised over used electronics that are exported from the United States to countries with less stringent environmental regulations. In addition, computers contain precious metals, such as gold, silver, and platinum, that 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.

In this context, you and several other Members of the Congress asked that we address a number of issues surrounding this problem. Specifically, we were asked to (1) summarize existing information on the volumes of, and problems associated with, used electronics and (2) examine the factors affecting the nation's ability to recycle and reuse electronics when such products have reached the end of their useful lives.

To address these issues, we are examining studies that provide nationwide estimates on the amount of used electronics,[1] as well as federal and state

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

government studies (including those by EPA and task forces in Oregon and Washington), industry and interest group studies, and local studies (including municipal solid waste characterization studies) that discuss the problems associated with used electronics. We are also visiting states and localities that have implemented programs or passed legislation to responsibly manage used electronics, including California, Maine, Maryland, Massachusetts, Oregon, and Washington. In addition, we are surveying participants in the National Electronics Product Stewardship Initiative and other key stakeholders, which include key stakeholders from federal, state, and local governments, environmental organizations, recyclers, retailers, equipment manufacturers, and academicians. To date, we have received responses from 41 of the 53 survey participants. We are also comparing current government and industry practices with existing practices for promoting recycling in other industries, such as bottle- and can-recycling programs and the Rechargeable Battery Recycling Corporation program. Further, we are examining EPA-sponsored federal, state, and local pilot programs that attempt to encourage recycling of electronic products. Our work is being done in accordance with generally accepted government auditing standards, which include an assessment of data reliability and internal controls.

We are here to present our preliminary observations on these issues. We will report the final results of our study and any recommendations we may develop at a later date. In summary:

- Available estimates suggest that the volume of used electronics is large and growing and that 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 either recycled, reused, disposed of in landfills, or stored by users in places such as basements, garages, and company warehouses. Available data suggest that most used electronics are probably stored. These units have the potential to be recycled and reused, disposed of in landfills, or exported for recycling and reuse 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. Additionally, standard regulatory tests show that some 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 the environmental regulations comparable to the U.S.

- Both economic and regulatory factors discourage recycling and reuse of used electronics:

  - 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. 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 provide little incentive for environmentally preferable management of used electronics. The governing statute, the Resource Conservation and Recovery Act, bars entities that dispose of more than 220 pounds of hazardous waste per month from depositing hazardous waste (including some used electronics) in landfills. However, RCRA does not prohibit households and entities that generate less than 220 pounds of hazardous waste per month from sending hazardous waste to municipal landfills. Consequently, since only four states currently ban disposal of used electronics in their trash or local landfill, 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, available data suggest that states and localities that do not have landfill bans have dramatically lower levels of recycling than the four states that have enacted landfill bans. In addition, federal regulations provide for neither a financing system for responsible management of used electronics, nor oversight of these products when exported—a particular problem in the case of some developing countries, where risks to the environment and human health may be more likely because of less stringent environmental regulations.

In the absence of a national approach, a patchwork of potentially conflicting state requirements is developing. This patchwork may be placing a substantial burden on recyclers, refurbishers, and other stakeholders. As we conclude our work, we will be examining the implications of our findings for the ongoing efforts among the states to deal with the problem, for the various legislative solutions that have been proposed to create a uniform national approach, and for options the federal government can pursue to encourage recycling and reuse of used electronics.

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 requires federal agencies to procure items that are, to the maximum extent practicable, produced with recovered materials. The Pollution Prevention Act provides 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. It 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 on 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.

Nonetheless, while large-quantity generators, such as businesses, schools, and government agencies, must treat some used electronics as hazardous waste due to the relatively high level of toxic substances, it is not illegal for households or for small quantity generators—non-household entities disposing of less than 220 pounds per month—to dispose of used electronics in landfills in most states. Under RCRA, household hazardous wastes, including used electronics, may be disposed of at municipal solid waste landfills. However, some states have begun imposing more stringent disposal requirements for used electronics. For example, because of concerns regarding the potential environmental and health effects of leaded glass in cathode ray tubes (CRTs), California, Maine, Massachusetts, and Minnesota recently banned them from disposal in municipal landfills.

As national awareness of potential problems associated with the disposal of used electronics has grown, EPA has taken steps to encourage recycling of used electronics. For instance, EPA, together with electronics manufacturers, retailers, and recyclers, sponsored several pilot programs in 2004 to measure the success of convenient collection options for used electronics. Other recent EPA efforts, such as the Federal Electronics Challenge and the Electronic Product Environmental Assessment Tool (EPEAT) program, attempt to leverage U.S. government procurement power to drive environmentally preferable design for electronic products. Finally, through the establishment of the National Electronic Product Stewardship Initiative (NEPSI) in 2001, EPA established a voluntary, multi-stakeholder initiative to reach consensus on a national approach to encourage recycling of used electronics. This voluntary effort ultimately dissolved in 2005 without agreement, however, because stakeholders could not reach consensus on a nationwide financing system.

