Public Policies for Solving the E-waste Problem

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The information age has ushered in a new challenge of what to do with electronic waste or "e-waste". The amount of electronic waste generated by developed countries each year is significant and continues to increase. Electronic waste ends up in storage, in landfills, or may be shipped overseas. E-waste has been found to contain a variety of hazardous materials such as lead, mercury, cadmium, barium, and bromine. Of particular concern for environmental policy is what may be happening to tons of electronic waste shipped overseas each year to countries that offer very little protection to people and the environment. This paper describes the nature and extent of the e-waste problem. The paper also compares current public policy approaches in the European Union and the United States in regards to the collection, treatment, recycling, reuse, and financing of e-waste programs. Finally, recommendations are made which strengthen U.S. regulation of e-waste and that minimize negative impacts to people in developing countries and adverse impacts on the environment. These recommendations include:

- *The US government should require that manufacturers reduce the number of hazardous materials in electronic products.*
- *Charge consumers an advanced recovery fee to finance collection and recycling programs.*
- *Encourage collaboration between electronics recyclers and electronics producers.*
- *Expand programs like EPEAT that create a larger market for recycled materials from e-waste.*
- *Ratify and enforce the Basel Waste Trade Ban.*

Together, these policies will bring the US back in step with policy solutions being implemented in other developed countries.

THE ELECTRONIC WASTE PROBLEM

Electronic waste includes devices such as personal computers, computer peripherals, televisions, PDA's, cellular phones, VCR's, DVD players, toys, and many others. The US Government Accounting Office (GAO) estimates that approximately 62 percent of US households had computers in 2003, compared to only 37 percent in 1997 (GAO, 2005). The Consumer Electronics Association estimates that the average US household owns 25 consumer electronics products and the average adult spends $1,200 annually on these products (Consumer, 2007). Other estimates suggest that the US now has more than 180 million computers in use (Taylor, 2006). While market data for the cellular phone industry is relatively secret, industry press releases indicate that worldwide sales of cellular handsets exceeded 1 billion units for the first time in 2006.

The accumulation of electronic devices is driven in part by the fairly rapid rate at which they become obsolete. New computer operating systems emerge every 2 – 3 years. Features are constantly being added to new devices which make them more compact, more versatile, and more compatible with emerging technologies. According to the GAO, "available estimates suggest that over 100 million computers, monitors, and televisions become obsolete each year, and this number is growing" (GAO, 2005).

Several studies indicate that most electronic equipment owned by households is stored at the end of its useful life rather than reused or recycled. There may be several reasons for

this behavior. For example, people may be hesitant to part with something they paid $1000 for only 3 - 4 years after they bought it. Plus, electronic devices have become so personalized that they become part of our daily lives. Some may find it difficult to let go of devices that they have used daily to get their news, communicate with family and friends, or that helped get them through school. Others have privacy concerns. Electronic devices can contain a significant amount of personal data that could be misused if put in the wrong hands. Although collection fees in most places are not expensive for the average household, some still may wish to avoid a $10, $20 or $30 fee by tucking old devices away in storage.

Composition of E-waste

One of the problems with storing computers and other electronic devices is that these devices and their components contain a variety of hazardous materials. Over 1,000 materials, including lead, mercury, chlorinated solvents, brominated flame retardants, PVC, plastics and gases, are used to make electronic products and their components; semiconductor chips, circuit boards, and disk drives (Computer, 2007). A brief description of some of the substances identified as being hazardous by the EPA includes:

Lead – The dangers of lead are well documented. The dangers to humans include damage to the central and peripheral nervous systems, blood system, and kidneys. Lead can be found in the solder used on circuit boards and on the glass panels in computer monitors and television sets.

Cadmium – Cadmium compounds accumulate in the human body, in particular the kidneys. Poisoning can occur from repeated exposures. Cadmium can be found in resistors, semiconductors, batteries, and cathode ray tubes (CRT).

Mercury – Mercury also accumulates in living organisms. It is known to cause chronic damage to the brain. Mercury often settles in bodies of water contaminating the food chain, particularly fish. Mercury can be found in electronic batteries, sensors, relays, and switches.

Brominated Flame Retardants (PBDE) – Concern is emerging over the effects PBDE has on the human endocrine system. PBDE can be found in circuit boards, cables and connectors, and certain other plastic components.

