ELECTRONIC WASTE: CAN THE NATION MANAGE MODERN REFUSE IN THE DIGITAL AGE?

HEARING

BEFORE THE

COMMITTEE ON SCIENCE AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

ONE HUNDRED TENTH CONGRESS

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ELECTRONIC WASTE: CAN THE NATION MANAGE MODERN REFUSE IN THE DIGITAL AGE?

WEDNESDAY, APRIL 30, 2008

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The Committee met, pursuant to call, at 10:00 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Bart Gordon [Chairman of the Committee] presiding.

BART GORDON, TENNESSEE
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Hearing on

Electronic Waste: Can the Nation Manage Modern Refuse in the Digital Age?

Wednesday, April 30, 2008
10:00 a.m. to 12:00 p.m.
2318 Rayburn House Office Building

Witness List

Dr. Eric Williams
Assistant Professor of Civil and Environmental Engineering
Arizona State University

Mr. Gerardo Castro
Director of Contracts and Environmental Services
Goodwill Industries of Southern California

Ms. Renee St. Denis
Director of America's Product Take-Back and Recycling
Hewlett Packard Company

Mr. Eric Harris
Associate Counsel and Director of Government and International Affairs
Institute of Scrap Recycling Industries

Mr. Ted Smith
Chair
Electronics Take-Back Coalition

Mr. Michael Williams
Executive Vice President and General Counsel
Sony Electronics Incorporated

HEARING CHARTER

COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

Electronic Waste: Can the Nation Manage Modern Refuse in the Digital Age?

WEDNESDAY, APRIL 30, 2008
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

On April 30, 2008 the Committee on Science and Technology will hold a hearing on the management of waste electronic equipment (e-waste) in the United States. Witnesses will discuss industry practices for recycling, refurbishment, re-sale and disposal of electronic products and the challenges associated with end-of-life management of electronic products.

The hearing will also examine the potential of research and development in green design efforts to make recycling easier and decrease the amount of toxic material used in electronic products, as well as in creating frameworks for understanding the economic and environmental impacts of reuse and recycling.

The Committee will hear testimony from six witnesses offering perspectives from the electronics manufacturing sector, the recycling industry, a non-profit service provider and academic research and development.

Witnesses

- **Mr. Gerardo Castro** is the Director of Contracts and Environmental Services, Goodwill Industries of Southern California, Los Angeles, California. Mr. Castro will discuss the scope and magnitude of e-waste in this country, as well as the volume of electronic products received by Goodwill Industries annually and their product recycling, refurbishing, and re-sale operations.
- **Ms. Renee St. Denis** is the Director of America's Product Take-Back and Recycling for Hewlett-Packard Company. Ms. St. Denis will discuss the origin and history of HP's take-back and recycling program and how it has influenced product design. She will also discuss, from HP's perspective, the types of innovations that are needed to promote electronic product recyclability and the increased use of recycled materials.
- **Mr. Eric Harris** is the Associate Counsel and Director of Government and International Affairs for the Institute of Scrap Recycling Industries (ISRI). Mr. Harris directs ISRI's waste policy operations and will discuss the challenges faced by e-waste recyclers as well as recycling best-practices. He will also discuss the amount of e-waste that is recycled in the U.S. versus the amount that is exported.
- **Mr. Ted Smith** is the Chair of the Electronics Take-Back Coalition. Mr. Smith will discuss the evolution of the e-waste problem, the advantages and disadvantages to product reuse, and the type of research and development initiative needed to foster more environmentally-friendly electronic products.
- **Mr. Michael Williams** is the Executive Vice President and General Counsel for Sony Electronics Incorporated. Mr. Williams will discuss Sony's approach to the electronic waste issue and whether their efforts in end-of-life management have influenced product design. Mr. Williams will also discuss, from Sony's perspective, the types of innovation needed to promote electronic product recyclability and increased use of recycled materials.
- **Dr. Eric Williams** is an Assistant Professor of Civil and Environmental Engineering at Arizona State University. His research focus is industrial ecology, life cycle assessment, and macro assessment of supply and demand. Dr. Williams will discuss the environmental impacts associated with the manufacturing of electronic products, the challenge in tracking the reuse and recy-

cling industry, and options for reducing the environmental impacts of this industry.

Background

Electronic waste (e-waste) is the term used to describe electronic products at the end of their useful lives. This includes: computers, televisions, VCRs, stereos, printers, cell phones, fax machines, copiers, and other commonly used electronic products. The use and production of these products is integral to the digital age and our economy. However, due to product failure or the desire to purchase more advanced technology, the number of discarded electronic products is rapidly increasing. Indeed the lifespan of some of this equipment is as short as 18 to 24 months. The National Safety Council[1] estimated that over 499 million personal computers became obsolete between 1997 and 2004 and the Government Accountability Office estimates that 100 million televisions, computers, and monitors become obsolete each year.[2] With the fast rate of technology improvement and the rate that many industrializing countries will soon also be discarding large numbers of used electronics, the volume of e-waste globally stands to grow substantially.

There currently is no specific federal law or regulation governing the disposal of consumer electronic products in the United States. In 2000, the National Electronic Products Stewardship Initiative (NEPSI) brought stakeholders together in an effort to create a consensus on the shape of a national e-waste management framework. This process stalled in 2004 when stakeholders could not agree on a financing mechanism for a product take-back system. Due to the presence of toxic materials like lead and mercury, several states now mandate end-of-life electronic product management. The patchwork of State laws has many in industry now turning to the Federal Government for a national framework that will harmonize the different State laws.

Thirteen states have e-waste laws. California implemented a program in 2005. Maine, Washington and Minnesota implemented e-waste programs in 2007, and other states with legislatively mandated programs will bring those programs online in the near future. Many electronics producers and retailers now offer some type of product take-back service. Despite this progress, the EPA estimates that at most only 15 percent of products at the end of their useful lives reach a recycling or reuse program. Cell phone producers, who have one of the most established take-back programs and whose product is easy for the consumer to return, only recapture a fraction of the phones they sell. According to the EPA, about two million tons of unwanted electronics end up in landfills or incinerators on average, while only 345,000 tons were "recycled."[3] Many producers, recyclers, and experts site consumer behavior and the logistics of gathering large volumes of waste as a major hurdle to cost-effective recycling.

Waste Management Issues

When properly handled, used electronic products can be a valuable source for reusable equipment or secondary feedstock. However, when not properly handled, studies show that the components of these items can be sources of toxins and carcinogens. Cathode ray tubes (CRTs), the glass picture tubes found in some televisions and computer monitors, contain approximately five to eight pounds of lead, chromium, nickel, and zinc. Circuit boards also contain considerable quantities of lead-tin solders and are likely to leach into groundwater or be emitted in gaseous form if destroyed in an incinerator. Up to thirty-eight separate chemical elements are incorporated into electronic waste items.

In addition to concerns about pollution and volume regarding disposal of these products in landfills, electronic equipment also contains valuable resources. The U.S. Geological Survey estimates that scrap electronics contain significantly higher concentrations of copper, gold, and other metals than an equivalent weight of a typical ore. The recovery of the metals in e-waste decreases the need for virgin materials and lessens the impact on the environment that extraction of those materials represents.

It is also important to consider that even with an increased content of recovered materials, the production of electronic products carries a significant environmental footprint. Rapidly changing production methods and a scarcity of current data make

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[1] National Safety Council, *Electronic Product Recovery and Recycling Baseline Report: Recycling of Selected Electronic Products in the United States,* Stanford Resources, Inc. (1999).

[2] Government Accountability Office, *Electronic Waste: Strengthening the Role of the Federal Government in Encouraging Recycling and Reuse,* November (2005).

[3] Environmental Protection Agency, *Management of Electronic Wastes in the United States,* November 2007. *http://www.epa.gov/ecycling/*

accurately assessing product life cycle difficult. Microchip fabrication, circuit board and component manufacturing, and the production of plastics, metals, glass, and the specialized chemicals used in the electronics industry have high energy and water requirements and require the use of chemicals that are harmful to human health and the environment. Many producers have made strides in increasing the efficiency and lessening the impact of manufacturing, but the entire life cycle of electronics still has a significant environmental footprint.

Obsolete devices from industrialized countries can find their way to developing countries, where old computers and cell phones are often used for a few more years or processed for disposal. High disposal costs and landfill fees in the developed world have conspired with low labor costs and lenient health and environmental regulations in the developing world to create an incentive to export used electronic products to nations like China and Nigeria. Some of these products are received for legitimate refurbishment and reuse, but an overwhelming quantity has no reuse value and is improperly and unsafely recycled or landfilled. Primitive recycling creates health hazards for the laborers and environmental problems for their communities. According to the Basel Action Network (BAN), approximately 80 percent of the e-waste directed to recycling in the U.S. is not recycled, and instead finds its way overseas. There is no universally accepted standard to qualify a product for reuse.

Many recyclers are environmentally responsible and health and safety conscious, but there are still numerous "sham" recycling operations that engage in harmful practices, particularly with regards to export. Stakeholders are working with the EPA to create a set of best practices for environmental management in electronics recycling, but there currently is no one universally accepted standard for electronics recycling. Electronics "recycling" can also be a misleading characterization of practices, since most of the material recovered from the product, in particular the plastics and the glass, is not reused directly in the electronics industry, and much is fated for incineration (i.e., fuel for smelters and furnaces).

The U.S. is behind many other countries in confronting the e-waste challenge. The European Union (EU) took action in 2000 by passing the Waste Electrical and Electronic Equipment Directive (WEEE), which bans the disposal of e-waste in landfills and requires electronics producers to take back their used products. The WEEE Directive imposes the responsibility for the disposal of e-waste on the manufacturers. Part of the impetus for this policy was the theory that giving the producers the responsibility of recycling their own products would encourage them toward greener designs and products that are more easily recycled. It is too soon to assess whether these disposal laws have motivated producers to adopt greener designs. However, the EU Restriction of Hazardous Substance (RoHS) Directive banning the import of electronics with toxics like lead and cadmium has motivated the use of greener materials in electronics sold around the world.

Recognizing the need to find better end-of-life management for these products, the EPA and many producers, retailers, State and local governments have been working to improve the awareness of the need for recovery of electronics and access to safe reuse or recycling options. This is a national problem and there is a need for standards and safeguards for environmentally sound disposal practices that strike a balance between manufacturer and consumer responsibility.

Chairman GORDON. This hearing will come to order. Good morning and welcome to today's hearing entitled *"Electronic Waste: Can the Nation Manage Modern Refuse in the Digital Age?"*

I would like to welcome our panelists, who will share with us their views on the end-of-life management of the electronics that we all use and enjoy every day.

Let me also point out that it appears we are going to have a joint session later on, which is going to unfortunately make us either have to finish up before or come back after, so we hope—I want you all to know that this is the start of this very important process and we will deal with it when the time comes.

This nation started on the path that brings us here today in the 1940s when we began producing and buying televisions. By the 1960s, about 60 million American homes had TV sets. By last year, we were over 250 million. In the 1980s we began to acquire home computers and businesses, universities and schools invested in personal computers. Between 1986 and 1990, around 28 million personal computers were sold in the United States and by 2000 that number had more than doubled.

We all own and use these electronic products—TVs, computers, cell phones, MP3 and DVD players, but we rarely stop to think about what happens to all these products once we are finished with them.

Today the amount we have to dispose of is in the billions. We know that many of these products end up in our landfills or are sitting in our attics and storage closets because we aren't sure what to do with them. Innovation in the electronics industry has produced staggering advances and I don't think anybody would want to turn back the clock on this progress. But if we could turn the clock back on something else, we would want to ask the engineers who began using lead in televisions to shield viewers from the X-rays and ask, "How can we come up with something better?"

Because now in 2008, with the transition to digital TV signals fast approaching and better technology on the market, we have millions of televisions and monitors with untold tons of lead heading to the landfills. And these old products also contain toxins like mercury and cadmium.

Fortunately, there is a growing awareness of recycling and going green. As we will hear today, e-waste is not just trash. These products contain precious materials like gold and copper, and it doesn't make sense to put gold in a dump.

Over a dozen states now have legislation mandating proper e-waste disposal and many electronic producers now offer take-back services. However, it is estimated that only 10 to 15 percent of these products reach recyclers. Clearly, much needs to be done to educate consumers about recycling and to make sure everyone has access to recycling.

But raising awareness is not the only thing that can be done to tackle our growing pile of e-waste. Today we will also hear about opportunities to design products to avoid end-of-life problems and to make product recycling more efficient and economically attractive. We must seriously look at the issue of reuse and help find ways to safeguard against its downstream problems.

We must also develop methods to adequately access the economic and environmental impacts of e-waste and policies to manage it.

This is a problem of global proportions. Technology and innovation have as much a role to play in solving it as they did in creating it. We don't want to stifle the innovation that has put the computing power of a room-sized mainframe into the palm of our hand, but we want to go forward with enough information and foresight to ensure that these modern marvels are not modern environmental problems.

[The prepared statement of Chairman Gordon follows:]

PREPARED STATEMENT OF CHAIRMAN BART GORDON

Good morning and welcome to today's hearing on electronic equipment waste (e-waste) in the United States.

I would like to welcome our panelists who will share with us their views on the end-of-life management of the electronics that we all use and enjoy everyday.

This nation started on the path that brings us here today in the 1940s when we began producing and buying televisions. By 1960, about 60 million American homes had TV sets. By last year, we were over 250 million.

In the 1980's we began to acquire home computers and businesses, universities and schools invested in personal computers.

Between 1986 and 1990, around 28 million personal computers were sold in the U.S. By 2000, that number had more than doubled.

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Innovation in the electronics industry has produced staggering advances and I don't think anybody would want to turn the clock back on that progress.

But if we could turn the clock back on something, we would want to ask the engineers who began using lead in televisions to shield viewers from x-rays and ask, "Can we come up with something better here?"

Because now in 2008, with the transition to digital TV signals fast approaching and better technology on the market, we have millions of TVs and monitors with untold tons of lead, headed to landfills. And these old products also contain other toxins like mercury and cadmium.

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We don't want to stifle the innovation that has put the computing power of a room-sized mainframe into the palm of our hand, but we want to go forward with enough information and foresight to ensure that these modern marvels are not a modern environmental problem.

Chairman GORDON. And now I would like to recognize Mr. Hall for an opening statement.

Mr. HALL. Mr. Chairman, thank you, and you adequately stated it. I will be more brief than you were. You have covered the subject. You wonder where a lot of the e-waste is going to wind up. You know, mine winds up just as far as I can throw it every now and then, and my grandchildren get tired of me telling them I can take a Big Chief tablet and cedar pencil and figure out anything you all can if you give me enough time.

It is an unusual panel, Mr. Chairman, and I really expect to get some good information from them, and I am pleased that we are having the hearing. E-waste is the unintended consequence of a high-tech industry that has grown substantially since its beginning in the second half of the 20th century, and although consumer electronics comprise less than two percent of the municipal solid waste, it is really one of the fastest growing waste, I guess streams, if you want to call it that, in the United States. According to the EPA, less than 20 percent of the e-waste is now recycled. Advancement in the consumer electronics field helped create this growing amount of e-waste as electronics rapidly become obsolete.

There are a lot of aspects to the e-waste dilemma: the definition of e-waste, the reuse and recycling of electronics, landfill disposal and hazardous waste, regulatory issues and export economies. The complexity absolutely creates a vast array of opinions on possible solutions to the problem. Today's panel is well suited to help us explore the options before us from recycling of e-waste to better design that will minimize the problem in the future.

The House has passed H.R. 2850, which is the *Green Chemistry Research and Development Act of 2008,* authored by my friend, Dr. Gingrey. I think this legislation was a step in the right direction, and like I said on the House Floor at the time of its passage, advances in the research and development of green chemicals and products will reduce the creation of substances that are harmful to our environment. This certainly applies to the problems with e-waste.

I look forward to hearing from the panel today. I yield back my time, Mr. Chairman.

[The prepared statement of Mr. Hall follows:]

PREPARED STATEMENT OF REPRESENTATIVE RALPH M. HALL

Thank you, Mr. Chairman. I am pleased we are having this hearing today. Electronic waste, or e-waste, is the unintended consequence of a high-tech industry that has grown substantially since its beginning in the second half of the 20th century. Although consumer electronics comprise less than two percent of municipal solid waste, it is one the fastest growing waste streams in the United States. According to the EPA, less than 20 percent of e-waste is now recycled. Advancements in the consumer electronics field help create this growing amount of e-waste as electronics rapidly become obsolete.

There are many aspects of the e-waste dilemma: the definition of e-waste; reuse and recycling of electronics; landfill disposal and hazardous waste; regulatory issues and export economies. This complexity creates a vast array of opinions on possible solutions to these problems. Today's panel is well suited to help us explore the options before us, from recycling of e-waste to better design that will minimize the problem in the future.

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I look forward to hearing from the panel today about this important issue. I yield back the balance of my time.

Chairman GORDON. Thank you, Mr. Hall.

If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point, and with unanimous consent, Mr. Hall, I will ask for that at the end of this hearing too in case there are other folks that would like to ask questions.

[The prepared statement of Ms. Johnson follows:]

PREPARED STATEMENT OF REPRESENTATIVE EDDIE BERNICE JOHNSON

Thank you. I am glad to see that this committee is addressing the issue of electronic waste.

Electronic products at the end of their usability must either be thrown away or recycled. Some electronics contain mercury, lead, cadmium or other toxic materials.

Today's hearing will be valuable because we have a variety of witness perspectives on this issue.

The Committee will hear testimony from witnesses offering perspectives from the electronics manufacturing sector, the recycling industry, non-profit service provider, and academic research and development.

This is actually an international issue. High disposal costs and landfill fees in the developed world have conspired with low labor costs and lenient health and environmental regulations in the developing world to create an incentive to export used electronic products to nations like China and Nigeria.

Our nation needs a uniform standard for recycling and appropriate disposal of electronic waste.

It is wrong to leave an environment of mercury, lead and cadmium for our grandchildren to clean up.

According to the Basel Action Network (BAN), approximately 80 percent of the e-waste directed to recycling in the U.S. is not recycled, and instead finds its way overseas.

There is no universally accepted standard to qualify a product for reuse.

I see a role for the Federal Government to play.

I will be particularly interested to know of the electronics industry's recommendations of how to develop an economical, uniform policy that is not harmful for our environment.

Again, welcome to our witnesses. Mr. Chairman, I yield back the remainder of my time.

[The prepared statement of Mr. Carnahan follows:]

PREPARED STATEMENT OF REPRESENTATIVE RUSS CARNAHAN

Mr. Chairman, thank you for hosting this important hearing on managing electronic waste in the United States.

The digital era provides us with useful technological advances, but with it comes the alarming result that our nation has already disposed of millions of electronic products and will continue to in the coming years. These electronics contain lead, mercury, and other harmful substances that, unless properly disposed of, can contaminate our environment and present health dangers to our citizens. I believe it is our responsibility to examine how we can best encourage the manufacture of electronic products while keeping the total cost of their life cycle, including the ultimate disposal, in mind. I look forward to hearing more from our witnesses on that subject.

In my own office, last year we transitioned staff to TV cards on our computers, enabling us to watch the House Floor without losing desk workspace. We've also been fortunate enough to install teleconferencing between my district office and my DC office via a flat screen, enabling me to hold meetings with constituents when I must be in Washington voting and appearing in committee. Our office is a prime example of many, many other businesses and households across the Nation. Our new technologies help me to do my job better. Yet, multiple television sets with Cathode ray tubes (CRTs) reside in a storage area. The disposal of CRTs is a pressing issue, particularly with the upcoming digital conversion.

I would like to thank today's witnesses, Mr. Castro, Ms. St. Denis, Mr. Harris, Mr. Smith, Mr. Williams, and Dr. Williams, for coming before the Committee. Mr. Harris, I'm pleased to tell you that one of your active Members is a constituent of

mine who has kept me informed of these issues. I will be sure to tell him that you appeared before us. I look forward to hearing all of our witnesses' testimonies.

[The prepared statement of Mr. Mitchell follows:]

PREPARED STATEMENT OF REPRESENTATIVE HARRY E. MITCHELL

Thank you, Mr. Chairman.

As American consumers attempt to keep up with the latest technology trends by purchasing the newest cell phones and laptops, the number of discarded electronic products is rapidly increasing.

When electronic products are properly handled, these products can transform into a valuable source for reusable equipment.

However, if these products are not disposed of properly, they are potentially harmful to both human health and the environment.

Currently, there are no federal regulations in place for the appropriate disposal of electronic waste (e-waste).

I look forward to hearing from our witnesses about potential practices for handing e-waste.

I want to extend a special welcome to Dr. Eric Williams, a Professor from Arizona State University, for testifying here today. Dr. Williams has focused his research on the environmental impacts of e-waste, and I look forward to his testimony.