Volume of Used Electronics and the Problems They Pose

The information we have reviewed to date 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 would become obsolete in 2003—a three-fold increase over the 33 million obsolete computers and monitors in 1997.[2] 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 CRT technology is replaced by new technologies such as plasma screens.[3]

Thus far, it appears that relatively few units 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 annually in U.S. landfills—only a fraction of the amount estimated to become obsolete annually, according to EPA. 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 units that are obsolete (or becoming obsolete), and the quantity either in landfills or sent to recycling centers, suggests that most used electronics are still in storage—such as attics, basements, and garages—and that their ultimate fate is still not certain, 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. Further, 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

[2]National 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.

[3]International 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.

lower levels of harmful elements common to ores, such as arsenic, mercury, and sulfur.[4] The research we have thus far 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 a computer's life can be saved through reuse instead of producing a new unit from raw materials.[5]

Regarding the issue of toxicity, the research we have reviewed to date is unclear on the extent to which toxic substances may leach from used electronics in landfills. On one hand, according to a standard regulatory test RCRA requires to determine whether a solid waste is hazardous and subject to federal regulation, lead (a substance with known adverse health affects) leaches from some used electronics under laboratory conditions. Tests conducted at the University of Florida indicate that lead leachate from computer monitors and televisions with cathode ray tubes exceeds the regulatory limit and, as a result, could be considered hazardous waste under RCRA.[6] On the other hand, the study's author told us that these findings are not necessarily predictive of what could occur in a modern landfill. Furthermore, a report by the Solid Waste Association of North America 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.[7]

[4]Bleiwas, 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 have not yet reviewed this study, this data should be used with caution.

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

[6]Townsend, 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 we have not yet reviewed this study, these estimates should be used with caution.

[7]Solid Waste Association of North America, *The Effectiveness of Municipal Solid Waste Landfills in Controlling Releases of Heavy Metals to the Environment* (2004). Because we have not yet reviewed this study, this data should be used with caution.

Economic 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 often inconvenient locations 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 them to the local landfill. These easy and inexpensive alternatives help explain why so little recycling of used electronics has thus far taken place in the United States. 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. For example, transfer stations in Snohomish County, Washington, charge consumers between $10 and $27 per unit for collecting used electronics and transporting them to recyclers. Moreover, such transfer stations are generally not conveniently located, and rural residents, such as those in Snohomish County, may need to drive more than an hour to get to the nearest drop-off station.[8] 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 the consumer 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

[8]Over 70 percent of the survey respondents felt that existing collection options for recycling used electronics were inconvenient for households.

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.[9]

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 their 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.

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 machinery is being used to process the relatively limited supply of used electronics being recycled in the United States. The firm's officials noted that in Europe, by contrast, where manufacturers are required to take financial responsibility for the disposal of their products, the increased supply of recyclable electronics

[9]This point is further underscored by our interviews with 8 electronics recyclers, who were unanimous in emphasizing that they could not cover costs without charging fees.

has decreased the firm's per-unit processing costs and increased the profitability of recycling used electronics.

Finally, recyclers incur additional expenses when handling and disposing of toxic components (such as batteries) and toxic constituents (such as lead), which are all commonly found in used electronics. These expenses include removing the toxic components and constituents from the product, as well as handling and processing them as hazardous material. Once separated from the product, these wastes are considered hazardous wastes and are 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. Since CRT manufacturing is declining in the United States, some recyclers send their CRT glass to a lead smelter in Missouri that charges recyclers for their CRT glass. 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.[10]

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

To encourage used electronics recycling, EPA sponsored pilot programs that addressed the cost and inconvenience issues. Office Depot and Hewlett-Packard, for example, partnered to provide free take-back of used electronics at Office Depot retail stores. Collected used electronics were sent 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.

[10]Boon, 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). Because we have not yet reviewed this study, this data should be used with caution.

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 little to preclude electronic products generated in the United States from being exported and subsequently threatening human health and the environment overseas. While several promising federal initiatives supporting electronics recycling have been launched, their voluntary nature makes their success uncertain.