While quantities of each material listed above are relatively small when measured on a per unit basis, when large quantities of e-waste are collected in landfills, established minimum thresholds for hazardous material classification are easily exceeded. Large quantities bring with them environmental, health, and safety hazards. For example, older landfills that do not have protective liners may allow leachate from e-waste to enter groundwater. Large quantities of e-waste also draw the attention of regulators. Several European States and several states within the US have banned e-waste from their landfills. This is the case even though the US and European countries utilize some of the most effective landfill techniques and technologies in the world.

Final Dispositions for E-waste

There are three primary ways that e-waste is commonly disposed of. It can be:

1. Recycled
2. Reused
3. Dumped in a landfill

A description of each disposition and their associated challenges are described below.

Recycling

The International Association of Electronics Recyclers (IAER) reports that 2.8 billion pounds of electronic waste was processed in 2005. Of that amount, the recycling process yielded 1.3 billion pounds of recyclable material (IAER, 2006). According to the IAER, the recycling industry faces several important challenges. First, the market for recycled e-waste is much smaller than markets for other recycled materials. Therefore, the demand for recycled components is low. Second, recycling operations are costly to establish. Equipment prices are high due to a lack of research and development spending as well as the relatively small number of firms producing equipment specially designed for electronics recycling. The variations in size, form factor, and construction of electronic devices make it difficult to develop technologies that could streamline the dismantling process. Until relatively recently, product design did not take into account dismantling and recycling. For example, some recyclers have reported frustration regarding the seemingly excessive numbers of screws securing electronic components to their chassis.

Finally, it is difficult for recyclers to build capacity to keep pace with the growing amount of e-waste in need of recycling. This is particularly true in areas where government has mandated the recycling of e-waste and has not adopted other policies to promote changes in earlier stages of the product life-cycle. Policies that mandate no-cost recycling or that impose a low cap on processing fees charged to consumers make it more difficult for recyclers to recover their costs and build capacity.

Reuse

Electronic equipment may be reused in a variety of ways. Parents may hand older computers down to children for school work, PC's may be donated to charitable organizations, or the owner may find a secondary use such as a back-up unit. Firms have emerged that specialize in restoring and reselling used equipment. They typically operate by making simple modifications such as adding memory to an item and then re-sell it. The rate at which electronic parts become obsolete poses a significant challenge to reuse. Moore's Law, which is applicable to many electronic parts such as hard drives, memory, and semiconductors, suggests that the computing power of new parts doubles every 18 months. At that rate, and because form factors are often not backwards compatible, it is difficult to make modest upgrades and still keep pace with rapidly evolving hardware and software requirements. As is the case with recycled electronic materials, there is not a strong market for used/reusable electronic parts. Low demand for used/reusable parts means that firms that refurbish those parts cannot expect a high rate of return. The other concern with reuse is that it is only a short-run solution. Reuse does not solve the dilemma of what to do with e-waste, it merely postpones the entry of e-waste into the waste stream. Some watchdog groups even

argue that removing reusable parts prior to shipping e-waste overseas robs people in the developing world of the opportunity to reuse the equipment themselves.

Landfills

The U.S. EPA has not published precise estimates of the percentage of e-waste entering the municipal waste stream as of the time of this report. However, preliminary estimates from other sources estimate e-waste to be 1-4 percent of all waste[1] (EPA, 2006). E-waste amounted to over 2.5 million tons in 2003 according to the IAER[2] (IAER, 2007). Research done for this report indicates three primary concerns with adding e-waste to landfills: the loss of valuable natural resources, the release of hazardous materials into the environment, and the non-biodegradable and often bulky nature of the materials. There are technical and public policy solutions that can minimize landfilling impacts. The potential technical fixes are numerous are the subject of separate research.

Exporting Toxics

There are a variety of reasons why E-waste gets shipped abroad. First, the process of dismantling electronic waste is both mechanically difficult and labor intensive. For example, some electronic parts are first sorted according to whether or not they are working. Working parts become available for reuse while non-working parts continue through to the recycling or landfilling process. Currently, sorting and dismantling operations are predominantly accomplished by hand. Cheaper labor in the developing world makes it more efficient for firms to send e-waste there for sorting and dismantling.

It costs money to dismantle and recycle electronic parts in ways that protect the environment and human health. Recyclers can maximize efficiency by shipping e-waste to developing countries that typically do not have the same level of environmental, health, or safety regulations in effect in Europe or the United States.