I yield back.

Chairman GORDON. As you can see, things are relatively crowded up here so we have staff both in the anterooms that are watching—this is being televised—as well as other Members who are also watching. So we welcome your testimony, and at this time I would like to introduce our witnesses.

Dr. Eric Williams is Professor at Arizona State University. He holds a joint appointment in the Department of Civil Engineering and the School of Sustainability. Mr. Gerardo Castro is the Director of Environment Services for Goodwill Industries of Southern California. Ms. Renee St. Denis is Hewlett Packard's Director of Product Take-Back and Recycling Services for America. Mr. Eric Harris is Associate Counsel and Director of Government Affairs for the Institute of Scrap Metal Recycling, and Mr. Ted Smith is the Chairman of the Electronics Take-Back Coalition. And finally, Mr. Michael Williams is the Executive Vice President and General Counsel for the Sony Corporation.

Our witnesses should know spoken testimony is limited to five minutes each, after which the Members of the Committee will have five minutes each to ask questions. We will start with Dr. Williams.

STATEMENT OF MR. ERIC D. WILLIAMS, ASSISTANT PROFESSOR, DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING AND SCHOOL OF SUSTAINABILITY, ARIZONA STATE UNIVERSITY

Mr. ERIC WILLIAMS. Chairman Gordon and other Members of the Committee, it is my pleasure to be here today to testify. Management of end-of-life of electronics is a new challenge. One reason is the rapid evolution of technology. While new electronic products like computers and cell phones have as long a potential lifespan as traditional white goods, in practice they are considered obsolete very soon and replaced with new models. These discards are our e-waste.

A second distinction is that the environmental intensity of manufacturing electronics is comparatively high. For example, it takes four times more energy to make a desktop computer than it con-

sumes while plugged in at home. In contrast, for a refrigerator, most of the energy is used in operation. Manufacturing is a small share. Surprisingly, a computer's annual energy costs are higher than for a refrigerator if one includes manufacturing. Extending electronics' lifespans thus could be an important strategy to mitigate environmental impacts. This does not mean that we should try to make do with slide rules or pocket calculators. Rather, robust markets for used electronics can help ensure that functions are well matched with the needs and wants of users.

A third challenge is how to manage substances of concern in electronics such as lead and brominated flame retardants. Much of the environmental concern concerning e-waste is about the potential for lead and other heavy metals to leach from e-waste in landfills. Circuit boards and cathode ray tubes are classified as hazardous waste because they fail EPA's TCLP leaching risk test. My colleagues and I at Arizona State University recently reviewed the literature, and our conclusion was that the risk of leaching from sanitary landfills is very small, if not negligible. The main reasons for this are, one, the TCLP test is considerably more aggressive than the leaching that actually occurs in landfills, and two, modern landfills have control systems to contain toxics that may leach out. In contrast, there is as yet no evidence that modern recycling of circuit boards and CRTs is environmentally preferable to landfilling.

A fourth challenge is that the reuse and recycling of electronics is often a net cost in the United States but in the developing world is a profitable business because the developing world has lower labor costs, higher demand for reused products and parts, and lower environmental protection. This results in substantial export of end-of-life electronics from the United States and other developed countries to developing countries.

The electronics reuse and recycling industry is a double-edged sword for the developing world. On one hand, reuse markets provide access to technology which people could otherwise not afford. Low-cost computers and cell phones in particular enhance education and economic development. The recycling and refuse industry employs thousands of people. On the other hand, the recycling of electronics is often done in developing countries via an informal industry. It is, in my opinion, by far the most serious environmental problem associated with end-of-life electronics. Yet there is as yet little action taken to improve health and safety conditions in this industry.

I believe that it is important we work toward electronic product solutions and policies which aim at triple bottom-line solutions: environmental, economic, and social benefits. While it is tempting to focus only on environmental issues, some environmental options have negative economic and social impacts for disadvantaged groups leading to complex ethical choices. We need to understand the tradeoffs between different options.

An important part of moving forward is understanding what is really going on with reuse and recycling. One reason for the current lack of information is that reuse and recycling activities do not have their own industry or commodity codes and thus are invisible to conventional statistics. Considering product design, using and developing alternate materials is an important strategy but it is

important to note that even a computer free of toxic substances would still be dangerous to recycle informally. Many of the toxics are generated or used in the recycling processes themselves.

The design of information systems for products is much less discussed but I think one of the major untapped opportunities to improve reuse and recycling. One idea is to place a radio frequency identification device into a computer to act as a black box, periodically recording the functionality of different systems. At the end-of-life, a computer arriving at a processing facility could be remotely scanned to test functionality and classify it for reuse versus recycling. There are many other possibilities.

To sum up, I am concerned that current policy direction around the world may not take us in the direction we want to go. I believe the United States should take a leadership role. Here are some suggested directions: one, investigate the pros and cons of different landfilling and recycling technologies to establish best practices; two, promote reuse domestically and abroad; three, cooperate with the developing world to mitigate the impacts of informal recycling; and four, while the public discourse on electronics in the environment focuses on end-of-life issues, information technology has many important environmental applications which we should not neglect or ignore.

So I and my colleagues at Arizona State University would like to thank you for your attention.

[The prepared statement of Mr. Williams follows:]

PREPARED STATEMENT OF ERIC D. WILLIAMS

Chairman Gordon and other Members of the Committee, it is my pleasure to be here today to testify on the topic of end-of-life electronics. My name is Eric Williams and I am an Assistant Professor at Arizona State University with a joint appointment between the Department of Civil and Environmental Engineering and the new School of Sustainability.

The fate of end-of-life of electronics, also known as e-waste, has gained a great deal of attention from policy-makers and public around the world. The chain of activities from manufacturing to operation to disposal is highly globalized and continues to globalize further. Policy decisions taken here in the U.S., in Europe, in China have global implications for the industries involved in electronics manufacturing and end-of-life. Here in the U.S. some states such as California and Maine have already developed and implemented State-level legislation mandating recycling of end-of-life electronics. Given the importance of the electronics industry both in the U.S. and globally, I believe it important that the U.S. Government takes a leadership role in developing responsible policies and practices for managing e-waste. In my testimony I intend to lay out one view of how this nation might work towards sustainable management of end-of-life electronics.

End-of-life electronics: a unique challenge

First I will discuss how management of end-of-life electronics is a unique new challenge compared to previous products. One reason is the rapid evolution of electronics technology. Rapid progress goes hand-in-hand with rapid obsolescence, which has two main implications for environmental management. One is that it stimulates purchases of new devices as consumers aim to take advantage of improved technology. A second is that the characteristics of the waste stream evolve along with the product.

A second reason is that the environmental intensity of manufacturing electronics, in particular information technology goods, is higher than many other consumer products. For example, it takes four times more energy to make a desktop computer than it consumes while plugged in at home. For a refrigerator, in contrast, most energy is used in operation, the energy used in manufacturing is a small share. This high energy intensity in manufacturing combined with rapid product turnover implies a surprisingly high net impact: when the energy used in manufacturing is am-

ortized over the life of the product, annual energy costs for owning a personal computer are higher than for a refrigerator.

How does this high environmental intensity of manufacturing tie in with the e-waste issue? Reduce, reuse, recycle, or the 3Rs, is a mantra of waste management. However, most of the environmental investment in high-technology electronics is in not in the materials but is in its complex manufactured form. Recycling is less effective at recovering this investment than for many other goods (e.g., an aluminum can). While appropriate end-of-life management is needed, the high environmental investment in form versus materials in electronics tilts the 3Rs such that Reduce and Reuse tend to be much more effective than recycling at reducing life cycle environmental impacts. Extending lifespan is thus an important strategy to mitigate environmental impacts. Extending lifespan does not mean that we should make do with slide rules or pocket calculators! Rather, we should work to match the performance specs of hardware with actual needs of users, for example with reuse markets.

A third reason e-waste management poses a unique challenge is the mix of materials used in making electronics. Electronics contain valuable materials for recycling such as copper, silver and gold as well as known toxic substances such as lead, cadmium and mercury. There are also new substances of concern: for instance, brominated flame retardants are added to circuit boards and cases to reduce flammability. Recent scientific studies show that some brominated flame retardants are endocrine disruptors and that their concentrations in human tissues are rapidly increasing. While the human health and environment effects of brominated flame retardants are uncertain, I believe there is enough evidence to justify concern and response.

Much of the environmental discourse surrounding e-waste centers around the concern that lead and other heavy metals could leach from e-waste put into landfills and contaminate ground water. Circuit boards and Cathode Ray Tubes (CRTs) fail the EPA's Toxicity Characteristic Leaching Procedure (TCLP) test, resulting in these items being classified as hazardous waste. The TCLP test involves grinding up the material in question, putting it into an acidic solution and measuring the amount of material (such as lead) that seeps out. My colleagues and I at Arizona State University recently reviewed the literature relevant to the actual risk of heavy metals leaching from e-waste in sanitary landfills in the U.S. Our conclusion was that the risk of environmental harm from landfilled e-waste is negligible, despite the failure of the TLCP test by some electronic components. The main reasons for this are: 1. that the TCLP tests are considerably more aggressive than the leaching that actually occurs in municipal (non-hazardous) waste landfills and 2. modern landfills have control systems to contain any toxics which may leach out.

Is modern recycling of circuit boards and CRTs actually environmentally preferable to putting these parts in sanitary landfills? We argue that this is not known and that it is conceivable that recycling could emit more toxic heavy metals over the life cycle. Recycling by definition mobilizes materials (e.g., via smelting), and depending on the level of process control can emit lead, mercury, and other hazardous substances. In contrast with landfills however, recycling has the virtue of replacing production of virgin materials with recycled substitutes. If the avoided lead emissions associated with mining and milling are larger than for recycling, recycling would reduce total lead emissions. If not, recycling e-waste has the potential to release more lead to the environment than e-waste in landfills. Currently there are no analyses addressing under what circumstances which option (recycle versus landfill) leads to lower life cycle emissions of heavy metals. I suggest that this issue be resolved before public policy mandates recycling as the default environmentally preferable alternative.

A fourth reason e-waste management presents a challenge is that while reuse and recycling of electronics in the developing world runs a net profit in the U.S. recycling often results in a net cost. The main factors contributing to this dichotomy are lower labor costs, higher demand for reused products and parts, and less stringent environmental protections in the developing world. Recycling in the developing world at a net profit versus recycling in the U.S. at a net cost creates a market dynamic for exporting electronics to the developing world. The electronics reuse/recycling industry is a double-edged sword for the developing world. On one hand reuse markets provides access to technology to people who otherwise could not afford it and creates jobs for thousands of people. Many of the electronics goods people own in developing countries were first used in the U.S. The availability of low cost recycled computers and cell phones, in particular, can play an important role in increasing the use of Information Technology (IT) to enhance economic and educational activities in developing countries.

On the other hand, recycling of electronics in developing countries is often implemented by an informal industry. U.S. NGOs such as the Basel Action Network

(BAN) and the Silicon Valley Toxics Coalition have reported that informal recycling activities in China, India and Nigeria cause serious environmental harm. For example, in many cases wires are pulled from computers, collected and burned in open piles to remove casings and recover re-saleable copper. This results in creation and emission of dioxins, furan and other environmental pollutants. Circuit boards are treated to extract copper and precious metals using acid, cyanide and/or and mercury often in a manners that leads to uncontrolled discharge of contaminated process liquid, sometimes next to rivers. Scientific evidence is mounting which confirms that the environmental impacts of these activities are indeed severe. In Guiyu, a town in China well known for informal electronics recycling, emissions of dioxins were shown to be thousands of times the U.S. standard and blood lead concentration in children were found to exceed levels of concern. It is my opinion that informal recycling represents by far the most serious environmental issue for end-of-electronics. Yet there is as yet little action being taken to improve health and safety conditions in the industry. I believe that the U.S. should work with developing countries to address informal recycling.

Policy and e-waste

End-of-life electronics management interfaces with environmental, social and economic issues. What are nations and regions around the world doing legislatively to address this management challenge? There are three primary approaches. The first legislative approach is enacting take-back systems which collect end-of-life electronics for recycling. Such systems have been mandated in the European Union, Japan and other nations, and a few U.S. states such as California and Maine. The ostensible goals of this legislation are to keep e-waste out of landfills and increase recycling of materials. However, the net environmental benefit of this legislation is, I believe, as yet unclear. Recycling may not be environmentally preferable to landfilling and in addition take-back systems could have an adverse affect on reuse of equipment. I do not believe the landfill versus recycle question has been sufficiently resolved to warrant a blanket priority for policy.

The second approach to legislation regulates the use of materials in electronics. The primary example of this type of policy is the Restriction on Hazardous Substances (RoHS) legislation promulgated in the European Union. RoHS restricts six hazardous elements in different applications; lead, mercury, cadmium, hexavalent chromium, and the polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) flame retardants. Any electronics manufacturer wishing to sell their products in Europe must abide by the rules, thus this regional legislation effects global change in the industry. Exposure to brominated flame retardants presumably occurs while the goods are in service, thus removing them has a high potential to reduce consumer risk. However, banning the use of lead in solder has been a particular source of controversy with respect to RoHS, with many in the U.S. arguing that the environmental need for the ban is unclear. For heavy metals like lead, exposure generally is not an issue during use of the product but depends on handling at end-of-life. Furthermore, while lead exposure in informal recycling is a clear risk to workers and local communities, the overall risk to workers from lead exposure is reduced but not clearly managed by banning lead solder, since lead is only removed from solder but not from CRTs, which contain far more lead than solder.

A third approach to legislation regulates trade in end-of-life electronics. This is usually applied at the national level, for instance China bans imports of used electronics and e-waste. However, while officially a ban is in place in China, the imports of e-waste coming in China have continued unofficially more or less as before. At the international level, the central framework for controlling international movements of hazardous substances is the Basel Convention. The Basel Convention requires prior notification between signatories when trading wastes classified as hazardous. Many categories of e-waste are classified as hazardous waste and thus are targeted for prior notification. Products intended for reuse, however, are exempt from control. Furthermore, the Convention does not suggest how to establish the reusability of a given trade flow in practice, a nontrivial challenge.

Do these current policy directions achieve desirable environmental, social and economic objectives for society? On the environmental side, many in the scientific community are of the opinion that the risk associated with landfilling e-waste has been vastly overstated. The most pressing environmental issue is, in all likelihood, the adverse impact of informal recycling in developing countries. Dealing with these and other issues can lead to complex ethical choices. Policies can result in tradeoffs between environmental, economic and social issues. For example a ban on exports of end-of-life electronics might seem an appropriate course of action to mitigate environmental impacts of informal recycling. However, a blanket trade ban would make used IT equipment less available abroad. Also, it would cut off the supply of raw

material to a reuse/recycling industry providing thousands of jobs to poor people. Is this appropriate, especially given an absence of prior attempts to redress occupational and safety issues of the industry?

While it may seem off-topic, I think it important to raise the issue of the environmental applications of IT. Informational Technology can be used to reduce a variety of different environmental impacts. For instance, it can reduce the impacts of transportation systems by enabling telecommuting, virtual meetings, and creating virtual networks of car-poolers. Furthermore, a great deal of energy consumption in residential and commercial buildings goes towards energy services not actually needed, such as heating or cooling unoccupied rooms. Substantial energy can be saved via computerized monitoring and control systems. The environmental management of electronics has come to be conceptualized in terms of its potential end-of-life impacts. While end-of-life impacts should certainly be better managed, we should allocate our attention and resources in proportion to potential benefits. The environmental potential of IT is significant yet relatively ignored.

Towards the future: Product, reuse/recycling processes and policy design

It is important to work creatively towards the design of products, reuse and recycling processes, and policies to achieve multiple societal objectives. An important starting point to achieve this goal is characterizing domestic and international flows of end-of-life electronics. Currently flows of e-waste products and materials are poorly understood. One reason for this is that reuse and recycling activities do not have their own industry or commodity codes and are thus invisible to conventional trade statistics systems. Under a grant from the National Science Foundation in the Environmental Sustainability program, my colleagues and I at Arizona State University are working to characterize international e-waste flows and come up with new solutions to capture this information. This is at present the only U.S. project of its ilk I know of. Japan in comparison is investing far more in order to characterize and plan management of international end-of-life flows for a variety of consumer products and recycled materials.

Product design can be viewed through three different lenses: materials, assemblies, and informatics. Material selection is one important strategy for optimizing end-of-use value. The RoHS legislation for example takes the step of banning two brominated flame retardants. The potential snag is that it is not yet clear whether environmentally acceptable alternatives are available. Research and development in green chemistry is needed to develop and test alternatives. We should however be cognizant that material selection faces limits. Even a computer completely free of toxic substances would still be dangerous to recycle informally because of the toxic substances generated and used in recycling. I believe the target should be managing the exposure to toxics by developing environmentally sound recycling processes rather than the complete elimination of all substances of concern.

Assemblies refer to how parts are put together, which also has effects on end-of-life processing. Disassembly is currently carried out by hand and labor costs are an important cost issue. Snap-fits for easier disassembly and making parts of concern such as nickel cadmium batteries easily accessible reduces labor costs of recycling and potentially reduces adverse impacts of informal recycling.

The design of informatics as it relates to the end-of-life of products is much less discussed than material and assembly choice. Information Technology can be applied to construct information systems to enhance the reusability and recyclability of products. For example, Radio Frequency Identification Devices (RFIDs) could be placed in computers to provide information wirelessly to reuse/recycling systems. One concept is an RFID "blackbox" for each computer, which periodically records the functionality of different subsystems. At the end-of-life, a computer arriving at a processing center can be wirelessly scanned for functionality and selected for reuse versus recycling.

Another layer of informatics design relates to the ease and security with which consumers can resell their computers. After purchasing a replacement computer, consumers often store their old computer, unused for years, until some decision is made regarding its end-of-life disposition. One reason for this is concern whether data on the old computer has been backed up and if it can be securely erased before selling. There are software applications which could be packaged with computers which create backups and then thoroughly erase all data. Another obstacle to used markets relates to the transfer of the right to use pre-installed software from first user to secondary user. In general software license agreements grant the secondary user the same rights to use software but in practice the current rights labeling system does not enable the secondary user to clearly establish this right from a legal perspective. To protect themselves from litigation from software companies, reuse and refurbishing companies routinely wipe hard drives of the used computers they

purchase. This loss of software reduces the value of the used computer. This could be avoided if pre-installed software rights were packaged with the computer in a verifiable way.

Considering end-of-life processes, one important task is to assess the environmental characteristics of recycling, especially those processes such as smelters and acid leaching which mobilize toxics. There are a variety of recycling processes and practices currently in use around the world. Assessment will reveal which are best practices and in what specific areas it may be most appropriate to invest in research and development of environmentally benign recycling processes.

Another layer of design is policy. It is fair to characterize the current status of policy development as one in which nations and states are experimenting with different policy designs to manage end-of-life electronics. There is still much room to develop policy alternatives. One alternative policy direction is to design systems intended to ensure environmentally safe end-of-life management while at the same time establishing a competitive market for reuse and recycling services. One concrete idea to realize this goal is termed e-Market for Returned Deposit. The e-Market system begins with a deposit paid by consumers to sellers at the time of purchase, electronically registered and tracked via a Radio-Frequency Identification Device (RFID) placed on the product. At end-of-life, consumers consult an Internet-enabled market in which firms compete to receive the deposit by offering consumers variable degrees of return on the deposit. After collection of the computer by the selected firm, the cyber-infrastructure utilizes the RFID to transfer the deposit to the winning firm when recycled. If the firm chooses to refurbish or resell the computer in lieu of recycling, the transfer is deferred until true end-of-life processing.

A second policy proposal focuses on redressing the environmental impacts of informal recycling abroad. The basic idea is to pay workers involved in reuse and disassembly not to recycle those components dangerous to handle with informal processing. This could be implemented via a system which establishes collection points at which workers would be paid fixed prices to deliver targeted parts. The price is set to create a financial incentive for informal recyclers to deliver the targeted parts rather than process them on their own. Under this system the collected parts would be transported and processed in appropriate recycling facilities. Since much of the cost associated with recycling is with transport and disassembly, this system would presumably be an inexpensive option to avoid informal recycling while maintaining an active reuse industry.