Hazardous Used Electronics Are Allowed in Municipal Landfills

Regulation of used electronics at the federal level 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. However, households and small quantity generators are exempt from many RCRA regulations, thus allowing them to deposit their used electronics in municipal solid waste landfills—even though cathode ray tubes 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 it lacks the authority to require environmentally preferable management of used electronics through recycling and reuse or to establish a mandatory national approach, such as a disposal ban. As a result, all of the office's efforts with regard to the recycling of used electronics are voluntary.

In response to RCRA's exemption for household hazardous waste and the growing volume of obsolete electronics within their boundaries, four states—California, Maine, Massachusetts, and Minnesota—recently banned from landfills some used electronics.[11] Our preliminary work suggests that such bans 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 told us that their states have seen substantial increases in used electronics recycling. One international electronics recycler, for instance,

[11]The landfill bans in Maine and Minnesota take full effect in 2006.

set up recycling facilities in the San Francisco area in 2003 because of the large volume of used electronics that were no longer being disposed of in landfills. In Massachusetts, an official with the Department of Environmental Protection told us that six businesses dedicated to electronics recycling were created following the enactment of a landfill ban. Finally, about 75 percent of the survey respondents to date said that a national disposal ban should be enacted to overcome the economic and regulatory factors that discourage recycling and reuse of used electronics.

Experts Believe a National Financing System is Needed to Support Recycling

Given the inherent economic disincentives to recycle used electronics, we found widespread agreement among our survey respondents and others we contacted that the establishment of some type of financing system is critical to making recycling and reuse sufficiently inexpensive and convenient to attract the participation of consumers. For instance, almost 90 percent of survey respondents believe that either an advanced recycling fee (ARF), extended producer responsibility (EPR), or a hybrid of the two should be implemented if national solution is instituted. Yet despite broad agreement in principle, participants in the recent multi-stakeholder 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 for used electronics had sufficient capacity to recycle large volumes, consumers and large-quantity generators 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 20 cents per pound to collectors 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 boundary, however, may prove difficult because the payout for used electronics 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.

While California's ARF focuses on consumers of electronics, Maine's approach focuses on producers. 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 their end of life—a strategy referred to as EPR. 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 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: they must still take their products to a consolidation point, and will still likely have to pay a fee.

Several other states, as well as some countries, 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.[12] 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 manufacturer take-back programs. In Europe, the European Union implemented the Waste Electrical and Electronic Equipment Management Regulations in July 2004, which requires producers of electronic products to be financially responsible for the recycling or reuse of their products at end of life. In our final report,

[12]An 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.

we will provide a more complete examination of various strategies for financing environmentally preferable management of used electronics.

Oversight of Exported Used Electronics Is Limited

The lack of oversight over exports of used electronics could also discourage environmentally preferable management of used electronics. In the United States, businesses, schools, government agencies, and other organizations, as well as households, face multiple options for their used electronics. In some instances, organizations and recyclers receive e-mails from brokers, who typically have partners in Asia, willing to pay them for their used electronics, regardless of whether they can be reused. For example, one broker requests up to 50,000 used monitors per month and does not require the monitors to be tested. Another broker specifically requests nonworking monitors and wanted to fill at least 10 containers, which equals anywhere from 6,000 to 11,000 units, depending on their size. One Seattle area recycler said that brokers such as these are probably not handling the units in environmentally preferable ways once the units are exported. Even so, one business we contacted said it regularly receives e-mail requests such as these.

Companies export used electronics because the largest markets for reused computers and computer parts are overseas, according to an EPA official. Likewise, demand is high for recycled commodities, which can be processed more cheaply due, in part, to lower wages and less stringent environmental requirements. Also, unlike their counterparts in some other developed countries, the United States officials have permitted the export of hazardous used electronics, such as CRT monitors and televisions, if the exporter asserts that the equipment is destined for reuse. While some environmental groups have called for a ban on exports of used electronics, the Congressional Research Service noted that such a ban would cut recyclers off from many of the markets able to reuse the materials.[13]

However, few safeguards are in place to ensure that exported used electronics are indeed destined for reuse.[14] Used electronics that are destined for reuse are not considered to be waste subject to RCRA export regulations. Instead, such electronics are considered to be commodities,

[13]Congressional Research Service, *Recycling Computers and Electronic Equipment: Legislative and Regulatory Approaches for "E-Waste,"* (Washington, D.C.: 2003).