There may also be loopholes in or inadequate enforcement of existing regulations pertaining to the exportation of e-waste. The IAER acknowledges that some exporters are likely to be sending broken electronics overseas even though on paper, they claim that the devices are destined for reuse. Once the e-waste is at its foreign destination, it is cheaper for importers to landfill non-working equipment than to ship it back to the country of origin.

STAKEHOLDER ANALYSIS

A variety of stakeholder groups have taken positions on their policy preferences in regards to e-waste. A summary of their positions are included below:

Computer Manufacturers – Manufacturers have expressed concern about compliance with the different approaches that are emerging in state legislation. They must increase spending to lobby state governments before laws are passed and spend more to ensure compliance after laws are passed. Manufacturers favor a uniform system of

[1, 2] Data should be used with caution as the methodology behind these estimates was not readily available.

regulation originating at the national level rather than having to comply with 50 different policies.

Federal Government – The federal government has considerable power to influence e-waste regulation. Regulations may take the form of laws passed by Congress, administrative rules enacted by federal agencies, or even executive orders originating from the President. The federal government must weigh each potential policy proposal against existing policies and laws, trade agreements, and international law. Inaction could lead to stress in international relations, environmental problems, and could jeopardize national security.

State & Local Governments – States and municipalities are leading regulatory efforts dealing with e-waste. States have to be concerned about compliance with existing state and federal law on the environment, health, and safety. They also must consider the impact of their actions on neighboring states. States have also developed financing systems for e-waste. Local governments are often responsible for operating collection sites and administering special recycling programs. While progress is being made at the state level, as states become invested in the regulatory scheme they put in place, it may lessen their ability to act collectively towards developing a uniform national policy solution.

Consumers – Consumers should expect the cost of government mandates to be passed to them from the manufacturers at the point of sale. Consumers may also be required to pay for collection or disposal fees when they try to get rid of their used electronics. Consumers represent a large population bloc but they do not appear to be well organized around the e-waste issue. Trend data suggest that consumer demand for electronic devices is inelastic; meaning that there would have to be a significant increase in price before demand declines. These observations make it unlikely that there will be much organized opposition to reasonable e-waste policy.

Retailers – Retailers have two primary concerns. They are concerned about complying with state laws that ban them from selling products from certain manufacturers and state laws that mandate certain labeling requirements. In some states, retailers can be fined for non-compliance. Retailers in California also have to be concerned about collecting Advanced Recovery Fees (ARF). Retailers may not be in support of policies that raise the cost of goods as that might lower consumer demand and decrease their profits. Retailers have the power to influence policy through individual lobbying efforts and those of trade associations.

Recyclers – Recyclers generally favor a market-driven policy approach. They want to encourage investment in the markets for e-waste recycling as well as secondary markets for the recycled products. Recyclers also favor improvements in product design that make the recycling process more efficient. Recyclers can influence policy through lobbying efforts and through trade groups.

CURRENT POLICY APPROACHES

According to the US Technology Administration, over ten countries have legislation regulating e-waste and more are considering legislation (USTA, 2006). The following paragraphs provide an overview of popular policy approaches to regulating e-waste. The regulations described are primarily focused on e-waste, although additional environmental regulations as well as trade or shipping agreements may also apply.

International Law

The Basel Convention was held in 1989 to address the issue of international trafficking in hazardous waste. By 1992, the Basel Waste Trade Ban restricted hazardous waste exports from developed countries to less developed countries. The Basel Ban has been ratified by 63 countries including all of the member states of the European Union. The United States has not ratified the ban (Basel, 2007).

European Union

In 2003, members of the European Union (EU) adopted a directive on waste electrical and electronic waste (WEEE). The directive encourages design changes that facilitate the dismantling and recovery of recyclable materials. The directive specifies rules for the collection, treatment and recovery of e-waste. Included in the directive is a rule that if an exporter sends WEEE out of the EU, "the exporter must prove that the recovery, reuse and/or recycling operation took place under conditions that are equivalent to the requirements of the directive" (EU, 2003). Financing the treatment, recovery, recycling, and disposal of WEEE is the sole responsibility of the manufacturer. Such a system enables consumers to dispose of electronic products free of charge and discourages the long-term storage of WEEE.