Conclusion

Are there product, process and policy designs which allow us to mitigate environmental impacts while at the same time realizing the social and economic benefits of recycling and reuse of electronics? Management efforts up to now have focused on heuristic goals such as increasing recycling rates and banning e-waste from landfills. It is not clear to me that this approach will take us where we want to go. We need to think about desired endpoints such as safety from exposure to toxics, net reduced energy use, availability of affordable IT to everyone, and creating jobs and capital. We should work backwards from these endpoints to find the policies, processes, and product designs which deliver the desired outcomes. In addition, we also need to work much harder on using IT as a tool to achieve environmental goals. Here are some suggested starting points:

- Investigate the life cycle environmental pros and cons of landfilling and recycling end-of-life electronics in order to benchmark best practices. This evaluation should allow reconsideration of whether the current TCLP based standard regulating the landfilling e-waste is appropriate.
- Undertake research to develop new materials as appropriate, such as bromine-free flame retardants. New materials need to be thoroughly evaluated before they are adopted.
- Encourage reuse of electronics through improved informatics design, such as bundling of backup/erase applications with new computers. These improvements make it easier for users to resell their computer securely and with software intact.
- Work to ensure that used electronics we export to developing countries is in good working order. Strategies to achieve this include use of RFID blackboxes to enable remote checking of recent functionality and certification schemes for used equipment.
- Work with developing countries to improve occupational, health and safety conditions in informal recycling industries.

I believe the U.S. Federal Government should take a leadership role in working towards a sustainable management of electronics. The electronics industry is not a domestic affair, and policies outside the U.S. federal context affect the global system. If the Federal Government does not take action, other nations will, setting the playing field without U.S. input. I hope we can proceed through a combination of thinking creatively, assessing carefully, and acting decisively to create sound policies and practices for end-of-life management of electronics. I and my colleagues at Arizona State University would like to thank you for your attention.

BIOGRAPHY FOR ERIC D. WILLIAMS

Eric Williams is Assistant Professor at Arizona State University with a joint appointment between the Department of Civil and Environmental Engineering and the new School of Sustainability. Eric has been active in researching the environmental assessment and management of information technology and electronics for nearly 10 years. Eric has a global perspective on the industry, having spent a good part of his career at United Nations University headquartered in Tokyo. His research articles in Environmental Science & Technology, "The 1.7 kg Microchip" in 2002 and "Energy Intensity of Computer Manufacturing" in 2004 have contributed to understanding of the supply chain environmental impacts of electronics. He is coeditor and contributor to the 2003 book *Computers and the Environment: Understanding and Managing Their Impacts,* the first integrated treatment of the issue. Eric's research results have been widely covered by the scientific and popular media, with reports in *Science, Nature, New Scientist, PC Magazine, Foreign Policy, Scientific American, Financial Times,* BBC, and other media outlets. Eric is co-chair of this year's IEEE International Symposium on Electronics and the Environment in San Francisco, the Nation's premier annual event addressing the environmental management of electronics. He is also currently member of a National Academy of Science committee tasked with the question of linking appliance energy efficiency standards with life cycle considerations.

Education

1993—Ph.D. in Physics, C.N. Yang Institute for Theoretical Physics, Dept. of Physics, State University of New York at Stony Brook, Stony Brook, New York

1988—B.A. in Physics, Macalester College, St. Paul, Minnesota

Professional Experience

8.2006–present—Assistant Professor, Department of Civil and Environmental Engineering & Global Institute of Sustainability, Arizona State University, Tempe

9.2005–7.2006—Visiting Assistant Professor, Department of Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh

9.2001–7.2006—Project Coordinator, United Nations University/Centre, Tokyo

9.2000–8.2001—Associate Fellow, United Nations University/Institute of Advanced Studies (UNU/IAS), Tokyo

9.1997–8.2000—Research Associate, UNU/IAS, Tokyo

9.1995–8.1997—JSPS Postdoctoral Fellow, Institute for Solid State Physics, University of Tokyo, Japan

9.1994–8.1995—Temporary Assistant Professor, Department of Mathematics, University of Minnesota, Minneapolis

Selected Publications

1. E. Williams, R. Kahhat, B. Allenby, E. Kavazanjian, J. Kim and M. Xu, "Environmental, social and economic implications of global reuse and recycling of personal computers," **in press,** *Environmental Science & Technology* (2008).

2. R. Kahhat, J. Kim, M. Xu, B. Allenby, and E. Williams, "E-Market for E-waste: an alternative management system for the U.S.," **in press,** *Resources, Conservation and Recycling* (2008).

3. A. Terazono, S. Murakami, N. Abe, B. Inanc, Y. Moriguchi, S. Sakai, M. Kojima, A. Yoshida, J. Li, J. Yang, M.H. Wong, A. Jain, I. Kim, G.L. Peralta, C.C. Lin, T. Mungcharoen, and E. Williams, "Current status and research on E-waste issues in Asia," *J. Material Cycles and Waste Management,* 1–12 (2006).

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5. E. Williams, "Energy intensity of computer manufacturing: hybrid analysis combining process and economic input-output methods," *Environmental Science & Technology* 38(22), 6166–6174 (2004).

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7. R. Kuehr and E. Williams (eds.), *Computers and the Environment: Understanding and Managing their Impacts,* Kluwer Academic Publications: Dordrecht (2003).

8. E. Williams and T. Tagami, "Energy use in sales and distribution via B2C E-commerce and conventional retail: a case study of the Japanese book sector," *Journal of Industrial Ecology* 6(2), 99–114 (2003).

9. E. Williams, R. Ayres, and M. Heller, "The 1.7 kg microchip: energy and chemical use in the production of semiconductors," *Environmental Science & Technology* 36 (24), 5504–5510, Dec. 15 (2002) (cover story).

Selected Research Projects and Awards

Industrial Ecology Fellow, "Substitution and Complementarity of ICT products and services," *AT&T Foundation,* Jan. 2008–Dec. 2008.

"Assessing and managing the sustainability of global reverse supply chains: the case of personal computers," *National Science Foundation,* Environmental Sustainability program, Sep. 2007–Aug. 2010.

Industrial Ecology Fellow, "Information Technology-based monitoring and control systems to mitigate energy use in households," *AT&T Foundation,* Jan. 2006–Dec. 2006.

"Energy consumption of IT infrastructure in Asia—Computer Use Patterns," *New Energy and Industrial Technology Development Organization (NEDO)*—Japan, April 2004–March 2005.

Industrial Ecology Fellow: "Effects of computer usage patterns on the life cycle energy consumption of IT infrastructure," *AT&T Foundation,* Jan. 2004–Dec. 2004.

"The Digital Economy and Energy," *Japan Foundation—Center for Global Partnership,* June 2001–May 2003.

Chairman GORDON. Thank you, Dr. Williams.

Mr. Castro, you are recognized.

STATEMENT OF MR. GERARDO N. CASTRO, DIRECTOR OF ENVIRONMENTAL SERVICES AND CONTRACTS, GOODWILL INDUSTRIES OF SOUTHERN CALIFORNIA

Mr. CASTRO. Mr. Chairman, Members of the Committee, my name is Gerardo Castro and I am the Director of Environmental Services and Contracts for Goodwill Industries of Southern California. I am pleased to testify before the Committee today on how we can best manage electronic waste.

Goodwill Industries International is a network of 184 local autonomous Goodwill agencies in the United States and 16 countries. We fund our mission through revenues collected from donated goods as well as through industrial and workforce development contracts with government and the private sector. In 2007, my agency served more than 31,000 people with disabilities or vocational disadvantages through education, job training and placement programs. We operate 54 retail stores, 40 attended donation centers, three campuses, and 21 workforce training centers.

During the past decade, we have seen a growing number of computers and other electronic devices dropped off at our stores and donation centers. Nearly all of our agencies received discarded electronics. In 2004, local Goodwill agencies handled nearly 23 million pounds of electronics. With the transition to digital televisions, California expects 15 million television sets to be discarded next year. The problem of e-waste is a growing one but it also represents a great opportunity.

My views today represent those of my agency, Goodwill Industries of Southern California. In 2003, California became the first state in the Nation to enact legislation which implemented strict standards for the disposal of e-waste, the California Electronic Waste Recycling Act, or S.B. 20 or S.B. 50. The program was later implemented in 2005. In 2007, my agency was able to divert a total of 4.6 million pounds of electronic waste out of county landfills. These products ranged from computers and monitors to printers and other peripherals.

California is the only state which uses the advanced recovery fee model to pay for the costs associated with collecting, de-manufacturing and recycling covered electronic products. Retailers are required to collect a fee of $6 to $10, depending on the size of the screen, on any cathode ray tube, liquid crystal display, or plasma device sold in California. These fees go into a State recycling fund to reimburse authorized collectors and authorized recyclers. Collectors receive 20 cents per pound for picking up unusable CRTs and delivering them to recyclers, who get 28 cents for canceling them.

Along with nine other California Goodwills, we are a State-authorized e-waste collector. As an authorized e-waste collector, we process over 10,000 CRT units per month. We follow specific procedures in recycling e-waste. First, we recycle working computers by wiping the hard drives to Department of Defense standards, install new hard drives and sell the refurbished units in our stores. These sales generate approximately 10 percent of our total e-recycling revenue. Another 70 percent comes from the dismantling and sale of plastic and metal circuit boards and other components to commodity dealers. The final 20 percent is obtained by taking unusable CRTs to State-authorized recyclers.

Through our national network of 2,100 stores and 4,100 attended donation centers in virtually every community in America, Goodwill already has the capacity and infrastructure to provide for nationwide collecting of e-waste products.

The Federal Government can encourage private-sector investment and not-for-profit involvement in the used electronic recycling reuse market through tax credits for consumers and manufacturers who partner with social agencies, recycling grants and other initiatives that help stakeholders solve this growing challenge.

Goodwill Industries looks forward to working with the House Science Committee to support a national solution to handle e-waste.

Thank you.

[The prepared statement of Mr. Castro follows:]

PREPARED STATEMENT OF GERARDO N. CASTRO

Mr. Chairman and Members of the Committee, my name is Gerardo Castro and I am the Director of Environmental Services and Contracts for Goodwill Industries of Southern California. I am pleased to testify before the Committee today on how we can best manage electronic waste.

We have 184 local, autonomous Goodwill agencies in the U.S. and 16 countries, and we fund our mission through revenues collected from donated goods, government contracts, and workforce development funding. Goodwill Industries of Southern California serves more than 31,000 people per year with disabilities or vocational disadvantages through education, job training, and placement programs. We also operate 54 retail stores, 40 attended donation centers, three campuses and 21 workforce/training centers in San Bernardino, Riverside, and Los Angeles counties.

In a survey conducted in 2005, we found that nearly all of our members receive electronics through their donation streams and our members handled nearly 23 million pounds of electronics in 2004.

During the past decade, however, we have seen a growing number of computers and other electronic devices donated to Goodwill agencies, and many of these items are just dropped off at our stores or donation centers. The problem is a growing one for us, but it also presents opportunities. With the transition to digital television, we expect to see an influx of television sets as well.

In a poll conducted by Goodwill Industries International, Inc., we found that 91 percent of our local agencies accept donated televisions, and local Goodwill agencies receive on average 118 televisions per month or 1,400 per year. The total for all Goodwill agencies is more than 163,000 per year. Fifty percent of our agencies resell the televisions in stores and 30 percent recycle the sets.

My views today represent those of my agency—Goodwill Industries of Southern California. Because of the environmental concerns specific to computers and other electronic devices, many of our local agencies are exploring various business-to-business solutions in the effective disposal of electronic waste and ways to recycle the waste. Other agencies are exploring methods of handling e-waste and still others are working to understand and comply with new State laws on recycling e-waste.

My particular agency received a total of 4.6 million pounds of e-waste products ranging from computers, monitors, printers, and other peripherals. A substantial number of these items are unusable and the cost of safely and responsibly recycling or disposing of these products can directly impact the job training and career services offered by our agencies.

More and more states have passed landfill bans, and for those Goodwill agencies that do dispose of electronic waste in landfills the fees to do so can be exorbitant. In addition, some agencies are working within various State laws on the effective disposal and recycling of e-waste.

In 2003, California became the first state to enact a law that implements stricter standards on e-waste disposal; SB20/SB50, the *California Electronic Waste Recycling Act,* provides reimbursement to authorized collectors and recyclers from a State e-waste fund. Today, 10 states have passed laws that create statewide e-waste recycling programs. Others have passed laws that prohibit e-waste from being disposed of in landfills or incinerated. In 2008, 18 states are considering e-waste legislation.

California is the only state that uses the Advanced Recovery Fee (ARF) model to pay for the costs associated with collecting, de-manufacturing, and recycling of covered electronic products, which is similar to the recycling payment system for beverage containers or used tires. Retailers are required to collect a $6–$10 fee on cathode ray tube (CRT), liquid crystal display (LCD), and plasma devices. The fees collected go into a fund to manage the recycling program.

Goodwill Industries of Southern California, along with nine other Goodwills located in the state, is a State-authorized e-waste collector. There are 600 authorized collectors in the state. The fund receives revenues from the point of sale fee on items with a screen purchased in California. The State of California has just completed its third year of the program. The program has been very successful when measured by the pounds of CRTs diverted from landfills. The program has built in review and adjustment points to maintain a self-funding level. The program is revenue neutral to the State of California as it involves zero tax dollars. It is authorized to adjust at least every two years on both the ARF and the fees paid to authorized collectors and authorized recyclers. We are expecting the state to increase the ARFs and reduce the fees to collectors by about three cents a pound.

As an authorized e-waste recycler, we process over 10,000 CRT units per month and pick up large corporate donations; in addition, individual donations are accepted at our donation centers. We accept computers, monitors, TV sets, digital cameras, printers, modems, and other electronic equipment. We collect CRTs and ship non-

working ones directly to a cancellation facility that will break them down into their basic commodity. All other obsolete or non-working electronics are de-manufactured by our workforce who are people with disabilities. We then sell the plastic, metal, circuit boards, and other components for their salvage value.

We follow a system and certain procedures in recycling e-waste. First, we recycle old computers by wiping the hard drives to the Department of Defense standard. We then refurbish and resell about 10 percent, and then dismantle and sell the plastic and metal parts for salvage; this amounts to about 70 percent. About 20 percent is sent to other authorized recyclers.

Other local Goodwill agencies are developing innovative business solutions to address the growing surplus of computer donations. I want to note that our local Goodwill agencies have the capacity and the infrastructure to provide nationwide collection, since we already have locations throughout the country in both urban and rural areas. Some agencies are refurbishing and de-manufacturing the equipment; reselling systems and components; expanding client training and career services; and avoiding high disposal costs.

Local Goodwill agencies handle e-waste in different ways depending on their size, community, and external partners. For example, some are involved with producer take back programs, while our agency, because we have SB 20/SB 50, is not. An internal Goodwill Industries International, Inc. taskforce identified four innovative e-recycling models that have so far been successful in meeting Goodwill Industries' revenue goals, concern for the environment, and most importantly, our charitable mission.

Specifically, the various models are as follows:

(1) *Retail*—a model focusing on the collecting, de-manufacturing, refurbishing and reselling computer systems and components in a dedicated retail store.

(2) *Client*—a model integrating client technology training and workforce development programs into computer collection, recycling, and reuse.

(3) *Corporate*—a model integrating corporate services into computer collection, recycling, and reuse.

(4) *Collaborative*—a model utilizing partnerships and collaboration to address computer collection and recycling.

Local Goodwill agencies are in a unique position to support producer take back programs, because we already have a strong existing infrastructure, and if any e-waste legislation is introduced in Congress, we support pre-emption language that would allow states, such as California, with the ARF model, and those with producer responsibility take back programs to continue running them. We have over 2,100 retail stores and 4,100 attended donation centers. Goodwill Industries is a self-sustaining enterprise and recycling helps us to be good stewards of the environment and also to help employ people with disabilities and disadvantages.

In the future, we do believe advanced product designs such as those already undertaken in Europe would help with the challenge of e-waste. We support incentives to manufacturers for the design of such products. Product design changes could facilitate the reuse, disassembly, and recycling of products. Standardized chargers for cell phones are an example of design changes that would add minimal costs to the product while achieving substantial impact in the reuse area. The Federal Government can play a vital role in assisting the development and sustainability of a recycling/reuse infrastructure while creating green collar jobs and stimulating research and development in a growth industry.

The Federal Government, by utilizing incentives, could aid and encourage necessary private sector investment in the used electronic recycling/reuse markets. This can be done through tax credits for manufacturers who partner with social agencies, recycling grants, and other initiatives that could spur innovative solutions and help stakeholders handle this problem. A partnership consisting of government incentives, private industry and social agencies can protect the environment, create jobs and spur innovation in the environmental field.

Additionally, increased federal support for pilot projects and other sustainable initiatives would be helpful in promoting the development of a recycling/reuse infrastructure. The Federal Government also can play a key role in educating consumers. We are currently working with a broad-based coalition to help inform consumers about the transition to digital television and the availability of coupons for a digital converter.

Goodwill Industries looks forward to working with the Committee on exploring the best ways to handle electronic waste. Thank you.

BIOGRAPHY FOR GERARDO N. CASTRO

Gerardo is Goodwill's Director of Facilities, Security, Environmental Service and Mailroom. He is a bilingual professional with more than 20 years of experience in construction and facilities management.

Gerardo represents Goodwill Southern California on the Goodwill Industries International E-waste Taskforce and has contributed in formulating policies on a State and national level. He also sits on the Board of Directors for the Secure Document Alliance, a trade organization tasked with obtaining national shredding contracts for nonprofit shredders such as Goodwill.

After a long career in poodle juggling and a stint with a professional knife-throwing company of gypsies, Gerardo decided to settle down and get a real job at Goodwill. Married with four children, he finds that life at home tends to be less than tranquil.

Chairman GORDON. Thank you, Mr. Castro. You and Goodwill should be congratulated on a very forward-thinking program.

Now Ms. Renee St. Denis from Hewlett Packard, you are recognized.

STATEMENT OF MS. RENEE ST. DENIS, DIRECTOR OF AMERICA'S PRODUCT TAKE-BACK AND RECYCLING, HEWLETT–PACKARD COMPANY

Ms. ST. DENIS. Good morning, Chairman Gordon, Ranking Member Hall and Members of the Committee, my name is Renee St. Denis and I am the Director of Product Take-Back for the Hewlett-Packard Company in America.

HP has a longstanding history of being a leader in electronics recycling. We first began recycling electronics in 1987 and in 1994 we opened a world-class electronics recycling facility. In our 21 years of recycling electronics, we have recycled more than one billion pounds of electronics from our consumer, small and medium business, and enterprise customers—quite an achievement.

We also operate a state-of-the-art printer supplies recycling facility outside Nashville, Tennessee, in Chairman Gordon's district. All of the material that is recycled in all of our and our partners' U.S. operations are managed in an environmentally sound manner. No waste is exported for disposal overseas and no electronic materials are sent to landfills.

In addition to implementing programs on the ground and testifying before Congress, we have played the leading role in the policy development and debate about the end-of-life of electronics in the United States and indeed around the world. Based on our considerable experience, we believe that appropriate legislation can create efficient, flexible recycling systems that optimize the environmental impact, research utilization and economic benefits of electronics recycling. We look forward to continuing to work with the Congress on such legislation.

We do see an increasing use of technology in the processing of electronic materials for recycling. Materials designed for recycling are first sent to a process where any materials requiring special handling such as batteries or CRT glass are removed and segregated for processing and treatment. At that point large pieces of metals or plastics may also be isolated and segregated for recycling. The residual materials are sent through a series of size reduction and sorting steps. These steps include mechanical shredding and the use of high-tech material separation processes such as eddy currents, air tables or magnetic separation.

I am pleased to report that HP's experience in designing and operating recycling facilities around the world have led us to incorporate much of our learning into new product design. For example, we have reduced the number and type of screws or fasteners used in new products, replaced paints and coatings on plastic parts with molded-in colors, and have successfully created a closed-loop recycling system for the plastics in our ink jet products.

However, as an industry, we still face challenges in a number of areas and we have provided suggestions for areas of research in our written testimony to help create a more efficient recycling infrastructure. I would like to highlight a few of those today. In one example, there are materials which have been used in products in the past which no longer have economic value. These include CRT glass and plastics with brominated flame retardants. Congress should consider support for research into appropriate uses of these materials outside the technology industry.

Another challenge is the inconsistent and somewhat inappropriate regulatory framework in place to manage used electronics. These products may be classified as hazardous waste due to the testing protocols used to assess the risk of managing them. The tests used to assess these risks were developed for assessing industrial waste, not products that we routinely use every day in our homes and offices. The tests can give misleading and contradictory results. The resulting regulatory classification that is put in place creates burdensome and costly regulatory requirements and impedes the development of a cost-effective recycling infrastructure while not creating any additional environmental protection. Congress could help to foster the development of an electronics recycling infrastructure by conducting research into the actual environmental and human health risks associated with the storage, transportation, selection and recycling of used electronics and into the development of new, appropriate testing protocols.

Another slightly different area of research that the Congress may want to consider is the overall climate impact of recycling discarded electronics. There is currently little data on the net carbon impacts of collecting, transporting and processing used electronics. Recycling can play a positive role in addressing climate change by conserving resources and displacing the energy associated with acquiring raw materials through mining or other processes. However, the process of recycling used electronics will also generate emissions of greenhouse gases and contribute to climate change. In a future carbon-constrained world, all these impacts must be better understood.