[14]The following are generally not classified as solid wastes under RCRA: Used electronics for reuse, whole circuit boards, shredded circuit boards, if free of certain hazardous materials, metal from used electronics, and scrap metal.

which means that they can be exported with little or no documentation, notification, and oversight. Nonetheless, instances have been recently documented in which environmental and human health threats have resulted from the less-regulated disassembly and disposal of U.S.-generated used electronics overseas. For example, 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.[15] Without the ability to track the exported units to importing countries, or to audit companies exporting used electronics, it is difficult to verify that exported used electronics are actually destined for reuse, or that they are ultimately managed responsibly once they leave U.S. shores. As our work continues, we will further examine the extent of the problems associated with irresponsible management of used electronics overseas.

Opportunities Exist for Federal Initiatives to Enhance Electronics Recycling

The federal government has taken some steps to affirm its commitment to encourage recycling of used electronics through the implementation of two voluntary programs sponsored by EPA. The Federal Electronics Challenge (FEC) and the Electronic Product Environmental Assessment Tool (EPEAT) both leverage U.S. government purchasing power to promote environmentally preferable management of electronic products from procurement through end of life. For example:

- 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 their 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 the end of their useful lives. To date, 11 federal agencies and 26 individual federal facilities participate in the FEC to some extent. The Bonneville Power Administration (BPA) recently documented cost savings associated with its FEC participation. BPA noted, for example, that the program 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 told us

[15]The 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.

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 each monitor's life.

- The EPEAT program promotes environmentally preferable management of electronics by allowing large purchasers, such as government agencies, to compare and select laptop computers, desktop computers, and monitors with environmentally preferable attributes. For example, EPEAT evaluates an electronic product's design 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. EPA expects EPEAT to be instituted in 2006, and products with higher environmental ratings could receive preferred consideration in federal procurement decisions.

While we will continue to examine the FEC and EPEAT programs in greater detail, including how stakeholders say they might be improved, our preliminary work suggests that the federal government can build on these initiatives by using its purchasing power to lead markets for electronic products in environmentally friendly directions. In fact, there is ample precedent for such a strategy, perhaps most notably in EPA's and the Department of Energy's Energy Star program. In that program, the federal government partners with industry to offer businesses and consumers energy-efficient products that ultimately save money and protect the environment. 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. Part of Energy Star's success can be attributed to federal actions, particularly those outlined in two executive orders that required federal agencies to purchase products equipped with Energy Star features. Since the federal government will spend over $60 billion on information technology products in fiscal year 2005, including televisions, computers, and computer monitors, it could go beyond the voluntary and limited FEC and EPEAT programs by broadening the programs' scope and requiring agency participation in, or adherence to, some of the programs' key practices. As with the Energy Star program, such actions may lead to cost savings and greater environmental protection. Of particular note, over

80 percent of the survey respondents to date said that federal government procurement criteria along the lines of FEC and EPEAT should be required, and about 95 percent of the survey respondents to date said that such procurement criteria would encourage environmentally preferable product design, as well as recycling and reuse.

Observations on Federal Actions to Encourage Recycling and Reuse of Used Electronics

In our future work, we will continue to examine factors affecting recycling in greater detail, and the diverse efforts by individual states and others to deal with these issues. It is becoming clear, though, that in the absence of a national approach, a patchwork of potentially conflicting state requirements is developing, and that this patchwork may be placing a substantial burden on recyclers, refurbishers, and other stakeholders. 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. Further, a retailer may have to set up a system in one state to collect fees on specific products and, at the same time, set up a different system in another state to take back a particular manufacturer's product. Hence, manufacturers we contacted said that while they had their preferences regarding, for instance, an ARF or EPR system, their main preference is to operate within a uniform national system that mandates a financing mechanism that preempts varying state requirements. Our preliminary survey results substantiate these views, with over 90 percent of survey respondents indicating that national legislation should be enacted and, if so, almost 90 percent believe a financing mechanism should be included.

Our future work will also discuss some of the options—both legislative and administrative—being considered to encourage environmentally preferable management of used electronics at a national level. Frequently cited options include disposal bans, consumer education programs, a variety of financing systems, export restrictions, and federal government procurement requirements. These options may offer suggestions for a uniform national approach and what aspects should be considered. Additionally, an examination of EPA's voluntary programs—the FEC and EPEAT—may shed light on other, more effective options available to the federal government that can save money over electronic products' life cycle; enhance environmental protection; drive markets for environmentally preferable product design; and establish a recycling infrastructure and markets for recycled commodities.

Finally, with rapid advances in technology, particularly in consumer electronics, new products are reaching the marketplace with remarkable

speed. Consequently, our future work will also examine the implications of these newer generations of electronics entering the nation's waste stream.

Mr. Chairman, this completes my prepared statement. I would be happy to respond to any questions you or other Members of this Subcommittee may have at this time.

Contact and Acknowledgments

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