United States

Current policy approaches in the United States include a patchwork of federal, state, and local regulations and several voluntary programs. Under the Resource Conservation and Recovery Act (RCRA), the Environmental Protection Agency provides regulatory oversight of the disposal of certain hazardous substances found in used electronic products. RCRA enables the federal government to assign ownership of hazardous waste, regulate the treatment and disposal of hazardous waste, protect human health and the environment, and assign financial responsibility for hazardous waste remediation. RCRA does not apply to households or other entities that generate less than 220 pounds of hazardous waste (GAO, 2005). Therefore, RCRA is effective at regulating large firms but smaller firms and households go unregulated.

The federal government relies on several voluntary programs to encourage e-waste recycling on a smaller scale. These programs include their "Plug-In to eCycling" campaign and the Federal Electronics Challenge. Plug-In to eCycling is a partnership between the EPA and consumer electronic producers and retailers to educate the public about reusing or recycling electronics. The program also creates pilot projects to promote innovation in electronics recycling technology. In 2004, the program was responsible for collecting over 11 million pounds of used electronics in a joint effort with four major retailers (GAO, 2005). The Federal Electronics Challenge (FEC) seeks to have an impact throughout the product life-cycle. The program is designed to help federal agencies purchase greener electronic products,

promote efficient operation and maintenance, and to manage obsolete electronics in an environmentally friendly way. The EPA encourages participation so that the purchasing power of the federal government can be used to increase demand for greener electronic products. The FEC has developed a tool it calls EPEAT that specifies the criteria by which electronic products will be judged to be "green" and assigns each product a rank (gold, silver, or bronze) depending on the number of criteria met by each product. The list of products is published on the Internet so that any consumer can utilize the information[3]. A January 2007 Executive Order by President George Bush mandates that most federal agencies participate in the EPEAT program.

A side-by-side comparison of the U.S. and E.U. approaches to dealing with e-waste appears in Table 1.

Table 1: National Regulations on Electronic Waste.

	National Regulations on Electronic Waste	
	European Union Directive on Waste Electrical and Electronic Equipment (WEEE)	*United States Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA)**
Production	Product design should take into account and facilitate dismantling and recovery.	Federal agencies must utilize EPEAT, but there are no national restrictions on product design.
Consumption	No limits prescribed.	No limits prescribed.
Disposal	Member States are required to adopt measures to prevent WEEE from entering landfills.	Consumers are allowed to dump E-waste into landfills.
Recycling/Reuse	Member States must meet mandatory targets for collection.	No targets have been established for collection.
	Member States shall set up systems that allow WEEE to be returned free of charge.	No national fee structure has been established.
	Producers must establish treatment, recovery, and recycling processes that meet established targets and comply with health, safety, and environmental laws.	Recyclers must comply with health, safety, and environmental laws.
	Producers are responsible for providing at least for the financing of the collection, treatment, recovery, and environmentally sound disposal of WEEE.	No national financing system has been established.
Exportation	Exporters must prove that the recovery, reuse and/or recycling operations in the destination State comply with the WEEE Directive.	Exportation of hazardous waste is allowed upon providing proof that the materials are destined for recovery operations.

*State laws may be more restrictive than federal law.

[3] Additional information about the EPEAT program can be found at: http://www.epeat.net/.

States within the United States

California and Maine are two states that are leading the effort to develop state and local legislation dealing with e-waste. California's approach establishes consumer responsibility for recycling fees, restricts certain types of hazardous substances in electronic equipment, and establishes producer responsibility for disposal of e-waste. In Maine, the financial burden for recycling is shared among electronics manufacturers, municipalities, and consumers. It is hoped that by making manufacturers responsible for those costs, it will create an incentive to make greener products. Maine offers grants to municipalities to help offset their costs, and it is hoped that consumers will reduce consumption to avoid the collection fee. Massachusetts, Oregon, and Washington also have state legislation related to e-waste. The primary critique of state-by-state regulation is that it is inefficient. Manufacturers favor a uniform national system of regulation that preempts state requirements (GAO, 2005). There is also a concern that some state regulations conflict with one another, making compliance more difficult.

There are also voluntary programs being utilized at the state/regional level. For example, the Northeast Recycling Council (NERC) has created the Northeast State Recycling Challenge modeled after the FEC[4]. States are also experimenting with green procurement and purchasing programs that include a mix of required and voluntary provisions.