Thank you again for the opportunity to share our views. I would be happy to answer any questions you might have.

[The prepared statement of Ms. St. Denis follows:]

PREPARED STATEMENT OF RENEE ST. DENIS

On behalf of Hewlett-Packard Company (HP), I am pleased to provide this testimony on the recycling of used electronics. My name is Renee St. Denis, and I am Director, Americas Product Take-Back, based in Roseville, California. HP is a technology solutions provider to consumers, businesses and institutions globally. The company's offerings span IT infrastructure, global services, business and home computing, and imaging and printing. More information about HP is available at *www.hp.com.*

HP applauds Chairman Gordon and Ranking Member Hall for convening this hearing to discuss electronic waste and appreciates this opportunity for HP to testify on this important issue. Today's hearing is a valuable first step in informing Members of the House and the public on the emerging challenge of managing and recycling used electronics in the United States. HP supports increased recycling to conserve natural resources and protect our environment through a harmonized national approach. HP calls on Congress to support a national solution to the challenge of recycling used electronics, the adoption of recycling incentives and the removal of regulatory barriers to cost-effective recycling, and market-based solutions to finance government recycling programs. We further call on Congress to support research in this area to help address challenges that are hindering the development of a cost-effective recycling infrastructure. We offer our suggestions for research priorities later in this testimony.

As a major manufacturer of a broad range of technology products, as well as a leading recycler of these products, HP has a strong interest in the development of policies relating to electronics recycling. HP has nearly twenty years of first-hand experience in product take-back and recycling. Since 1987, HP has successfully collected and recycled more than one billion pounds of used or unwanted computer-related equipment globally. With our vast knowledge and experience, HP's goal is to recycle an additional one billion pounds of equipment (for a total of two billion pounds worldwide) by the end of 2010. HP has established a recycling service throughout the U.S. (as well as other countries around the world) that provides consumer and commercial customers with a convenient opportunity to recycle their old products in an environmentally sound manner. For more information on HP's environment and broader global citizenship activities, see: *http://www.hp.com/hpinfo/globalcitizenship/*.

HP currently partners with operators of seven large, state-of-the-art recycling facilities in the U.S. and Canada, as well as operating our own technologically-advanced facility used to recycled print supplies. Our recycling facility for printer supplies is located outside of Nashville, Tennessee, in the district of Chairman Gordon. This facility consists of a 40,000 square foot building, including separation and recycling technology. The facility employs approximately 50 full time employees and processes all of the material returned to HP through our different print supplies programs in the U.S., Canada and Latin America.

All materials collected in the U.S. and recycled by HP are managed in the U.S. and Canada in an environmentally sound manner; under HP's program, no waste materials are shipped overseas and no electronic material is sent to a landfill. In the past year, HP recycled almost 40 million pounds of electronic waste in the U.S. in 2007 and reused or donated an additional 30 million pounds. Including remarketed equipment, we achieved a total reuse and recycling rate in 2007 of 15 percent of relevant hardware sales. While this metric attempts to account for the time difference between when HP products are sold and returned, we recognize the difficulty of matching returned product to the appropriate sales period, which may affect the accuracy of the calculation.

HP encourages Congress to continue to support technological innovation such as HP has employed to reduce the impact of electronic products on the environment and to encourage the reuse and recycling of electronic products. Creating opportunities and incentives to support the innovation of American companies which efficiently achieve superior recycling results will help to best protect our nation's natural resources for future generations.

We wish to emphasize the following points in our testimony today:

- HP's history and leadership in electronics recycling, including the effect of these recycling activities on design and manufacture of HP products as a means of reducing the overall environmental impact of our products.
- The need for further research into creating innovative recycling and disposal methods for the leaded glass from CRT tubes and the older plastics from electronics in order to find innovative, effective reuse options for these materials of concern.
- Increasing the understanding of regulators, environmental groups, and the general public on the subject of the environmental issues surrounding the management of discarded electronics, and the appropriate level and type of regulation surrounding recycling operations and the shipment and handling of whole products. Additional research on these issues is warranted ensure that the emerging electronics recycling industry can find market- and economic-based solutions for recycling and reuse, while also providing for protection of the environment.

- The necessity of research into the net carbon or climate impact of electronics recycling is crucial to designing appropriate collection, reuse, and recycling systems, particularly given the likelihood of future legislation that limits emissions of greenhouse gases or places greater costs on such emissions.

I. HP'S RECORD OF ACHIEVEMENT IN RECYCLING ELECTRONICS

HP has been recycling used electronics for over 21 years. HP has made great strides in increasing the volume of our products recovered for reuse and recycling. However, the number of PCs, servers, print cartridges and other electronics reaching the end of their usable life is growing rapidly. In order to meet this need, HP offers a variety of recycling services to customers in 52 countries and territories worldwide.

Managing this increasing volume of discarded equipment conserves natural resources by reducing the need for raw materials and energy to manufacture new products. As such, our commitment to responsible product reuse and recycling is integral to meeting our energy efficiency objectives.

Product reuse and recycling offers other benefits as well. Remarketing used equipment is profitable for HP, and businesses and consumers are increasingly seeking out manufacturers that offer responsible reuse and recycling options for used equipment. Plus, many governments have passed legislation, such as the European Union's Waste Electrical and Electronic Equipment (WEEE) Directive, requiring that discarded electronic equipment be recycled. Our proactive approach to product reuse and recycling helps us meet legal requirements, maintain access to markets and win business.

HP began remarketing used equipment in 1981 and recycling in 1987. This year, we exceeded our goal to recycle one billion pounds (450,000 metric tonnes) of electronic products and supplies by the end of 2007. We have set an aggressive new goal to recover an additional one billion pounds for reuse and recycling by the end of 2010.

Beyond that major milestone, our world wide efforts in 2007 yielded significant progress. Specifically, we:

- Increased our annual recycling volume by more than 50 percent over 2006 to 113,000 tonnes (250 million pounds). For comparison purposes, the Environmental Protection Agency (EPA) has reported that our nearest competitor recycled 78 million pounds. See "Plug Into e-Cycling with the EPA: 2007 Activities" (EPA 530–F–08–002).
- Collected approximately three million hardware units weighing 28,500 tonnes (63 million pounds) for reuse and remarketing, an increase of more than 31 percent compared to 2006.
- Increased the volume recovered for reuse and recycling as a proportion of relevant sales from 10 percent in 2006 to 15 percent.
- Introduced recycling programs in several countries, including Bulgaria, Indonesia, Malta, Philippines, Romania and Turkey.
- Introduced several products that use recycled materials and include features to facilitate recyclability.

We offer a range of take-back services for both companies and consumers. Responsible take-back is core to our leasing and reuse services, and saves customers time and expense managing old equipment. Free return and recycling is available for print cartridges in 47 countries or territories. We make arrangements with commercial customers depending on the equipment involved and the specific circumstances. Consumer recycling services vary from country to country, depending partly on local regulations.

In all cases, it is important to manage the disposal of returned equipment to protect data security. We have safeguards in place for all products we take back, whether by trade-in, via donation or through our recycling services.

The equipment returned to HP is managed through a network of partners and service providers who perform the recycling of the equipment. HP formerly partnered with a large electronics recycling company to operate two recycling centers in the U.S.; our partner now operates these facilities with the assistance of HP. HP invested in the development of those recycling centers in order to directly participate and lead the development of the types of technology and processes necessary to recycle used electronics to the environmental and data security standards we require. Over time, an infrastructure has started to emerge which has created an ability for HP to reduce our focus on the actual recycling operation and to renew our focus on the design of products which are easier to recycle and can include recycla-

ble commodities in their manufacture as well as the development of recycling services for our customers.

Any reusable equipment is segregated. From there, any customer data is destroyed and the equipment is then reused either in whole or in part. Equipment without a reuse channel is sent for removal of any hazardous components (typically CRT glass, batteries or other elements). After removal of any hazardous components the equipment is either manually or mechanically separated into a variety of basic commodities: various types of precious and base metals, plastics and other constituent materials. These materials are processed in the separation process to create valuable commodity streams which are then sold for reuse into a variety of industrial processes. These include the manufacture of new parts and products for a number of industries, including, in some cases, the electronics industry.

II. RECYCLING AND ITS IMPACT ON HP's PRODUCT DESIGN

HP established our Design for Environment (DfE) program in 1992, and it remains central to our business strategy today. Our approach to DfE encompasses the entire product life cycle. In addition to considering important product attributes such as energy efficiency and materials innovation, design for recyclability (DFR) is one of our primary design for the environment priorities. We believe that our experience and expertise in recycling provides an important feedback loop to designers to design future products so that they can be more readily recycled.

HP's DFR efforts include using common fasteners and snap-in features and avoiding the use of screws, glues, adhesives and welds where feasible. This makes it easier to dismantle products and to separate and identify different metals and plastics. The materials we choose can also enhance recyclability. For example, in 2007 we introduced several notebook PC models with LED technology, eliminating mercury fluorescent tubes and making the display screens easier to manage at end-of-life. These efforts have significantly improved the recyclability of HP products, and we are pleased to report the following:

- **HP notebook PC products** are now more than 90 percent recyclable or recoverable by weight (as per the definition used in the European Union WEEE regulations).
- **HP printing and imaging products** are typically 70 percent to 85 percent recyclable or recoverable by weight (as per the definition used in the European Union WEEE regulations).

We also made great progress in incorporating recycling materials into our products. For example, HP has engineered print cartridges that use recycled plastic without compromising quality or reliability. We design HP print cartridges to meet the needs of our recycling system and incorporate recycled material. Since we take back only our own cartridges, we can be certain about the material content, making it easier to process exhausted cartridges and reuse the material to manufacture new ones. More than 200 million cartridges have been manufactured using the process through 2007. HP used more than five million pounds (2,300 tonnes) of recycled plastic in its original HP inkjet cartridges in 2007, and the company has committed to using twice as much in 2008. HP also uses post-consumer recycled plastic recovered through our return and recycling program in the manufacture of original HP LaserJet print cartridges. This recycled plastic can represent as much as 25 percent, by weight, of the newly molded LaserJet cartridge housing. HP has also incorporated recycled content into some hardware products. For example, in 2007, we introduced a speaker module made from 100 percent post-consumer recycled plastics in all HP Compaq 6500 and 6700 series Notebook PCs.

We strive to use recycled plastics in our products, but their potential is limited for several reasons:

- Most recycled plastics contain substances such as BFRs, which we have eliminated from the external cases of our current products. (See Part III below).
- Mixed plastics do not have the mechanical properties necessary for use in new IT products.
- It is difficult to separate dissimilar plastics during recycling to produce a homogeneous material.

As we discuss in further detail below, Congress should consider supporting research on ways to promote the use of recycled materials in future products and help overcome these challenges.

As one outside observer states in HP's Global Citizenship Report (see *http://www.hp.com/hpinfo/globalcitizenship/gcreport/productreuse/perspectives.html*) :

HP has made significant strides in design for recycling. Its engineering and design teams have taken into account the concerns of refurbishers and recyclers by creating products that can easily be repaired, refurbished, disassembled or recycled. Such enhancement in product design has been augmented by the company's assistance to recyclers, making available to them guidelines that greatly simplify the recycling process.

Among the latest of the company's techniques in the area of design for recycling is the concept of modular design, which combined with the use of the proper "environmentally-friendly" materials help HP to increasingly establish itself as a leading "green" IT supplier. HP further pushed to reduce its products' environmental impact by incorporating more easily recyclable plastics, reducing the number of different plastic types in a single product and replacing coating and paint with molded-in colors. Furthermore, reuse, as a way to extend the life of a system, has been facilitated by HP's modular design approach, enabling simple component swapping during the refurbishing process.

These efforts have resulted in HP products qualifying for a large number of global ecolabels, including the EPEAT (Electronic Product Environmental Assessment Tool) designation in the U.S. HP is working hard to improve our record of success in this area, including establishing the following goals:

- Double the use of recycled plastic in print cartridges in 2008 compared to 2007, to 4,500 tonnes (10 million pounds)
- Eliminate the remaining uses of BFRs and PVC from new computing products launched in 2009 as technologically feasible alternatives become readily available that will not compromise product performance or quality and will not adversely impact health or the environment

III. INNOVATION NEEDED TO INCREASE THE RECYCLABILITY OF ELECTRONIC PRODUCTS

There are two materials which present particular challenges to the current recycling processes used within the electronics industry and which will present even greater challenges as time progresses. These materials are (a) the leaded glass found in CRT tubes and (b) plastics which may contain flame retardant additives which have been banned from further use in many countries in the world.

A. CRT glass

Cathode Ray Tubes (CRTs) are the glass picture tubes found in previous generations of computer monitors, televisions, and other displays. CRTs contain leaded glass for two reasons:

- It improves the optical quality of the glass. Adding a small amount of lead to glass is very common when creating glass for lenses, and you may have also heard of leaded crystal. Optical quality is especially important at the front of the CRT.
- It acts as a shield against radiation generated by the electron gun and electron beam.

Users of computer equipment are in the process of transitioning from CRT displays to flat panel technologies, but large volumes of traditional CRT displays remain in use or in storage. This presents a recycling and logistical challenge. Among other things, one important challenge is the limited current opportunities to reuse leaded CRT glass. Congress should consider support for research in new applications for leaded glass in building, the medical field, and other applications.

B. Plastics containing banned/restricted flame retardants

Both the internal circuit boards and the external plastic housings of electronic products contain chemical flame retardants for fire safety purposes. Many of the chemical flame retardants used in the past, such as brominated flame retardants (BFRs), have come under increasing scrutiny by environmental and health officials in many countries, and several U.S. states and many countries have banned or restricted the use of some of these chemicals. These chemicals cannot be removed from the plastics, so as a result the presence of these chemicals in plastic parts presents a significant recycling and reuse challenge. To address this concern, Congress should consider support for research on reuse opportunities for plastics containing banned or restricted chemicals.

IV. RESEARCH NEEDED ON THE PROPER REGULATORY APPROACH FOR THE CLASSIFICATION OF USED ELECTRONICS

The Federal Government can play an important role in promoting recycling by establishing an appropriate regulatory framework for managing used electronics, including the removal of regulatory impediments to cost-effective recycling. Under some interpretations of current federal and State regulations, used electronics may be classified as "hazardous waste," even though they are routinely used in our homes and offices and pose no risk to human health or the environment when properly stored, transported, and recycled. When these used products are classified as hazardous waste, they become subject to burdensome and costly regulatory requirements associated with their collection, storage, transportation, and processing. When classified as "hazardous," these regulations can impede the development of a cost-effective recycling infrastructure without adding to greater environmental protection. Congress and the EPA should work to reform these regulatory requirements to facilitate recycling of used electronics, while continuing to protect human health and the environment.

Additional research should be conducted regarding the actual environmental and human health risks associated with the storage, transport, and recycling of used electronics. This research should also consider whether new test methods for assessing these risks should be developed, instead of the current practice of using the test method developed and employed for testing industrial process waste.

V. RESEARCH INTO THE NET CLIMATE IMPACT OF RECYCLING OF ELECTRONICS

Another area that warrants further research is the overall climate impact of recycling discarded electronics. There is currently little data on the net carbon impacts of collecting, transporting, and processing large volumes of discarded electronics. In a future "carbon constrained" world, these impacts need to be better understood.

Recycling can play a positive role in addressing climate change by conserving resources such as precious metals contained in electronics, and displacing the energy impacts associated with mining or otherwise producing necessary raw materials. But the process of collecting and transporting these products on a large scale will also generate emissions of greenhouse gases, and therefore contribute to climate change. We need a better understanding of whether the benefits of recycling these products outweigh the potential adverse climate impacts associated with this activity, as well as ways of mitigating any adverse impacts. Unfortunately, little research has been done in this area to enable policy-makers and industry to understand these impacts and assess ways of mitigating them. These climate impacts can also have an important effect on the economics of e-recycling in a future world where emissions of greenhouse gases are capped or otherwise restricted.

V. CONCLUSION

HP is committed to strengthening our leadership in e-recycling and innovative product design. We have suggested a number of areas for further research that would enable HP and others in the tech industry to do a better job at these tasks. HP looks forward to working with the Subcommittee and other Members of Congress on the development of a national recycling system that leverages the capabilities and expertise of manufacturers, retailers, recyclers, and others to achieve efficient and low cost opportunities for all consumers.

BIOGRAPHY FOR RENEE ST. DENIS

Renee St. Denis is the Director of Product Take-Back and Recycling in the Hewlett Packard Americas organization. In this role, Ms. St. Denis represents HP on issues relating to the sound end-of-life management of electronics. Ms. St. Denis and her team are responsible for developing environmentally sound disposal solutions for all excess and obsolete Hewlett-Packard products, as well as developing customer solutions and legislatively required take back programs across the Americas.

Ms. St. Denis and her team manage take back and recycling programs at several locations in the U.S., Canada and Latin America with several suppliers. These programs account for in excess of four millions of pounds of hardware products and supplies being responsibly recycled each month. Finally, Ms. St. Denis is responsible for designing and implementing systems which ensure the compliance of HP with regard to manufacturer-responsibility and fee-financed take back legislation across the Americas.

Ms. St. Denis received her Bachelor's Degree in Finance at the University of the Pacific in Stockton, California, and her Master's of Business Administration at the

University of Southern California in Los Angeles, California. Renee has worked for Hewlett Packard for 17 years in a series of operational and management roles. Prior to joining HP, Renee was employed in a variety of roles regarding quantitative analysis of financial instruments.

Chairman GORDON. Thank you, Ms. St. Denis, right on time.

Mr. Eric Harris is recognized.

STATEMENT OF MR. ERIC HARRIS, ASSOCIATE COUNSEL/DIRECTOR OF GOVERNMENT AND INTERNATIONAL AFFAIRS, INSTITUTE OF SCRAP RECYCLING INDUSTRIES

Mr. HARRIS. Mr. Chairman, Members of the Committee, good morning. My name is Eric Harris. I am here today representing ISRI, the Institute of Scrap Recycling Industries. ISRI is the world's largest trade association of recyclers with 1,550 member companies and over 3,000 facilities throughout the United States. Our members process, broker, and industrially consume a number of recyclable commodities including metal, ferrous and non-ferrous, paper, plastic, glass, textiles, tires and rubber, and of course, electronics. Twenty percent of ISRI's membership now focuses on electronic recycling. In fact, it is our association's fastest growing segment.

Our electronics recyclers provide comprehensive recycling operations, everything from logistics, including collection and transportation, to asset management, that is, cleaning hard drives and testing and reselling for reuse, and of course processing electronics scrap to extract the various commodities such as steel, gold, titanium, silver, copper, plastics, and glass for use as valuable material feedstock in the manufacturing of new products.

So what are some of the key challenges for electronics recyclers? The first, something very sensitive to our industry, is hosting this issue with the moniker of waste. In our opinion, scrap is not waste and recycling is not disposal. It is very important to distinguish between scrap and waste as well as recycling and disposal. Simply stated, scrap is the opposite of waste. Electronic scrap like scrap paper and glass and plastic and metal and so forth is not waste when responsibly recycled. Defining scrap electronics as waste undermines and overlooks the values that those electronics retain when properly recycled.

One of the other biggest concerns we have in the industry is the cost to collect, transport, and responsibly recycle household electronic equipment, which remains the greatest challenge for our industry for two primary reasons. Household electronics, as Mr. Williams has already pointed out, some of the equipment has a negative cost to recycle. In other words, it costs more to recycle the equipment than the value you can extract from processing it. In addition, existing law, federal law, allows household electronic equipment to be sent to subtitle D landfills. This creates a tension in the market because we lack the contractual connection with the consumer and there is a behavioral pattern that suggests that this equipment should continue going to the landfill.

Because of these reasons, until a sustainable market presents itself, ISRI does support a short-term financial mechanism from OEMs that would allow us to have help to collect, transport, and responsibly recycle those household electronic equipment goods

that have a negative cost to recycle, for example, the cathode ray tubes in the televisions and monitors of today's market. There are three primary reasons why, this will enhance competition and not inflate the value of the recycling service that our members provide. The OEMs have greater access to their own customers. They can convince and educate their customers on the value of responsibly recycling the materials they sell. And lastly, it provides an incentive for the OEMs to design their products with an eye towards recycling. A great example in today's market is manufacturers' continued use of mercury in their products. If you see the flat-screen monitors and televisions, if you take the time to refurbish that system, pull the back panel off, what you will see is a row of fluorescent bulbs that have mercury powder. They are difficult to replace and they are difficult to remove for recycling. As a result, they are not cost-effective in today's market. We need to encourage more collaborative programs to work with the OEMs to improve their design.

On the commodity side, we need better markets for scrap plastics and scrap glass. CRT glass-to-glass manufacturing is becoming more and more obsolete throughout the world, and the few lead smelters that are remaining are actually refusing new contracts from recyclers to process their CRT glass. This is only complicated further by the four to eight pounds of leaded glass that we see in the monitors and TVs entering in today's market. As a result, recyclers have fewer and fewer markets for the CRT glass. In our terms, this is a barn-burning issue: what do we do with the glass?

For plastic, it remains difficult to separate and sort commingled plastic resin streams to the quality that compete with virgin plastics. You have to imagine a truckload of commingled electronics from toaster ovens to monitors to radios shows up at our facility and now we have to process that material and process the plastic to a point where it can compete with virgin plastic. This is a challenge.

All in all, what this does is creates hesitancy in the marketplace. Recyclers are hesitant to further invest in the technology needed for greater automation and optical sorting to address the CRT glass and the plastic. So how do we inject investor confidence? We would suggest targeted research and development to new and used markets for mixed scrap plastic and glass and potentially investment incentives for new recycling equipment such as an accelerated depreciation model for new recycling equipment that is energy efficient and climate friendly and designed to increase recyclable yields.

And lastly, how do we find a responsible recycler? There are a spectrum of players on the market from the leaders of our association all the way down to what we call the sham recyclers out there, and we would caution the Committee for the need for new laws and regulations and would encourage enhancing policy that rewards responsible recycling. On our side of the equation, we have created a Recycling Industry Operating Standard, or RIOS, that is an integrated, comprehensive management system that incorporates environment, health and safety and quality goals for the recycler in tomorrow's market.

[The prepared statement of Mr. Harris follows:]

PREPARED STATEMENT OF ERIC HARRIS

Mr. Chairman and Members of the Committee. Good Morning. My name is Eric Harris and I am the Associate Counsel and Director of Government and International Affairs for the Institute of Scrap Recycling Industries, Inc.—the "Voice of the Recycling Industry."

Introduction

ISRI is the world's largest trade association of recyclers with well over 1,550 member companies that operate over 3,000 locations in the United States who process, broker and industrially consume scrap commodities, including metals, paper, plastics, glass, rubber, textiles and electronics. More than 20 percent of ISRI's membership is involved in electronic scrap processing and industrial consumption of scrap material generated by electronics recyclers. In fact, electronics recycling is the fastest growing segment of ISRI's membership.

In 2007, the domestic scrap recycling industry manufactured approximately $71 billion of specification grade commodities that were used in lieu of virgin materials to manufacture basic products in the United States and throughout the world. This figure includes more than 81 million tons of iron and steel, five million tons of aluminum, 1.8 million tons of copper, and two million tons of stainless steel, just to name a few. Of the $71 billion of scrap recycled last year, nearly $22 billion worth of these commodities were exported to 152 countries worldwide, making a significant positive contribution to the United States' balance of trade with other nations and serving as the first link in the global manufacturing supply chain. Scrap accounts for approximately 40 percent of the world's raw material needs.

Scrap recycling is one of the world's most climate friendly activities. The use of recycled scrap materials to manufacture new products sustains the Earth's natural resources, while at the same time, conserves impressive amounts of energy in the manufacturing process, and thereby significantly reduces greenhouse gas emissions from those facilities.

For example, recycling 1,000 computers and monitors rather than landfilling them would prevent a net total of 52.64 metric tons of carbon equivalent (MTCE) and 193 metric tons of carbon dioxide equivalent ($MTCO_2$) from entering the atmosphere. This is the equivalent of not driving 42 cars for an entire year. This would also save over 3,370 million BTUs. And, the energy savings would equal 27,171 gallons of gasoline.[1]

U.S. Electronic Scrap Generation and Recycling

Approximately 2.8 billion pounds (1.4 million tons) of electronic equipment were recycled in 2006, including 65 million units of computer equipment (CPUs, monitors and printers). The electronics recycling process yielded approximately 1.3 billion pounds of recyclable materials, more than half of which were metals. Consumer electronics, alone, are now considered to be approaching more than three million tons generated annually.

According to a recent study by the Consumer Reports National Research Center, E–Waste 2006, 90 percent of Americans own at least one computer. That means there are over 270 million computers in America. However, 45 percent of American consumers retain electronics because they are unsure of the appropriate method to deal with such items at the end of their useful lives. Moreover, 35 percent of American consumers retain electronics because they consider it inappropriate to dispose of them with the garbage. Consequently, upwards of 50 percent of American consumers have yet to send their obsolete electronic equipment into the recycling stream.

With the proliferation of new electronic products every day, obsolete consumer electronic equipment levels are expected to increase to 400 million units annually during the rest of the decade, including 100 million units of computer equipment. If we combine both consumer and non-consumer computer equipment (commercial, industrial and government sectors), we can estimate that more than two billion will become obsolete over the next five years.

ISRI members provide comprehensive recycling operations, which covers everything from logistics (e.g., collection and transportation) and data security to de-manufacturing, to manufacturing specification grade commodities from the electronic products. Our members make their living scrubbing and reselling hard drives, by testing and then reselling cell phones, monitors and CPUs that are in good working order, and using machinery and equipment to shred or otherwise process electronics

[1] United States Environmental Protection Agency WAste Reduction Model (WARM), *http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_home.html*

to extract the various commodities that are contained in electronic equipment including steel, aluminum, gold, silver, titanium, copper, nickel, plastic and glass—for use as valuable raw material feedstock in the manufacture of new products.

Once electronics products reach our members they are first triaged to determine whether they are to be resold, refurbished, or processed into specification commodity streams.

Whether the decision is made to refurbish or process into specification grade commodities, the export market for the resulting product is an essential part of the legitimate recycling chain. With regard to reusable or refurbished electronics, there is an increasing presence of large for-profit reuse markets in developing countries, especially Asia, Africa, and South America, where the majority of the population simply cannot afford to purchase the latest available technology. It is both environmentally and socially responsible to provide for the continued export of these viable products that make basic technologies and communications available where they would otherwise potentially not be. There is now even a growing market in the third world for the purchase of monitors to be converted into TVs.

As a result of the above, recycling experts anticipate that as collection of household electronic equipment in the United States increases, exports of certain recyclable streams will also increase; for example, used, intact equipment for reuse; used components for reuse; used equipment for refurbishment; and, fully processed materials for use as raw materials in manufacturing.

Key Challenges

The key challenges to increasing electronics recycling in the United States include, among other things: (1) how to adequately cover the costs associated with collection, transportation and recycling of household electronic equipment; (2) distinguishing scrap from waste and not over regulating; (3) free and fair trade; (4) developing adequate end-use markets for recyclable plastics and glass and demand for that material; (5) Design for Recycling; and, (6) promoting EPA's Responsible Recycler practices and ISRI's Recycling Industry Operating Standard (RIOS) as the proper means to address environmental concerns.

How to adequately cover the costs?

The cost to responsibly recycle electronic products remains the greatest challenge for recyclers. As the competition to collect household computer equipment increases across the country, recyclers are being forced to take in a growing list of older, less valuable electronic equipment, such as televisions, AM/FM radios, and old hairdryers. Under current market conditions, much of the collected electronic equipment, for example at weekend collection events, has little to no resale value and has a net-negative cost to recycle (the cost to recycle the equipment outweighs the value of the processed material). This problem is only exacerbated when you factor in the logistical challenges and associated costs to get the collected electronic equipment transported to a facility that can responsibly recycle it.

As a result, until such time as the market for recyclable electronics becomes economically viable, ISRI's policy continues to support holding producers responsible for the collection, transportation and recycling of household electronic equipment that has a net-negative cost to recycle, such as cathode ray tubes in monitors and televisions. ISRI firmly believes that producer responsibility will provide manufacturers with the needed incentive to design their products with an eye to the future, incorporating design changes that maximize recycling at the end-of-life. This concept, which ISRI calls Design for Recycling, is critical to the success of increasing the recycling of electronics long term. In the interim, as successful business people, we believe that if given the flexibility and opportunity to internalize the costs manufactures will create a model that will be less bureaucratic and burdensome and cheaper for the tax payer.

While ISRI will ultimately defer to the wisdom of the Congress and the states to decide which financial mechanism is most apt to spur markets for electronic recycling, we strongly encourage the Congress and the states to end any financial mechanism as soon as markets for recyclable electronics become economically viable. We are not an industry that seeks government subsidies, and we believe markets must ultimately stand on their own based on solid business principles.

However, whatever financial mechanism the Congress and the states might decide to adopt in order to sustain this market, ISRI suggests that a portion should be applied to the research and development of end-use markets for the scrap materials recovered from electronics products, particularly plastics and glass.

Scrap is not Waste, Recycling is not Disposal

For recycling in general, and particularly for electronics recycling, we need to avoid creating unnecessary impediments. It is very important to distinguish between scrap and waste as well as recycling and disposal. Simply stated, scrap is the opposite of waste. Processed scrap materials are commodities that have a significant value on domestic and international markets as raw material feedstocks that substitute for virgin materials in the manufacture of new basic materials such as copper, steel, and plastics. Unlike scrap, 'waste' has no value and is typically buried in a landfill.

Electronics scrap, like scrap paper, glass, plastic, metal, textiles, and rubber, is not waste when recycled. Defining scrap electronics as waste undermines and overlooks the value that these electronics retain, if properly recycled. Saddling them with the moniker of "waste" imposes a whole host of unwarranted regulatory burdens that will undermine the ability to allow the recycling system to operate effectively and efficiently.

Private sector electronics recyclers are subject to all the federal and State environmental, safety, and export/import regulations that are applicable to any industrial operations. For example, recyclers currently operate under a host of applicable environmental regulations, such as permitting requirements in the *Clean Air Act,* the *Clean Water Act* and its various storm water provisions, among others. In addition, electronics recyclers adhere to State requirements which in some cases are more stringent than the corresponding federal requirements, federal and State transportation and occupational safety and health laws, U.S. export laws and regulations and the import requirements of foreign countries, such as those administered by China's General Administration on Quality Supervision, Inspection and Quarantine (AQSIQ).

For these reasons, it is critically important that we avoid confusing the valuable commodities manufactured by scrap recyclers with wastes, whether in our vernacular or in written form.

Free and Fair Trade

Another key aspect underlying ISRI's policy is the concept of free and fair trade. We have been in the recycling business a long time and experience tells us that the specification grade commodities we manufacture are some of the best examples of basic supply and demand economics. These materials are traded in the global marketplace, supplying America's basic manufacturing industries with valuable raw material feed stocks that are used in place of virgin materials, and also contributing significantly towards a positive balance of trade with other nations. And these global markets are far from new—the London Metal Exchange started trading copper in 1876, harnessing an already existing global market in copper.

Despite the realities of the global marketplace, however, exporting electronic scrap continues to be besmirched. We have all seen the horrendous photographs and broadcasts regarding China's artisan communities. But, there has been little to no coverage regarding China's sophisticated recycling parks, which have been developed in China over the past ten years in an effort by the Chinese government to reign in the "rogue recyclers" who have been responsible for some terrible situations. However, costs and demand for scrap material is still driving the market. Experts tend to agree that this is largely being driven by the fact that most of all new electronic equipment is being manufactured in Asian markets. As a result, since demand is so high, Asian brokers are able to pay more for the obsolete electronic equipment than in Europe and the United States. Thus, countries like China continue to purchase obsolete electronic equipment from countries all over the world, including the United States.

ISRI contends that the stigma associated with "exporting" is misguided and exports should be viewed from the prism of the realities of the global economy. The focus must be to promote responsible recycling globally and concentrate efforts towards enhancing and promoting environmentally capable facilities that will receive and properly handle recycled materials anywhere in the world. ISRI suggests that the United States government should refocus its attention on negotiating trade agreements with key trading partners around the world, such as China and India. These agreements could detail the environmental and safety requirements for these facilities and establish a process that would allow the materials to flow more on the basis of value of the commodity and less on the geographic location of the collection.

Markets for Plastic and Glass

Two of the greatest challenges of electronics recycling are the difficulties in recycling chemically coated glass from cathode ray tubes (CRTs) and sorting the different resins of plastic.

ISRI has suggested that State bills and a federal bill should focus on establishing a *short-term* financial subsidy for *consumer* generated monitors and televisions with CRTs. Moreover, additional markets for the recycled glass are a critical necessity. If CRT manufacturing is, as most predict, soon to be obsolete and lead smelters continue to charge a fee analogous to a hazardous waste landfill fee then recyclers need alternative end-use markets for that CRT glass. ISRI strongly recommends that research and development dollars need to be invested to develop alternative markets.

With regard to plastics, despite the continual improvement in automation and optical sorting technology (which helps distinguish between different colors and streams, due to the heterogeneous nature of input materials) sorting variations of mixed plastic resins remains a challenge for recyclers. In addition, since the market for engineered plastics is not fully developed in the United States, the vast majority of baled plastic is being exported. And, although foreign markets are driving the price of baled plastic in the right direction, the stigma on exporting, in general, is creating a lack of confidence in the U.S. market.

Although no single technology has solved the task of sorting plastic to a level that can compete against virgin resin streams, the technology has improved. What is lacking is investor confidence in the overall market. ISRI contends that as the market matures and end-use markets for plastic and glass develop investment dollars will follow. Similar to CRT glass, research and development dollars are needed to help develop new end-use markets for mixed plastics scrap. This will create more opportunities in the market place and thus increase investment confidence in existing optical and sorting technology.

Targeting funds to advance technology in these two fields would have a positive impact on making end-use consumer markets more economically viable, which would, over time, ensure these markets could stand on their own without a subsidy. In fact, ISRI believes it would be wholly appropriate for the Congress to support research efforts aimed toward the development of technologies that could remove the remaining impediments in plastics and glass in order to utilize these materials in the manufacturing process.

Designing for Recycling©

Removing hazardous components from scrap electronic equipment and sorting through material that is difficult to recycle, such as mixed plastics, costs recyclers time and money. ISRI has long advocated working with manufactures to design their products to be easily recycled at the end of their useful lives, without using hazardous, toxic constituents, or impediments that can hinder the recycling of those products.

To date, voluntary calls by the recycling industry to motivate manufacturers to adopt a Design for Recycling© philosophy have been met with only a tepid response. We do recognize that electronics manufacturers have taken some steps towards designing for recycling; however, there is significant room for improvement. For example, manufacturers use of mercury. The new technology in flat screen monitors utilizes a system of lamps containing mercury powder. These mercury lamps are very time consuming to remove or replace, which makes this new technology difficult to recycle. Similarly, some of the cell phone batteries with small traces of mercury take up to five minutes to remove. And, laptops contain tiny mercury lamps that are very difficult to locate and remove. In the end, it takes a lot of extra time to recycle in the proper manner. This drives up the labor costs, which makes recycling these products less profitable. Design for Recycling© will help to avoid these additional costs and improve recycling efficiency.

More collaborative opportunities are needed to think through some of these design issues before these products reach the market. For example, EPEAT is an electronic product design standard adopted by the Environmental Protection Agency that has been very successful in the marketplace. Most major computer manufacturers are using EPEAT as their measure of environmental product design, and are competing to gain additional credits from EPEAT by going beyond what other OEMs have done. Some manufacturers have incorporated significant amounts of recycled plastic in their products. This creates demand for recycled plastics from computers which increases the value that recyclers can capture for the material. Similar types of programs could be encouraged by the Congress.

EPA's Responsible Recycler Practices and ISRI's Recycling Industry Operating Standard

For the past two years, ISRI has represented electronics recyclers in a multi-stakeholder process to develop responsible recycling practices (R2) for electronics recyclers. The Environmental Protection Agency has convened and facilitated this effort. Once completed, ISRI intends to incorporate this set of specific performance practices into its Recycling Industry Operating Standard (RIOS) for electronics recyclers.

ISRI developed RIOS as an integrated management system standard designed specifically for the scrap recycling industry and the ANSI–ASQ National Accreditation Board will oversee the third party registrars who will audit recyclers. It provides electronic recyclers with an affordable tool to monitor their quality, environmental, health and safety goals. Few industries worldwide have endeavored to undertake such a huge step, but the recycling industry in the United States has always been, and intends to remain, the global leader in recycling technology, environmental protection, worker safety and the production of high quality materials. RIOS is a tool for us to accomplish those goals and will help assure that ISRI members who recycle scrap electronics will do so in a manner that is best for our country and the world in which we live.

ISRI is hopeful that the combination of the EPA led effort, R2, and RIOS will provide a "one-stopshop" for electronics recyclers. This will help to build needed confidence in the market place and reward responsible recyclers that are willing to be audited to a set of requirements in an open and transparent process.

Conclusion

In closing, I want to remind the Committee that our members have provided stable, good-paying jobs in this country during the boom years, the lean years, in war time, and in peace time. In one capacity or another, ISRI members have been recycling electronics for decades as an integral part of their recycling operations. We feel these experiences from our membership will assist the Committee in developing effective solutions that will help address the onslaught of consumer based electronic products that are now entering the market.

Thank you for this opportunity to address the Committee today. ISRI looks forward to future opportunities to work with the Committee to continue advancing these and other solutions on issues important to recycling.

BIOGRAPHY FOR ERIC HARRIS

Mr. Harris advocates policy and provides legal counsel for ISRI. Areas include: climate change and sustainability, electronics, air, the Basel Convention, and ISRI's arbitration program. Mr. Harris received his masters of law degree from the George Washington University in International Environmental law and his law degree from the University of Montana. Before coming to ISRI, Mr. Harris provided legislative counsel to U.S. Senator Max Baucus from Montana.

Chairman GORDON. Thank you, Mr. Harris.

Mr. Smith, you are recognized.

STATEMENT OF MR. TED SMITH, CHAIR, ELECTRONICS TAKEBACK COALITION

Mr. SMITH. Good morning, Mr. Chairman, Members of the Committee. Thank you for inviting me to testify here today. My name is Ted Smith. I am the Chair of the Electronics Take-Back Coalition. I am also the founder of the Silicon Valley Toxics Coalition, former Executive Director there, which was formed 25 years ago to address the issues of health, environment, and the development of the electronics industry.

I want to run through several slides very quickly. The problem I think is multifaceted, as you have heard. The products don't last very long. The equipment is toxic. More e-waste is thrown away than is recycled. More recyclers simply export their products to developing countries and the toxic components resulting from poor design make e-waste hard to recycle. The shrinking lifespans is one

of the serious issues that we face. New technology drives consumers to buy new products at astonishing rates. The prediction is 32 million new television sets will be sold this year and 22 million new computers will be sold, and the February 17, 2009, digital conversion deadline is rapidly approaching. We predict that this is going to mean millions more televisions will be coming into our waste stream over the next few years.

You have heard that e-waste is toxic—lead, mercury, cadmium, brominated flame retardants. Our landfills are beginning to fill up. It is still a small percentage of our landfill waste but it is the fastest growing, as you have heard, and of all the equipment that is currently being collected, we predict that something like 87.5 percent is currently being trashed and only 12.5 percent is being recycled. And this is the key: Of the products that are being recycled or collected for recycling right now, we estimate that 50 to 80 percent are being exported for processing in developing countries, and what this looks like is, some of the most primitive processing you can imagine. There is video of this that I highly recommend if people have time to look at it, but what we know is that the products are being taken apart with hammers and that they are being burned. They burn the plastics in order to get the metals, which have value, and when they burn the plastics, it is creating dioxin clouds which are affecting the children in these communities throughout the developing world. This is happening in China. It is happening in Asia. It is happening in Africa. This is one of the biggest problems that we are facing right now and I think the United States is primarily responsible for this.

So what can Congress do? We do support strong producer responsibility. We have been working with State legislatures around the country. There are now almost a dozen states that have passed laws. Most of them are producer responsibility. We do think that we need to close the door on exporting the hazardous e-waste to poor countries and we do need to promote a comprehensive green design initiative. Producer responsibility means electronic manufacturers should bear the responsibility throughout the product life cycle. This is a design initiative that started in Europe which has now spread around the world and we are working actively to bring it into the United States. We think that the legislation needs to include strong goals and timetables that drive increases in recycling and we support federal legislation but only if it is strong legislation and not lower than what is already happening in the states and certainly we don't want to see a situation where the Federal Government would pass legislation, preempt the states and have a lower standard than what is already happening out there.

But primarily we think that the role of the Federal Government can focus on two things: it is preventing the export of the hazardous waste because the states cannot address that. We know that there are good processing options that do exist in the United States and other developed countries and we think that we do need to ban the export of the toxic e-waste so that we can prevent the harm that we know is going on.