GOVERNMENT INACTION

Current US policy is not solving the problems presented by e-waste. The accumulation of e-waste in the US and the exportation of e-waste abroad is the result of the US government's failure to act on the issue. For decades, Congress has passed laws and the EPA has engaged in rulemaking on issues related to toxic waste. The power of the federal government to intervene in the e-waste issue should not be disputed. It is likely that e-waste has not been high on the policy agenda. There may be several reasons for this. First, there have been no high profile environmental "mishaps" to draw government's attention. In fact, significant amounts of e-waste are in garages, basements, and office storage rooms where it rarely gets noticed. The problem may also be the result of a lack of information about the issue. European countries began examining the issue in the 1990's but most activity in the US has occurred only in the past ten years. Public policy studies have only emerged in the past 3 years. There is still a lack of reliable data to help determine the extent of the problem.

Externalities

Maintaining a hands-off approach to e-waste at the federal level in the US is leading to several negative externalities. Concerns have been raised by watchdog groups that people in developing countries are being exploited by international trade in e-waste. The Basel Action Network has documented several "digital dumps" in Southeast Asia, India, and Africa where children can be found standing atop mounds of e-waste while they disassemble electronic parts. In the GAO study, they found that foreign brokers in those countries were willing to purchase large quantities of *non-working* electronic equipment (GAO, 2005). The exportation

[4] For more information about the NERC State Electronics Challenge, visit: http://nerc.org/adobe/nsec_fact_sheet.pdf

of non-working electronic equipment suggests that exporters intend to either landfill the items or recycle them using a system of cheap labor and hazardous techniques. Precise export numbers are difficult to locate. One of the criticisms of the current US approach to e-waste is a lack of oversight on e-waste exports, and hence, a lack of statistics about the extent of e-waste exports.

Though the issue has not been mentioned in other e-waste policy analyses, US national security could be at stake when so many electronic devices are shipped overseas. Hard drives, memory cards, and a variety of other magnetic and optical media commonly installed in electronic devices may contain sensitive personal information about their users if not properly wiped prior to disposal. Names, addresses, dates of birth, social security numbers, driver's license numbers and other information could be used to further criminal enterprises abroad or for cyber-terrorism operations.

Digital dumps may threaten already scarce resources in developing countries. Toxic substances accumulating in piles or buried in underground pits will eventually lead to contaminated soil and groundwater. When considering the impact on developing countries, it should not be assumed that e-waste will be disposed of at facilities where advanced techniques and technologies are used.

The current regulatory regime is inefficient. Producers are finding it difficult to navigate the patchwork of federal and state laws. Court challenges to potential conflicts in the law could delay enforcement of existing statutes and delay progress on developing new policy approaches. Court actions would be costly and time consuming for both producers and for the government. States are likely to find that enforcement costs are relatively high. Monitoring interstate transportation of e-waste, enforcing product bans at retail establishments, and ensuring compliance at collection and recycling sites are just a few of the enforcement challenges that need to be funded in some states.

RECOMMENDED POLICY PROPOSALS

Public policy can be used to mitigate the growing e-waste problem at various points within the product life-cycle. The recommendations in this paper can be categorized into three different groups: policies that influence production, policies that influence consumption, and policies that focus on recycling and disposal. All of the recommendations require that the US federal government, rather than individual states, take a larger role in solving the e-waste problem.

Production/Product Design

The US government should require that manufacturers reduce the number of hazardous materials in electronic products. The European Union has adopted the ROHS (Reduction of Hazardous Substances) directive that restricts the use of lead, cadmium, mercury, hexavalent chromium, and brominated flame retardants in electronic products. Producers have already begun to change production processes and materials in order to comply with ROHS. Failure to comply would mean missing out on a multi-billion dollar market. Since a large market for safer products has already been created, producers will have

already spent much of the money needed for research and development. Remaining costs associated with activities such as modifying or replacing equipment, the use of more costly substitute materials, and product labeling will be passed on to consumers.

Some opposition from industry should be expected. To lessen opposition, requirements could be phased in by product type or by establishing increasing minimum percentages of non-toxic outputs over time. The incremental approach is already successfully being used by the federal government in its EPEAT program.

The benefits of mandating non-toxic components include:

- Protection of the environment.
- States can landfill e-waste without accumulating additional toxic substances.
- Minimize negative health, safety, and environmental impacts abroad.