But the other major initiative that I would like to talk to you today about is what we think that the Federal Government can do to encourage green design and green engineering. E-waste would

not be an issue if the products themselves were not so toxic, and industry's efforts to green their products are increasing but we think still inadequate compared to rapid pace of the design changes. The manufacturers can design electronic products using green chemistry and green engineering principles to make their products more durable, more upgradeable, to be carbon neutral, fully recyclable and requiring fewer unsustainable materials. We think that a national sustainable electronics initiative is the way to go where we can combine some of the best thinking in the country from within industry, within academia, within government agencies, public health and environmental organizations to develop the new strategies, not only to address the problems of electronic waste but also to really try to solve these problems at the front end, which we do think is the place where we need to do it, and we think that the new initiative could be composed of a national clean electronics council, which would be a governing body, again a multi-stakeholder body, as well as a national clean electronics research and development fund funded by Congress. We think that the appropriate role could be to assess the current and future environmental and human health impacts, develop strategic plans to identify priority research needs, funding public and private research institutions, and to assure the diffusion and adoption of safer and cleaner technologies.

Thank you very much.

[The prepared statement of Mr. Smith follows:]

PREPARED STATEMENT OF TED SMITH

E–WASTE: The Exploding Global Electronic Waste Crisis and Why Green Design Is the Solution

Introduction

I am Ted Smith, the Chair of the Electronics TakeBack Coalition, a national coalition of organizations promoting green design and responsible recycling in the electronics industry. I was also the Executive Director of the Silicon Valley Toxics Coalition, an organization I founded 25 years ago.

The Electronics TakeBack Coalition appreciates the opportunity to speak to the Committee today on this important issue of electronic waste.

What's the problem we need to solve?

- The electronics we buy don't last very long, and we are buying them at increasing rates. Shorter product lifespans, coupled with explosive sales in consumer electronics, mean that more products are being disposed of, and discarded computers, TVs, and other consumer electronics (so-called e-waste) are now the fastest growing waste stream in the U.S.
- Electronic products contain many toxic materials because they are not designed properly. E-waste contains toxic materials harmful to humans and our environment. Over 1,000 materials, including chlorinated solvents, brominated flame retardants, PVC, heavy metals, plastics and gases, are used to make electronic products and their components.
- Most e-waste is thrown in the trash—only a small amount, around 15 percent, is collected for "recycling." It's legal in most states to put e-waste in the trash.
- Most "recyclers" actually export the products they collect to developing countries with no worker safety or environmental protections. There the products are dismantled and separated using such primitive and toxic technologies that workers and communities are exposed to many highly toxic chemicals. Consumers have no way to know if the recycler at their city's Earth Day col-

lection event is really going to recycle their old product, or load it in the container and ship it to China.

- Toxic components and poor design make e-waste hard to recycle.

The whole problem is made worse by the fast approaching 2009 digital conversion of television signal, which we see as the largest government mandated planned obsolescence in history.

[For more details on these aspects of the problem, please see the E-Waste Briefing book, in the Attachments.]

How do we solve the problem?

1. Establish Producer Responsibility for electronic products at the "end-of-life."

The first step in solving the problem is to mandate producer responsibility—something that is already happening in State legislation. We need the manufacturers to be responsible for taking back and recycling their products when we are done with them. We believe that if they have financial responsibility for their products at disposal time, then they will have an incentive to design them to be more recyclable. While the cost of recycling is passed on to the consumers, the cost is internalized into the price (not added as a visible fee), which rewards the companies who have designed their products to be more recyclable. Since their better-designed products will cost less to recycle, they can add a lower amount to their price to cover the recycling.

We support strong producer responsibility legislation, that includes goals and timetables that act to drive the companies to do more recycling than they are doing with voluntary programs. Some companies do have voluntary take-back programs, but except for Sony, none of the television companies—the ones selling over 30 million TVs each year in this country—have a national take-back program. In fact, they have been lobbying against legislation to require them to take-back their products. And for the companies that do have programs, the volumes are not significant enough to solve this problem. Dell and HP's take-back programs only take-back about 10–15 percent of what they sold seven years ago. This is why we need legislation that actually drives them to do take-back in a way that keeps up with the volume of products they are selling.

> *"Individual producer responsibility encourages competition between companies on how to manage the end-of-life phase of their products. This in turn drives innovation, such as in business models, take-back logistics and design changes, to reduce the environmental impact of products at the end of their life."* [Joint Statement by a group of electronics companies and NGOs on Producer Responsibility for Waste Electrical and Electronic Equipment, March 2, 2007.]

2. Close the door on exporting toxic e-waste to poor countries.

While the states are passing take-back legislation, these laws can't legally restrict exports. Sadly, it's perfectly legal to export toxic waste from the U.S. to developing countries, even though it violates the laws of most of the countries where e-waste ends up. We are currently solving our e-waste problem by dumping it in poor countries. And while you will hear from the recycling industry that we shouldn't prevent export of toxic electronic products or components as long as they have "commodity value," we believe that if it's toxic, it's toxic—whether it has value or not—and it should be controlled to be sure that it isn't poisoning people elsewhere in the world. It's not that we oppose exporting altogether—it's fine to export once you have actually removed the toxics from the materials. But that's not what's currently happening. (Instead, the EPA is just removing these toxic materials from the definition of "hazardous waste.")

So we need the Federal Government to act to close the door on this export of toxic e-waste to poor countries. Since there are many processing options for these materials in the developed world, Congress could solve the problem by banning the export of these toxic materials to developing countries. This would have the added benefit of creating more jobs in this country.

3. Promote Green Design and Green Engineering

Producer responsibility helps support redesign of electronics. But we need some other significant efforts that will result in a wholesale change in the way the electronics industry thinks about design. Currently, many companies claim to have "green products" when they have only done two things: reduced the products' energy consumption and complied with the chemical reductions mandated by the EU. But what I am talking about is a much broader scale of green design.

We want to see this industry think about the whole life cycle of their products when they design them—a concept known as Green Engineering. They shouldn't just consider the product's use as a product—but also the impacts from production (including resource acquisition) and disposal of the product. Working from two very good lists developed by engineers of what comprises "green engineering," we think it adds up to having the industry do the following:

- **Fully assess and minimize the potential environmental, human health and social impact** of the product's production, use and end-of-life treatment, including commonly used recycling and disposal technologies (like shredding).
- **Don't use customers as the testing ground for whether materials in the product are safe or dangerous.** Ensure that all material used and or released are as benign and inherently safe as possible BEFORE putting products on the market, by applying a precautionary approach to chemical management and by finding safer substitutes for chemicals that persist and accumulate in the environment.
- **Design for carbon neutrality** when possible to reduce the energy impact of the product throughout its life cycle.
- **Maximize design for reparability, reuse and durable use** to increase the longevity of the product and thereby reduce consumption of limited material resources.
- **Plan for recyclability and ease of disassembly** of the product, including using materials that can be recycled easily into new products, and minimizing waste.
- **Minimize use of raw virgin materials,** and maximize use of recycled materials, to reduce consumption of limited natural resources.
- **Invest in solutions that go beyond our current dominant technologies** to improve, innovate and invent technologies that achieve sustainability.
- **Actively engage communities and stakeholders** in the development of new design solutions that improve the life cycle impact of electronic products.

Focus on Safe Materials

U.S. based high-tech companies know pretty well what materials they do not want to use in their products based on their toxicity and overall impact on the environment. But they are not so sure about what they do want to use. Companies have recently had to phase out the use of those materials that are now being regulated in Europe and Asia through laws such as the Restrictions on Hazardous Materials (RoHS). Likewise, the EU's REACH legislation will have an enormous impact on chemical use by the electronics industry, since it will cover as many as 1,800 chemicals that are classified as Persistent Bioaccumulative Toxics or as carcinogens, mutagens or reproductive toxins.

Since most global companies based in the U.S. no longer do their own research and development—especially on environmental design—there is a real need and demand for better environmental assessment tools that are comprehensive, objective and credible for all stakeholders. Currently, the U.S. EPA does not certify chemicals as "safe" or "green"—they will sometimes provide data, but they have been unable to evaluate and assess the data to reach conclusions about which chemicals or materials are safer and preferable to others. Further, the system they use to approach these concerns is based on risk rather than hazard, which is less helpful in the real world. This is the approach that EPA's Design for the Environment program has adopted.

Currently, federal policy is rudderless—not just for electronics but for many industries that rely on the use of hazardous materials—and too often companies simply don't know how to address the many trade-offs inherent in materials selection. They don't know how to evaluate the strengths and weaknesses of new materials based on the trade-offs between reproductive toxicity and global warming potential, as just one example. There is a new tool, called the **"Green Screen"**[1] that can be used to help to fill this gap. It provides a transparent way to "grade" chemicals based on actual hazard (not risk) and tells you which ones are "better" to use and which ones are "worse." We think it would be helpful to U.S. industry, particularly in sectors that have a toxic and energy intensive footprint. But it's a methodology, and there needs to be sufficient funding and institutional resources to apply this ap-

[1] *http://cleanproduction.org/library/Green%20Screen%20Report.pdf*

proach to a lengthy list of chemicals. For information, see *http://www.cleanproduction.org/Green.Greenscreen.php.*

U.S. Falling Behind. The basic university research at industry labs and within universities is simply not keeping pace with global developments. Some of the best "green chemists" in the country—such as John Warner at University of Massachusetts, Lowell—are very concerned that most of his graduate students come from other countries, since U.S. high schools and colleges and not preparing enough chemists domestically who want to help meet these challenges. At the same time, the green chemistry revolution is expanding vigorously in other countries, such as China and India. I was in China last year on a university speaking tour, and met many enthusiastic and bright students who are very excited about using the tools of green chemistry to help solve the critical problems of environmental design. But in the U.S., we are falling further and further behind.

What Can Congress do to help promote Green Design and Green Engineering?

Industry is simply not developing a sufficient green design agenda on its own. The structure of this industry, where most of the production is done by various subcontractors around the world—not by the companies themselves—acts as a disincentive for R&D on green design. Therefore, we believe that Congress can help by establishing and funding a National Sustainable Electronics Initiative (NSEI), that brings together members of industry, academia, government agencies, and public health and environmental organizations, to insure the rapid development of electronic products that embrace the Green Engineering principles—that are cleaner, safer and more sustainable throughout their life cycle. This initiative would be composed of a National Clean Electronics Council (a governing body) and a National Clean Electronics Research and Development Fund (funded by Congress.)

The National Sustainable Electronics Initiative should develop strategies to:

1) Minimize their environmental and public health impacts on workers, consumers and communities from manufacture through use and final disposal or recycling. This includes but is not limited to:
   a) reducing the toxicity and volume of packaging
   b) minimizing product shipping throughout its life cycle, from raw material extraction through disposal
   c) reducing or eliminating toxic materials in product manufacture
   d) effective and enforceable environmental standards to assure that toxic electronic waste will be properly managed in strict compliance with international and domestic laws, including the laws of importing and transit countries, that govern export of hazardous electronic waste, worker safety, public health and environmental protection, and the use of market labor rather than incarcerated labor;
2) Be taken back at the end-of-life by manufacturers
3) Be designed for reuse and recyclability, including maximizing componentization and part interchangeability
4) Be designed to minimize material use per functional unit (de-materialization)
5) Minimize energy use/ maximize energy efficiency
6) Fully assess the environmental and public health impacts of new materials and technologies prior to use and/or market release (e.g., new chemical components, nanomaterials, bio-plastics, etc.)
7) Minimize energy use/maximize energy efficiency
8) Fully assess the environmental and public health impacts of new materials and technologies prior to use and/or market release (e.g., new chemical components, nanomaterials, bio-plastics, etc.)

The NSEI would promote a full-life cycle assessment approach for the electronics industry, with continuous improvement goals to be set by the National Sustainable Electronics Council in consultation with a National Sustainable Electronics Research and Development Fund.

The Council, which would be comprised of representatives of the electronics industry companies, environmental and public health organizations, and national government agencies, would be responsible for:

- assessing the current and potential future environmental and human health impacts of consumer electronics

- developing a strategic plan for the reduction and minimization of all detrimental impacts, including the identification of current barriers and opportunities, the identification of priority research needs, and the setting of Strategic Program Goals for the industry,
- awarding funding on a competitive basis to universities, corporations, private research institutions and national laboratories, for addressing priority research needs, for eliminating current barriers, and for developing safer and cleaner technologies,
- assuring the diffusion and adoption of safer and cleaner technologies,
- assessing the effectiveness of the implementation of the strategic plan,
- reporting on a bi-annual basis on the performance of the industry in meeting the Strategic Program Goals, and
- managing the Research and Development Fund

4. Promote Tools For Consumers to Select Green Electronics

Consumers always ask us what electronic products are environmentally preferable. Who makes a "green TV?" Which laptop is greener? The primary tool available for this purpose is the fairly new EPEAT tool—the Electronic Products Environmental Assessment Tool. It's like an Energy star label, currently only for business computers. We'd like to see this expanded to other electronics products, including Televisions. The EPEAT board was slated to develop standards for televisions next, but has recently decided to postpone this plan. We think it's crucial for EPEAT to address televisions as its next target, since we are buying so many televisions, and because there is so much new technology coming out in televisions very quickly. We would like to see Congress provide enough funding to EPEAT to make sure the standards development process moves forward, plus we would like to see enough money to allow them to market the EPEAT program in a way that makes it a viable tool for consumers, not just institutional purchasers.

ATTACHMENTS:

SUSTAINABLE DEVELOPMENT THROUGH THE PRINCIPLES OF GREEN ENGINEERING

JULIE BETH ZIMMERMAN
DEPARTMENT OF CIVIL ENGINEERING, UNIVERSITY OF VIRGINIA
OFFICE OF RESEARCH AND DEVELOPMENT, U.S. ENVIRONMENTAL PROTECTION AGENCY

http://web.mit.edu/d-lab/assignment_files/green.pdf

INTRODUCTION

Concerns regarding population growth, global warming, resource scarcity, globalization, and environmental degradation have led to an increasing awareness that current engineering design can be engaged more effectively to advance the goal of sustainability and that there will need to be a new design framework that consciously incorporates sustainability factors as performance criteria. Sustainability has been defined as "meeting the needs of the current generation without impacting the needs of future generations to meet their own needs" and is often interpreted as mutually advancing the goals of prosperity, environment, and society. The 12 Principles of Green Engineering (Anastas, 2003) are collectively a design protocol for engineers to utilize in moving towards sustainability.

The impact of population growth has long been understood as one of the grand challenges to mutually advancing these goals and creating a sustainable future. When the issue is examined more closely, the data demonstrate that the vast majority of population growth is occurring in the developing world while population is stagnant, and in some cases declining, in the industrialized world (Figure 1). This may suggest that within the complex equation of growing population including birth and mortality rates, socio-political pressures, access to health care and education, cultural norms, etc., there is an empirical correlation between the rate of population growth and level of economic development, often equated with quality of life.

This relationship suggests that one approach to be seriously considered in meeting the challenges of stabilizing population growth and advancing the goal of sustainability is through expanded economic development and improved quality of life. Historically, however, increases in development and quality of life have been inextricable linked with environmental degradation and resource depletion. There is a significant amount of evidence that suggests that conventionally an increasing human population has put an increasing strain on natural resources used for consumption and waste assimilation. While there is no single satisfactory index of the state of the environment, the relationship between population and environment can be analyzed in terms of resource depletion or dimensions of environmental quality such as land use, water quantity and quality, pollution generation particularly from increased energy demand, bio-diversity, and climate change. A brief review of each of these indicators supports the notion that, traditionally, population growth has had a detrimental impact on the environment.

Therefore, the question is how to bring about continued development and enhanced quality of life in both the developing and developed world without the historical environmental degradation and resource consumption. Green Engineering, along with Green Chemistry (Anastas, 1998), are engaged through science and technology on ensuring that quality of life, or state of economic development, is increasing through benign chemicals and materials and life cycle-based design as well as material and energy efficiency and effectiveness. This decouples the historical relationship of population growth and environmental degradation on the path towards an improved quality of life. The 12 Principles of Green Engineering (Anastas, 2003) (see Table 1) provide a framework for scientists and engineers to engage in when designing new materials, products, processes, and systems that are benign to human health and the environment.

THE 12 PRINCIPLES OF GREEN ENGINEERING

A design based on the 12 Principles moves beyond baseline engineering quality and safety specifications to consider sustainability factors and allow designers to consider them as fundamental factors at the earliest stages as they are designing a material, product, process, building or a system. These Principles were developed to engage in design architecture—whether it is the molecular architecture required to construct chemical compounds, product architecture to create an automobile, or urban architecture to build a city, the Principles are applicable, effective, and appro-

priate. If not, the value of these design principles diminishes as their usefulness becomes dependent on local parameters and system conditions and they cannot effectively function as global design principles.

The 12 Principles of Green Engineering (Anastas, 2003).

PRINCIPLE 1—Designers need to strive to ensure that all material and energy inputs and outputs are as inherently non-hazardous as possible.

PRINCIPLE 2—It is better to prevent waste than to treat or clean up waste after it is formed.

PRINCIPLE 3—Separation and purification operations should be a component of the design framework.

PRINCIPLE 4—System components should be designed to maximize mass, energy and temporal efficiency.

PRINCIPLE 5—System components should be output pulled rather than input pushed through the use of energy and materials.

PRINCIPLE 6—Embedded entropy and complexity must be viewed as an investment when making design choices on recycle, reuse or beneficial disposition.

PRINCIPLE 7—Targeted durability, not immortality, should be a design goal.

PRINCIPLE 8—Design for unnecessary capacity or capability should be considered a design flaw. This includes engineering "one size fits all" solutions.

PRINCIPLE 9—Multi-component products should strive for material unification to promote disassembly and value retention. (minimize material diversity).

PRINCIPLE 10—Design of processes and systems must include integration of interconnectivity with available energy and materials flows.

PRINCIPLE 11—Performance metrics include designing for performance in commercial "after-life."

PRINCIPLE 12—Design should be based on renewable and readily available inputs throughout the life cycle.

ADVANCING GLOBAL SUSTAINABILITY

Science and technology will play a fundamental and vital role in advancing global sustainability by engaging in next generation design of fundamental products, processes, and systems necessary for maintaining and enhancing quality of life while protecting the planet. For global sustainability to be advanced the current operational model of unilateral knowledge transfer from the industrialized world to the developing world could be expanded to include knowledge exchange. The exchange would allow for learning about indigenous knowledge and traditional design, potentially simple and elegant, which has developed and adapted for local people and place. This would provide an opportunity to integrate the best and most appropriate knowledge, methodologies, techniques, and practices from both the developed and developing worlds in terms of designing for sustainability. The examples of innovations in science and technology from the developing world highlight alternative strategies to deliver services such as clean drinking water, medical treatment, energy and power production, material and product development, building technologies and techniques.

CONCLUSIONS

The achievements that have been obtained using green engineering principles are exceptional examples of design with a new sustainability perspective. If the challenges of sustainability are going to be addressed both within the currently industrialized nations as well as those developing nations whose path to development will be most consequential for the environment and society, it will be essential that these new design imperatives be incorporated systematically in the next generation of products, processes, and systems. Within this context, the technological dialogue that takes place between the developed and developing world must be able to consider and utilize both a high level understanding of complex systems as well as an incorporation of simple elegance found in millennia of experience and tradition. The sources of technological inspiration will likely need to be broad and diverse if we are to design the products and systems of tomorrow to be sufficiently improved and more sustainable than those of today.

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See also http://www.epa.gov/oppt/greenengineering/pubs/whats_ge.html for more about EPA's Green Engineering initiative.

Information on EPEAT

http://www.epeat.net/

EPEAT is a system to help purchasers in the public and private sectors evaluate, compare and select desktop computers, notebooks and monitors based on their environmental attributes. EPEAT also provides a clear and consistent set of performance criteria for the design of products, and provides an opportunity for manufacturers to secure market recognition for efforts to reduce the environmental impact of its products.

The EPEAT Registry on this web site includes products that have been declared by their manufacturers to be in conformance with the environmental performance standard for electronic products—IEEE 1680–2006. The standard is summarized *here,* and may be purchased from the *Institute of Electrical and Electronics Engineers.* EPEAT operates a *verification program* to assure the credibility of the Registry.

EPEAT Registered Products Search Tool

Product	EPEAT™ BRONZE	EPEAT™ SILVER	EPEAT™ GOLD	Total
Desktops	4	58	38	100
Integrated Systems	0	11	0	11
Monitors	6	284	12	302
Notebooks	4	126	14	144
Totals	14	479	64	557

* Integrated System is a desktop and integrated monitor as one product

The Electronic Waste Crisis and Why Green Design is the Solution

Ted Smith
Electronics TakeBack Coalition

Testimony to the House Committee on Science and Technology

April 30, 2008

Electronics TakeBack Coalition

What's the Problem?

- The electronics we buy don't last very long
- Electronic equipment contains many toxic materials
- More e-waste is thrown into the trash than is recycled
- Most "recyclers" simply export the products to developing countries with no worker safety or environmental protections
- Toxic components and poor design make e-waste hard to recycle

Electronics TakeBack Coalition

Growing Sales, Shrinking Lifespans

- New technology drives consumers to buy new products at astonishing rates:
  - Americans will buy 32 million new digital televisions in 2008 (3.9 million just for the Superbowl)
  - Americans bought 22 million computers in 2007.
  - The February 17, 2009 conversion deadline from analog to digital TV signal is leading consumers to throw out working (but not digital) TVs.

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E-Waste is Toxic Waste

Electronic products contain toxic materials harmful to humans and our environment:

- **Lead**: Lead exposure causes brain damage in children and has already been banned from many consumer products.
- **Mercury**: Mercury is toxic in very low doses, and causes brain and kidney damage. It can be passed on through breast milk.
- **Cadmium**: Cadmium is a known cancer-causing substance. It accumulates in the body and can cause kidney damage.
- **BFRs**: Brominated flame retardants (BFRs) may seriously affect hormonal functions critical for normal development. Incineration of plastics containing BFRs generates toxic brominated dioxins and furans.
- **Plastics**: Plastics, including PVC, make up to 13.8 pounds of an average computer. Hazardous chemical additives also phthalates) can leach when PVC components of electronic products are landfilled, and burning PVC produces dioxins, a group of the most potent synthetic chemicals ever tested, which can harm the immune and reproductive systems, and some of which are known to cause cancer.

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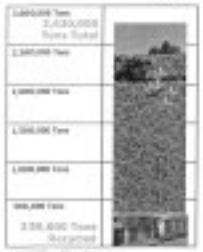
Most Toxic E-Waste Ends Up In Our Landfills



Each year, we generate 2.63 million TONS of e-waste in the U.S.

TRASHED: 87.5%
2.3 million tons end up in our landfills or incinerators.

RECYCLED: 12.5%
Only 109,000 Tons are collected for recycling.

Source: EPA 2005

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What happens to that 12.5% that is "recycled?"

50% – 80% of e-waste collected for "recycling" is EXPORTED for processing in developing countries.

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Exported E-Waste Exposes Poor Communities to Toxics

- In China, products are dismantled under primitive, unsafe conditions, exposing workers and nearby communities to toxic contamination. Workers here seek metals, like copper. They dump or burn the rest.

Photo by Basel Action Network

Electronics TakeBack Coalition

E-Waste Dumping - China

Irrigation canal in Guiyu, China, now used to dump used CRT glass from recycling operation.

© Basel Action Network

Electronics TakeBack Coalition

E-Waste Dumping, Nigeria

Photo by Basel Action Network

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What Can Congress Do to Solve The E-Waste Problem?

- Support Strong Producer Responsibility Legislation (Oppose weak legislation)
- Close the door on exporting e-waste to poor countries
- Promote a comprehensive Green Design initiative

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Producer Responsibility

- Electronics manufacturers should bear responsibility throughout the product life-cycle for their products and should take back and recycle older, obsolete products
- Strong legislation includes goals and timetables that actually drive increases in recycling.
- We support federal legislation only if it's very strong legislation, and not lower than what's passing in the states.

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Close the door on export

- State legislation can't address export problem
- Good processing options exist in developed countries
- Congress should act to ban the export of toxic e-waste to developing countries

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Promote Green Design and Green Engineering

- E-waste wouldn't be an "issue" if it weren't so toxic
- Industry's efforts to "green" their products are inadequate
- Manufacturers should design electronic products using Green Chemistry and Green Engineering principles
- Green Design for electronics must address the whole life cycle.
- In addition to using less toxic materials, "green" products should be designed to be:
  - durable/upgradeable/repairable
  - carbon neutral
  - fully recyclable
  - requiring fewer unsustainable material streams.

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How Can Congress Promote Green Design?

- We need a comprehensive initiative to bring together the key leaders from industry, academia, government agencies, and public health and environmental organizations to develop new strategies
- Congress should establish the **National Sustainable Electronics Initiative** to insure the rapid development of electronic products that embrace the Green Chemistry and Green Engineering principles – that are cleaner, safer and more sustainable throughout their life
- This initiative should be composed of a National Clean Electronics Council (a governing body) and a National Clean Electronics Research and Development Fund (funded by Congress).

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National Sustainability Electronics Initiative would be responsible for:

- **Assessing** current and potential future environmental and human health impacts of consumer electronics throughout the life cycle;
- **Developing a strategic plan** to identify priority research needs and set Strategic Program Goals
- **Funding** public and private research institutions for addressing priority research needs and developing safer and cleaner technologies;
- Assuring the **diffusion and adoption of safer and cleaner technologies**

Electronics TakeBack Coalition

Contact

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Electronics TakeBack Coalition

BIOGRAPHY FOR TED SMITH

Ted Smith is founder and former Executive Director of Silicon Valley Toxics Coalition, a grass roots environmental coalition formed in 1982 in response to environmental pollution caused by electronics manufacturing in Silicon Valley, California. Ted is also co-founder and Chair of the steering committee of the Electronics TakeBack Coalition, which is working to promote life cycle producer responsibility within the high-tech electronics industry. In addition, Ted is co-founder and Coordinator of the International Campaign for Responsible Technology (ICRT), an international network committed to working for the development of sustainable, non-polluting technologies. He has served on the boards of several environmental non-profit organizations and is an environmental stakeholder in formal processes convened by Hewlett-Packard and Dell. He is a widely published author and respected speaker, and is co-editor of *"Challenging the Chip: Labor Rights and Environmental Justice in the Global Electronics Industry"* published by Temple University Press, 2006. In 2001, Ted was recognized by the Dalai Lama for his environmental leadership. In 2006 he was named a Purpose Prize Fellow. He is a graduate of Wesleyan University and Stanford Law School and was a VISTA Volunteer in Washington, DC from 1967–1969.

Chairman GORDON. Thank you, Mr. Smith.

Mr. Williams, you are recognized.

STATEMENT OF MR. MICHAEL T. WILLIAMS, EXECUTIVE VICE PRESIDENT AND GENERAL COUNSEL, SONY ELECTRONICS INC.

Mr. MICHAEL WILLIAMS. Chairman Gordon, Ranking Member Hall and distinguished Members of the Committee, on behalf of Sony Electronics and its employees, I would like to thank you for providing us this opportunity to testify about Sony's environmental stewardship program.

Sony has long been an industry leader in the design and manufacture of environmentally friendly information technology and consumer electronic products. Sony has now made an even a stronger commitment to the environment when last September Sony launched the first national comprehensive electronics recycling initiative in the United States. Our program provides customers free recycling of any of their unwanted Sony products from a Trinitron television to a PlayStation to even a Sony Ericsson mobile cell phone. Under our program, Sony takes full manufacturer responsibility for all products that bear the Sony name and we will recycle Sony products at no cost to the consumer, or, the way I explained it to my 83-year-old mother, if we make it, we take it.

To carry out our nationwide take-back program, Sony contracted with Waste Management to establish 138 drop-off locations throughout the country. Our goal is to have 150 drop-off locations with at least one recycling center in each state by September. Our long-term goal is to have a collection location within 20 miles of 95 percent of the United States population. In addition to establishing these permanent locations, we also work with our local retailers and local municipalities to have recycling events. We have planned 50 of those events this year. Since last September, our program has collected almost seven million pounds of consumer electronic products. Our five-year goal is to collect 600 million pounds. In summary, Sony has set a goal for itself to collect one pound of recycled product for every pound that we sell. Sony wants to make the recycling of our products as easy for consumers as it is purchasing them.

Mr. Chairman, we believe this is a path to sustainability. But our environmental work at Sony doesn't stop at collection. All Sony products collected must be recycled using the strictest environmental standards. We seek at least 95 percent recycling rates. In addition, we provide full public accountability of where and how our waste material is disposed. We seek to reuse as much material as possible and we prohibit the exportation of hazardous waste to developing countries.

But Sony's environmental efforts are also forward looking as well. We continue to introduce a variety of environmentally friendly electronic products, and today I brought along two examples—the Sony e-Reader and our OLED television. Now, the Sony e-Reader, Mr. Chairman, Ranking Member Hall and Members, is a unique on-the-go reading experience. This little book, this little tablet can hold up to 160 novels, and with its rechargeable battery, you can have 7,500 page turns, and if you are like me, sometimes I forget to bring my reading glasses, you can even press a button and it changes the size of the font. But just think of how much paper, how much energy is saved with an e-Reader product.

I have also brought along our OLED television. This stands for organic light-emitting diode. It is only three millimeters thick, or I should say three millimeters thin. It represents the latest in Sony display technology, and it is also exceptionally energy efficient. The OLED technology can result in reduced power consumption of up to 40 percent per square panel inch, and because we use organic polymers in this display, it does not have any mercury or lead.

Mr. Chairman, these are just two products that Sony is doing today. Coupled with our stewardship program, our full producer responsibility take-back program, we believe this is the path that companies should take.

Thank you again for the opportunity to testify before this committee, and Sony looks forward to working with you in developing a successful national e-waste program.

[The prepared statement of Mr. Williams follows:]

PREPARED STATEMENT OF MICHAEL T. WILLIAMS

On behalf of Sony Electronics Inc. and our employees throughout the country, I would like to thank the Committee for the opportunity to testify about Sony's environmental stewardship program.

Sony's National E-Cycling Program

Sony has long been an industry leader in the environmentally-friendly design of our consumer electronics and information technology products. Sony has now made an even stronger commitment to environmental stewardship. Last year, we announced a ground-breaking program to encourage consumers to recycle and dispose of electronic devices in an environmentally sound manner.

Sony teamed up with Waste Management, Inc. to implement the first national recycling initiative in the U.S. to involve both a major electronics manufacturer and a national waste management company.

Our program provides customers free recycling of any of their unwanted Sony products, including Playstation consoles and Sony Ericsson phones. Under this program, Sony takes *full manufacturer responsibility* for all products that bear the Sony brand. We will recycle those products at no cost to the consumer. This not only includes consumer products, but business and professional products as well.

While Sony will recycle its own products for free, our recycling locations will also accept non-Sony consumer electronics and information technology products.

To fully carry out this nationwide e-waste take-back program, Sony and Waste Management Recycle America utilize 138 drop-off centers throughout the country. This is an increase from the initial 75. In addition to setting up permanent collec-

tion centers, we are also holding recycling events, coordinating with retailers and local municipalities. By the end of this year, we plan to have held at least 50 special recycling events.

Our goal is to have 150 drop-off locations throughout the United States, with at least one recycling location in every state by September 2008. Our longer term goal is to have a collection location within 20 miles of 95 percent of the United States population at which consumers, retailers, and municipalities can have any product from any consumer electronic manufacturer recycled.

Sony has set a goal to recycle one pound of consumer electronics goods for every pound sold. This is sustainability.

Since its inception last September, our program has collected almost seven million pounds of consumer electronics products. Our five-year goal is to raise that number to 600 million pounds per year.

In summary, Sony wants to make the recycling of our products as easy for consumers as the purchasing of products.

Other Sony Recycling Programs

Beyond the program described above, in an effort to encourage customers to recycle, Sony offers customers Sony credit toward the future purchase of a similar product if they send in their old product for recycling. This "trade-up" program is applied to laptops, digital cameras and camcorders. By going on to our website, *www.sonystyle.com,* customers can enter specific values describing their old product. Once the appropriate value is determined, customers will receive an e-coupon valid at our Sony Style website toward the purchase of a new product. Depending on the product, values can range up to $1,000.00.

Product Recycling

After products are collected through the Sony Take Back and Recycle program, Waste Management will store, track inventory and dismantle the products into the form of common raw materials where they can be bought and sold on the global market. In some cases, it is likely that recycled plastics will be purchased for reforming into a new current model electronic product.

All products which are collected through the Sony Take Back and Recycle program must be recycled using the strictest and highest environmental standards. We seek at least 95 percent recycling rates, with less than five percent of materials going to landfills. In addition, we provide full public accountability of how and where the material goes. We seek to reuse as much as possible in new Sony products. Most importantly, we prohibit the exportation of hazardous waste to developing countries.

Product Innovation

Sony has long been an industry leader in product innovation. And we are continuing to add an array of environmentally-friendly electronic products, such as our e-Reader.

The Reader Digital Book offers a unique, on-the-go reading experience. With a compact and lightweight design, it holds up to 160 e-Books. You can easily hold it in one hand, and with its rechargeable battery, you can turn up to 7,500 continuous pages on a single charge.

Today, I have brought with me an example of Sony's latest product innovation, our new OLED television. OLED (or Organic Light Emitting Diode) is a revolutionary Sony display technology that offers exceptional picture quality and color reproduction from a screen that is a mere 3mm thick. Unlike liquid crystal display (LCD) televisions, the Sony OLED TV does not utilize a backlight. In LCD TVs, a backlight must remain "always on" for video display. Rather, each OLED pixel produces its own light and is off, using no power, when displaying blacks.

While this OLED technology offers exceptional contrast ratios and outstanding dark scene detail, it also leads to improved power performance. Under normal viewing conditions, the OLED technology can result in reduced power consumption of up to 40 percent per panel square inch. As with all Sony BRAVIA LCD HDTVs, the OLED displays do not incorporate any lead content, and, with no backlight needed, offer no mercury content as well.

Sony hopes to utilize this technology for other future products, such as laptops, cell phones and larger size televisions.

Sony's Comments on Federal Legislation

Sony urges you to adopt legislation that supports our efforts and extends the environmental stewardship we have demonstrated to all electronics manufacturers and retailers. While we are confident that Sony's voluntary e-waste recycling program will make great strides forward, only a truly comprehensive and consistent program

will allow all interested parties to achieve our shared recycling goals. Sony, therefore, respectfully requests that any legislation reflect the following:

- **Preemption**

  Although it is of course a significant event when Congress preempts State regulation on a particular point, Sony believes that electronics recycling is an issue on which State preemption is essential. We and other stakeholders already have to comply with numerous, and sometimes contradictory, State and local e-waste laws. The inconsistency between these programs inevitably creates inefficiencies in the system and minimizes any economies of scale that could be achieved. And since Sony (and likely no other manufacturer) does not build products to be sold in a particular state, adding a federal bill without State preemption merely adds more complexity rather than simplifying and streamlining the process. In the end, a patchwork quilt of different and ultimately contradictory State and municipal laws will only serve to undermine everyone's shared goal of recycling as much electronic waste as efficiently and cheaply as possible.

- **Producer Responsibility**

  Sony believes that it is the individual manufacturer's responsibility to assure that any product that bears its name is properly recycled using the highest standards possible at the end of the product's life. That said, other stakeholders who directly benefit from the sale or enjoyment of electronic products must also bear some responsibility. More specifically, retailers—at the very least—must take an active role in the collection of e-waste and consumers must be encouraged to take the extra step necessary to properly dispose of their products.

- **Market Share**

  In order to create a level playing field, **any manufacturer obligation should be based upon present market share** and not on historical activities or waste collected. Systems based upon the amount of waste collected will give a cost advantage to those companies that are new to the market. Such companies can avoid any recycling cost by simply staying in business and changing their brand or company name every year. Many of these "no name" brands are made of lower quality materials, which can contain higher levels of toxic chemicals and may be more difficult to recycle. Any mandate not based upon today's market share will give those companies a "free ride" on recycling. This will lower their costs when compared to responsible companies by rewarding manufacturers who avoid their environmental obligations and penalizing responsible companies by putting environmentally-advanced products at a competitive cost disadvantage.

- **Products Covered**

  Our recycling program covers all of our branded products from movies (i.e., DVDs), to professional equipment used to project movies in theaters, to laptops or televisions used to watch movies at home.

  Sony, therefore, respectfully urges you to adopt one program with one set of requirements which will require full producer responsibility for all products manufactured. The advancement of technology has enabled manufacturers to create an array of products using the same chemicals and metals that are used in the products commonly covered in e-waste recycling mandates. Given this, Sony suggests adopting legislation to target all products that contain these same internal and external components and chemicals.

- **Cost**

  Sony internalizes the cost of recycling and requests that any mandate require the same. Currently, Sony pays to recycle our old products. While there are several financing mechanisms that allow for recovery of this cost, Sony believes that internalizing the cost is the most effective and fair method for funding a comprehensive electronics recycling program. Such funding mechanisms create market incentives for manufacturers to *ex ante* design and produce the most environmentally-friendly products possible. In addition, it encourages manufacturers to develop and implement the most efficient and cost-effective recycling procedures. Indeed, it is Sony's ultimate goal through design improvements, the growth of the recycling industry, and economies of scale to drive these recycling costs down, thus making recycling cost effective. Until that time, Sony considers the cost of recycling as part of the cost of doing business.

Thank you again for the opportunity to testify before the committee. Sony looks forward to working with you in developing a successful, national e-waste recycling program.

BIOGRAPHY FOR MICHAEL T. WILLIAMS

Michael T. Williams is Executive Vice President, General Counsel & Secretary of Sony Electronics Inc.

As General Counsel, he leads and manages a law department of over fifty members which is responsible for providing accurate and timely legal advice and guidance and rendering proactive, cost-effective counsel to achieve the Company's business goals at prudent risk levels. Mr. Williams is responsible for overseeing the environmental compliance support program of Sony Electronics and supports the environmental compliance activities of several Sony affiliated companies and joint ventures located throughout the world.

As Executive Vice President, Mr. Williams is also responsible for managing six other company departments: Corporate Security (including supply chain security & brand integrity); Trade Strategy & Compliance; Government Affairs; Technologies Standards Office; Community Affairs; and Ethics, Compliance and Personal Information Management.

As Sony Corporation's outside counsel for more than two decades, Mr. Williams represented the Company in a variety of litigation and business transactions, most notably working on the successful defense of the Company in the Go Video dual deck VCR litigation, as well as many class action suits.

Mr. Williams is a member of the American Bar Association; Association of Corporate Counsel; State Bar of California; United States District Courts in the State of California; and the United States Court of Appeals for the Fifth, Eighth, Ninth and Eleventh Circuits.

His professional appointments include Director and member of the Executive Committee of the National Association of Manufacturers, Director and member of the Executive Committee of the San Diego Regional Economic Development Corporation; Past Chairman, City of Palos Verdes Estates Planning Commission and Director of the Palos Verdes Home Association.

Additionally, Mr. Williams is active in various charitable organizations and events, including benefits for the Special Olympics of Southern California, San Diego Homeless Youth Project and ProKids. Along with Sony Electronics, he is being honored by the Minority Corporate Counsel Association this year for his success in establishing a diverse workforce.

Mr. Williams proudly served his country as an infantry officer in the United States Marine Corps. from 1975 to 1979. He received his Juris Doctorate, *cum laude,* from the University of San Diego School of Law and a Bachelor of Arts degree, *magna cum laude,* from Ithaca College. He resides in Rancho Santa Fe, CA with his wife and two daughters.

DISCUSSION

Chairman GORDON. Thank you, Mr. Williams. I hope it will be a few years, but I have a TV I am going to bring back to you one of these days.

Mr. MICHAEL WILLIAMS. Not a problem, Mr. Chairman.

Chairman GORDON. At this point we will open the first round of questions, and the Chair recognizes himself for five minutes. I am not going to take that. What I am going to do is ask—and many of you have been responsive already. I am going to submit questions to you and ask your suggestions on any type of federal research that might be beneficial both in the back end of recycling or the front end in developing technologies to make it easier to recycle on the back end, and I also will ask you about any other type of federal programs you think could expedite this. Your testimony has been very good.

And now I am going to yield the balance of my time to Ms. Richardson.

Ms. RICHARDSON. Well, thank you, Mr. Chairman. I have several questions and I would also like to—I think I will only get through a couple, if I could submit the rest into the record.

My first question is, I was very appreciative of Mr. Castro. First of all, I represent southern California and several of your sites are in my district, so welcome to Washington. One of our major issues regarding these recycling programs is the cost. California is the only state, as you mentioned, sir, with a consumer fee to pay for recycling. Almost other states have the manufacturer take the responsibility for the recycling cost. Which one of these models would you recommend would be best, and this question is for both Ms. St. Denis and I think Mr. Williams. My question is on the advanced recovery fee in California.

Ms. ST. DENIS. Thank you for your question. In our experience with the model in California and the models that have been developed in other states, we find that where the manufacturers are more directly involved in the recycling processes, as they are in other parts of the world, the systems become more efficient. We are much more tied to actually doing the recycling ourselves or having it done on our behalf. I am sure Mr. Smith would agree that the more we are involved in the recycling, the more we are motivated to find alternatives to some of the materials of concern that are in the products. The system in California has proved to be somewhat inefficient. There is a need for an increase in the fees. That was discussed at a meeting earlier this week. And increasing those fees from a range of $6 to $10 to a range of $10 to $30, and we see that as, you know, a burden on current consumers that is really going to pay for the waste of former consumers and so we are much more in favor of the producer responsibility systems that we are seeing developed in other states.