Policies That Influence Consumption

Charge consumers an advanced recovery fee to finance collection and recycling programs. Disposal fees can be a double-edged sword. On the one hand, it is an attractive way to finance collection and recycling operations. If the fees are set too high however, they create a disincentive for individuals to bring their electronics to official collection sites where they can be properly disposed of. The advanced recovery fee (ARF) currently being charged to consumers in California at the point of sale may prove more effective. ARF's don't discourage proper disposal because there is no need to charge another fee at the time of disposal. Also, ARF's add money to the collection/recycling program years before it is needed. Those up-front funds can be used to deal with the cost of collecting and recycling existing e-waste. When coupled with a policy that reduces toxic materials, the cost of disposal should decrease over time. ARF's could be discounted over time or surplus funds can be invested in new recycling technologies.

Consumers are likely to view the fee as an added tax. Government should make the case that the ARF is a shift in the timing of the transaction, not something new that consumers have to pay for. Retailers may object if the fees are high enough to decrease sales or if the fee is difficult to collect. Neither result should be assumed. Given the American appetite for electronic devices in recent years, it is unlikely that a reasonable fee will have a significant impact on consumer demand. The sales tax systems in place across the US provide a model for how the ARF might be collected. The government should strive to make the ARF as easy to collect as the sales tax.

A coercive approach to reducing consumption is not recommended. Based on the rapidly growing number of electronics purchases mentioned previously in this paper, it seems unlikely that US consumers would readily accept restrictions on their liberty to purchase electronics. The decrease in consumer demand as a result of such a restriction might also inhibit the manufacturer's ability to recover the costs of switching to non-toxic products. Such a restriction would be among the most costly and difficult to enforce.

Encouraging Recycling/Reuse

Encourage collaboration between electronics recyclers and electronics producers. As those in the electronics recycling industry have stated, many of the challenges they face can be alleviated by anticipating their dismantling and recycling needs in the design phase of electronic products. Efforts to voluntarily bring recyclers and producers together should be encouraged. Annual summits provide a relatively inexpensive forum for recycling challenges to be discussed and may provide opportunities for innovative product design strategies to be developed. The incentive for producers to participate in such discussions may not be as great as that of electronics recyclers. However, they may work collaboratively if they see it as an opportunity to avoid policies like Maine's where producers are held financially responsible for the cost of recycling.

Expand programs like EPEAT that create a larger market for recycled materials from e-waste. The US government should continue to encourage the use of recycled materials in new electronics through programs like EPEAT. States may also wish to mandate EPEAT criteria for state government purchases. Such a move would create a larger market for recycled electronic materials and make the recycling industry more profitable.

Enforcement/Oversight

Ratify and enforce the Basal Waste Trade Ban. As the GAO suggests in its 2005 report, the US has not put sufficient effort into monitoring e-waste bound for overseas destinations. Even if electronics manufacturers begin producing non-toxic products in the near future, there will still be massive amounts of legacy waste that needs to be disposed of in an environmentally friendly and safe manner. President Bush and Congress should follow the lead of other developed countries and ratify the Basel Ban. The argument that preventing international trade in hazardous waste will hurt the US economy should not outweigh the social cost to poor countries. If the market for recycled electronic materials can be stimulated using the aforementioned policies, the economic argument is weakened even more over time.

If political, philosophical, or other reasons make ratification of the Basel Ban unlikely, the US Department of Commerce and the EPA could require that e-waste shipped overseas be handled using methods similar to those already required in the US. This would help safeguard human health and safety as well as preserve fragile resources overseas. The EU has already implemented this approach. The EU has found it to be difficult to enforce. Once e-waste is shipped overseas, the country of origin does not usually have the authority to oversee foreign recycling operations. Therefore, the most effective option is to ratify the Basel Ban.

CONCLUSION

A large international problem such as the safe and environmentally responsible disposition of e-waste requires an effective national policy. Even though the benefits of producing non-toxic electronics and disposing of them in an environmentally responsible manner are self-evident, there is little evidence to suggest that those activities will occur without some encouragement from government. There are economic, technical, and social challenges that are not being resolved efficiently within the current regulatory framework. The recommendations offered in this paper will help the US catch up with other developed

countries who have taken the lead on the e-waste issue by facilitating the efficient design and recycling of electronic products and preventing some of the negative externalities that are worsening in developing countries.

Resources

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