Ms. RICHARDSON. Well, Ms. St. Denis, according to your testimony, HP, your recycling rate for 2007 was 15 percent so it sounds like to me you could use a little help. So wouldn't you think maybe a combination of the two, maybe a fee that the consumer pays directly and then also a portion that you are involved with?

Ms. ST. DENIS. So——

Ms. RICHARDSON. Because 15 percent isn't satisfactory.

Ms. ST. DENIS. Well, so the 15 percent is predicated on one very important factor, and that is the behavior of the consumer. The California system also does not provide any—neither system provides direct incentives to the customers to recycle the electronics. So we do recycle everything customers want to give us. Another important fact to note is that none of the recycling that takes place in California is counted in that 15 percent number because we don't do the recycling ourselves; it is handled by State agencies. So we can't count that. The 15 percent reflects only what we do ourselves, which, again, is what we are seeing in the states that have legislation emerging. The first of those actually took effect in large scale in Minnesota this year, so you will see that number go up.

Ms. RICHARDSON. Ms. St. Denis, maybe I am not clear. What I thought you said in your answer to the advance recovery fee was that it would be better served if you were more engaged and involved, and then when I referenced the area that you are engaged and involved in, it is only 15 percent of what you are saying your

role of what you are doing. So what would you—let me ask it in a different way. What would you suggest as to how we could increase that number or increase consumer education to assist you?

Ms. ST. DENIS. So I think one thing that is important is to educate the consumer about the need to recycle these products when they are done with them. We find that they are often stored for long periods of time before they enter into the recycling system, and when we have events, much like the one that you had here last weekend, there is overwhelming demand for this service. So people show up with a lot of things to recycle but they often don't know that systems exist. We manufacturers often advertise this fact as part of our new sales but there is a lack of understanding in the sort of the general population that they have a responsibility to start these products on the way to the appropriate recycling solution. There also are states where these products can still be landfilled and so in many cases those products escape what we think of as the kinds of systems that we put in place.

Ms. RICHARDSON. And Mr. Williams, what is your thought on the advance recovery fee? And I am down to my last minute.

Mr. MICHAEL WILLIAMS. Yes, ma'am. In terms of the advance recovery fee, in the past we have supported that but since then, as you can tell from my testimony, we believe in producer responsibility. We make it, we will take it back. We will take responsibility for the product. That being said, the issue with advance recovery fees, is the money being collected to address legacy issues, manufacturers have gone out of business, or the current players in the marketplace. Moreover, with advance recovery fees, not all State governments are fiscally responsible. The money may be collected on the sale of a television, but if it goes into the general fund, we don't know where that money is going to be 10 or 15 years from now when we may need it. That is where we think federal legislation in this area is essential. Moreover, not only should the producer take some—take responsibility, but other stakeholders have to be involved to make this successful. We need the retailers to be involved. They have a stake in this outcome as well as consumer education.

Ms. RICHARDSON. Thank you, Mr. Chairman.

Chairman GORDON. Thank you, Ms. Richardson. As usual, you had very good questions, and Mr. Hall is recognized for five minutes.

Mr. HALL. Because we are only about 10 minutes away from the joint session, I won't ask questions but I will yield to Mr. Bartlett, who I think has some interesting questions involving Dr. Gingrey's bill. I yield my time to you, Roscoe.

Mr. BARTLETT. Thank you very much, and thank you all for your testimony. As I sat here thinking about what I might say or ask you, I really was in quite a quandary, because what we are dealing with is really a self-inflicted wound, a self-inflicted problem. We have recycling problems. We have huge energy costs in making this equipment that we then throw away. We have big environmental problems. Much of this equipment is made with planned obsolescence. You just expect the people very shortly to throw it away. You design it to dispose of it. You don't design it so that it can be

repaired or upgraded, and we behave as if resources are unlimited like there is unlimited amount of energy.

This morning I noted that in every one of the papers I looked at in our Hill newspapers, the major headline on the front page of every one of them had to deal with energy and the high cost of gasoline, that everybody is being blamed and the person that really is to blame for this is the millions of us who are out there riding around in our SUVs. The demand is just greater than the supply. It is simply a supply-and-demand problem which is why the price of gasoline is up. I said this was a self-inflicted problem and it really is. Much of the equipment, this electronic equipment that is sold is bought with discretionary money. You just don't need it. And we have to trade off in our society today, what is more important, to spend more time with these silly games or to use less energy so there will be more of it available for our kids and our grandkids. Yet we have a huge beast to feed out there. We have this huge industry that is making this stuff, and if you aren't buying it and throwing it away, they aren't making it.

How do we resolve this problem? What do we do? I have 10 kids, 16 grandkids and two great-grandkids. We are handing them a huge debt, not with my votes, if you will look at my voting record. Wouldn't it be nice if we left them a little energy? I am having a big problem with a society that just wants to consume, profligate spending, just play, play, play with no thought for tomorrow, no thought for your kids, no thought for your grandkids, and here we are today talking about a problem that is almost totally self-inflicted. You know, if you want to—if people need to work, why can't they work rebuilding this equipment and repairing it rather than just throwing it away? There is no reason, for instance, that—we don't have frames on cars anymore. When we used to have a frame, no reason that that wouldn't last 100 years. Why does it have to go to the junkyard in 16 or 18 years? You know, these things are not limitless. There is a limit to the amount of energy that is out there. There is a limit to the amount of these metals and so forth that are out there. There is a limit to the capacity of the environment to absorb all of these things. How do we reach a balance in this so that we aren't looking just to the next election pandering to people so we will get elected, so that we aren't looking just to the next quarterly report so that it will look good so that your stockholders feel good about you and invest even more money in you? How do we strike a balance that looks long term to the future?

Mr. SMITH. If I could start a response, I think—I agree with everything you said and I think that the strategy of trying to bring in a producer-responsibility approach into the United States and really importing that policy initiative from Europe and elsewhere is at least a part of the solution, because what that does is to internalize the costs of production into the full life cycle of the product, and if the producers have to be responsible for those costs throughout the entire life cycle, they are going to tell their designers, you know, let us figure out a way to make these products last longer, be more efficient and be less expensive throughout the life cycle. So the point is that if they have to pay for the costs of recycling and disposal, we think that that is going to send some important

design signals up to the front end where it really belongs. It will help shift that focus. It is probably not going to solve all the questions that you are raising because I do think that the rapid obsolescence is the major thing.

You probably know of Moore's law, which was based on Gordon Moore, one of the founders of the semiconductor industry. If you look at the slope of change in the industry, it looks like this. It is a logarithmic scale going straight up to the sky. When you look at the slope of the environmental and social improvements that we have, it is a much shallower slope like this. I think our job is to try to figure out how to make those slopes be coincidental, and right now we are way out of whack on that, in my opinion.

Chairman GORDON. Thank you, Mr. Williams, and Mr. Hall is recognized for a unanimous-consent request.

Mr. HALL. Mr. Chairman, EPA has provided a written statement to us and I ask unanimous consent that the statement be included in the written record and that any questions Members might have for EPA and their answers also be included, and I thank you.

Chairman GORDON. Thank you, Mr. Hall, and I will raise you one. Mike Thompson, the Chairman of the E–Waste Caucus also has a statement that he would like to submit and I ask unanimous consent that that be made part of the record.

Mr. HALL. I object.

Chairman GORDON. I think he is kidding.

Mr. HALL. I withdraw my objection.

Chairman GORDON. If there is then—since there is no objection, those two records will be made a part of the record.

[The information follows:]

PREPARED STATEMENT OF REPRESENTATIVE MIKE THOMPSON (D–CA)

Thank you for the opportunity to comment briefly on electronic waste, or "e-waste." I appreciate Chairman Bart Gordon and Ranking Member Ralph Hall allowing me to submit these remarks to the record as part of your hearing on e-waste, a subject I've been involved with since I was first elected to Congress.

As you will hear today from the other witnesses, electronic products are becoming smaller and lighter, but they also are creating an ever-growing environmental and waste disposal problem. That's because it's often cheaper and more convenient to buy a new PC or cell phone than to upgrade an old one. Today, the average lifespan of a computer is only two years and Americans are disposing of 3,000 tons of computers each day.

The buildup of e-waste on the local and State level has led sixteen states, including California, Tennessee and Texas, to implement their own e-waste laws—each very different from one another. Thirteen additional states are also considering e-waste legislation. As states continue to develop their own approaches, the need for a federal solution grows. Without federal action, both consumers and businesses will have to contend with an unmanageable patchwork of State laws. This might also put many U.S. manufacturers at a competitive disadvantage if they have to juggle multiple State regulations.

As the founder of the Congressional E–Waste Working Group, I along with co-chairs Congresswomen Louise Slaughter and Mary Bono Mack, and Congressman Zach Wamp, with the assistance of Congressman Wynn and Senators Ron Wyden, Maria Cantwell, and Sherrod Brown recently submitted a comprehensive concept paper to nearly 60 stakeholders in the electronics industry. Five of the six witnesses on your panel this morning received the paper and have since commented on it. I want to thank them for their valuable feedback and I look forward to working with them in near future as we craft this important legislation.

The concept paper represents an important step towards enacting a federal e-recycling solution. It relies on an extended producer responsibility model, with manufacturers, retailers and recyclers sharing the responsibility for establishing and maintaining a national program to collect, transport, reuse and recycle e-waste with little

or no cost to consumers or government. The document incorporates many of the principles articulated in e-recycling proposals and comments put forth in past years by electronics manufacturers, the environmental community, retailers, recyclers, waste handlers, the states, and other interested groups. It also addresses the exporting of e-waste to third world countries, the role of the states and the Environmental Protection Agency, and creates incentives for greener production and reuse.

Thank you for bringing much needed attention to this issue and to allow us to gather expert testimony on the problem of e-waste. The other members of the E-Waste Working Group and I look forward to working with you as we work towards enacting a comprehensive plan to reduce e-waste in a way that considers the interests of all stakeholders.

Chairman GORDON. Mr. Lipinski, you can close us out.

Mr. LIPINSKI. Do we really have any time, Mr. Chairman?

Chairman GORDON. Well, we don't have much. If you want to have one question or statement.

Mr. LIPINSKI. I just want to say that there has to be some way of working this in. Very quickly, one thing that I find difficult is not knowing as a consumer what needs to be recycled. I had a VCR, and I wasn't sure, can I throw this in the trash, what do I do with this, so the information to begin with, and what is it—very quickly, Mr. Williams, why is Sony—why did Sony take this step? Why is Sony doing as much as you are doing?

Mr. MICHAEL WILLIAMS. It is the right thing to do, number one. Number two, because it makes sense. You are being the responsible producer. You hope that people have brand loyalty and that you take responsibility for your product. I want to design and build in, as Ted was talking about earlier, in terms of market efficiency. If I know it is going to be recycled, I am going to design it with parts and machinery with that in mind. So it makes sense for us from an economic point of view to recycle the products, to create recycled waste for, let us say, as an example, plastic, so I have enough of a supply of post-consumer recycled plastic that I can use in my new models, and so we have to create the supply of the recycled material in order to put it into our new products. The way we do that is to get our consumers who have the Sony products to bring them to us and to recycle them. So it is in our interests, it is in the environment's interest to do what we are doing today and also to educate the American public that going green is good for business, it is good for the environment. It is a win-win situation. But it is going to take some work and effort on the part of Congress through initiatives, legislation, and on the part of industry to educate the American consumer why it is in everyone's interest to recycle responsibly and properly.

Mr. LIPINSKI. I commend Sony on that, but I agree that there is more that we are going to have to do to make sure this is done across the board. Thank you.

Chairman GORDON. Thank you, Mr. Lipinski.

Before we bring the hearing to a close, I want to thank our witnesses for testifying today. Mr. Hall also would like to know where to take his Victrola.

Mr. MICHAEL WILLIAMS. I don't think that has the Sony brand on it.

Chairman GORDON. The record will remain open for additional statements from Members and for answers to any follow-up questions the Committee may ask of the witnesses, and let me ask, is there anyone that wants to ask the witnesses to come back after

the joint hearing? If not, then again, I want to thank our witnesses. We are going to submit additional questions to you. This is an issue that this committee is very interested in, and we consider this one of our major areas of concern this year, and as I say, we are interested in knowing on the federal level—if there is—we are not looking to do something if there is not something there to do, what we can do in terms of research to help on the recycling end, and if there is something on the front end to make it easier to recycle as well as other areas.

So with that, the witnesses are excused and the hearing is adjourned.

[Whereupon, at 10:58 a.m., the Committee was adjourned.]

Appendix 1:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Eric D. Williams, Assistant Professor, Department of Civil and Environmental Engineering and School of Sustainability, Arizona State University

Questions submitted by Chairman Bart Gordon

Q1. You state in your testimony that you and your colleagues' review of the scientific literature concluded that the risks associated with disposing electronics in sanitary landfills are negligible. You also mention that the EPA's Toxicity Characteristic Leaching Procedure (TCPL) test is "more aggressive" than the actual conditions in landfills. What type of further study is needed to accurately assess the environmental and human health impacts of electronics disposed in landfills?

A1. It is possible that the core research establishing the risk of toxics leaching from sanitary landfills is mainly done. I suggest that if the National Research Council were asked to do a study on the interfaces between the risk of toxics leaching from landfills, the TCLP test and e-waste that it would be a valuable step to gauge the degree of scientific knowledge and consensus on this issue. This report would clarify if and what further work is needed.

I think an important related issue is the potential to mine landfills at a later date to recover valuable materials. Existing research suggests that despite favorable concentrations of valuable materials in landfills compared to ore deposits, the relatively small size of the landfill "deposit" pose a challenge to recycle from landfills at low cost. There are strategies however which ought to be researched. One strategy is to consider how defining a new waste category as material destined for future recovery would affect the economics and environmental issues associated with mining landfills. A second strategy to work on developing materials recovery processes which economically scale favorably down to smaller deposit sizes.

Q2. You say in your testimony that end-of-life management for electronics is a qualitatively new challenge and that we do not have the proper tools to measure the impacts of recycling and other end-of-life policy options. What types of tools do we need to make these assessments and what type of research is necessary to develop these tools? Which agencies would be best to fund this type of research and how should it be prioritized?

- *What funding opportunities exist in addition to the National Science Foundation's Environmental Sustainability Program to study and assess the end-of-life management of electronics and other products?*
- *You mention in your testimony that Japan is investing more than the U.S. to characterize and plan for the management of international end-of-life flows for a variety of consumer products. By not investing in the analysis of this issue, is the U.S. at a competitive disadvantage?*

A2. What opportunities exist other than NSF Environmental Sustainability to support research related to end-of-life electronics? To summarize, few and far between. Regions 4 and 5 offices of the USEPA have supported the work at the University of Florida on leaching potentials from landfills. While in principle research on electronics reuse/recycling could be supported as part of federal and State programs addressing waste related issues, I know of no dedicated programs devoted to e-waste. In practice, it is definitely an underfunded area.

The NSF and EPA are natural agencies from which to base future research on management of end-of-life electronics. NSF could focus on the more fundamental knowledge needs while EPA could focus on applications. I hesitate to prioritize research topics in an ordered listed as society needs to decide what aspects of the end-of-life electronics it deems most important and weigh issues accordingly. I scope out below how I view the main challenges and some of the research related to addressing these challenges:

- Global environmental impacts—from a global perspective the main environmental impacts associated with end-of-life electronics are probably due to informal recycling in developing countries. Research addressing this would include 1. exploring policy/business models to develop new systems for managing global end-of-life flows 2. research into alternative recycling technologies.
- Domestic environmental impacts—for people in the U.S. I believe the main potential exposure issue is brominated flame retardants. Research is needed to determine the risk of these substances and to develop and assess alter-

natives in view of the improved fire safety gained from flame retardants. The energy use associated with production and manufacture of equipment is an important issue to consider from global warming and resource scarcity perspectives. Potential health impacts due to exposure to electromagnetic fields should also receive more attention.

- Social and economic benefits—Reuse and recycling of electronics is an important economic activity and access to low-cost used machines delivers social benefits. On the technology side, developing informatics systems such as RFID tags can help improve the functioning of reuse/reusing. Also, work is needed to develop and assess electronics policy alternatives which encourage reuse.
- Applications of Information Technology—while I understand the focus here is on end-of-life management issues, it is also important to bear in mind that there are many important environmental applications of information technology. The potential benefits outweigh much of the environmental risk of equipment in my opinion. More research is needed to develop and promote adoption of applications such as home energy management systems, Internet-enabled ride sharing programs, and telecommuting.

News tools and methods to be developed in this research include multi-issue models of alternate reuse/recycling systems, computer-aided toxicity screening methods, materials/emissions models of different recycling processes, simulation models of environmental/economic/social implications of different global paths for electronics, and designs for informatics systems supporting reuse and recycling (e.g., RFID systems).

Is the U.S. at a competitive disadvantage compared to Japan due to its relatively small investment in research and development related to green electronics? Potentially yes, although the economic impacts are difficult to gauge. There are two aspects, manufacturing and reuse/recycling. For manufacturing, Japan has been proactive in responding to the European Directive on Restriction on Hazardous Substances which regulates materials used in electronics. U.S. manufacturers on the other hand objected to the European legislation on scientific grounds and have been less willing to respond. I believe U.S. manufacturers had valid concerns about policy developments in Europe, but at the time there was insufficient research activity by neutral parties (e.g. academia) in the U.S. engineering/scientific community to weigh in substantively on the debate. Ultimately the European legislation went through in spite of the questions raised by U.S. industry. The outcome is that the Japanese electronics is relatively well situated to deliver products meetings the new regulations in Europe and elsewhere.

Considering the end-of-life, Japan is also being proactive in working to assess and address concerns being raised regarding the environmental impacts of international flows of end-of-life electronics. The relative lack of response in the U.S. may have been based on the perception that environmental problems of end-of-life electronics abroad are the jurisdiction of recipient countries. However, public pressure on this issue is resulting in response even if the Federal Government takes no action. Many nations are implementing bans on importing e-waste. NGOs are developing guidelines for environmentally friendly recycling practices which many firms follow in order to maintain a positive perception by customers. The result is that U.S. manufacturers are increasingly acting in an policy environment in which the U.S. had has little voice. Investments in research and development are part of a process through which the U.S. can engage in and influence the international discourse.

In addition, the internationalization of reuse and recycling may present a business opportunity for those firms situated to take advantage of trends. For example, there is an increasing international need for technologies and facilities which can safely recover valuable metals from circuit boards. Japanese smelters such as those operated by Dowa Holdings have advanced technologies and could serve future international markets for recycling services.

Q3. In your testimony you propose interesting ideas to facilitate reuse and prevent harmful recycling practices in developing countries. What would be needed to develop and evaluate ideas like the use of Radio Frequency Identification (RFID) technology to indicate functionality or link a recycling deposit to a piece of equipment? How can innovative management options be encouraged?

A3. The first step is a set of high-level feasibility studies exploring technological, economic and other aspects of different proposals. Based on the result of these feasibility studies, specific research is needed to develop the most promising options. Some of this research will be product engineering/technology related, such as the design and integration of RFID tags in computers. Another aspect of the research re-

lates to design and operation of the overall system, which should integrate engineering, business and social aspects.

How can innovative management options be encouraged? It may be that the new technology and management system go hand-in-hand with new policy. For example, one proposal my colleagues and I at Arizona State have made is for an electronics take-back system which establishes an Internet market in which reuse and recycling companies compete to offer consumers rebates on a prepaid recycling deposit. This system would utilize RFID and other information infrastructures. Thus in this case the innovative management system is integrated with policy. A general strategy to encourage innovative management options is to encourage joint industry/academic research to couple academic understanding of the issues with real world commercial systems to enable workable solutions to real problems.

Q4. What policy tools would you suggest to compel electronics producers to consider end-of-life management in their product designs? If CRTs are permitted into landfills, how do we encourage green engineering and the thorough evaluation of materials before they are used products?

A4. To summarize my response, I recommend first exploration of voluntary product certification and take-back systems which explicitly create a market for improved designs. There are three types of policy tools currently on the table. The first is command-and-control mandating of design aspects, the European Directive Restriction on Hazardous Substances is the prime example of this approach. Though not addressing recycling, there is precedent for this type of approach in the U.S.: the appliance efficiency standards managed by the Department of Energy.

The second type of policy is voluntary certification programs such as Energy Star. A new computer certification scheme, EPEAT, includes recycling and reuse related aspects. Voluntary certification programs seem to have an effect well beyond the demand of individual consumers for green products. This is partly because green purchasing programs for organizations create a market for certified products which one designed spills over into other markets. Another factor is that firms compete to gain certification as a means to establish an image of a socially responsible corporation.

The third approach is economic instruments. Making manufacturers responsible for recycling under the mantle of Extended Producer Responsibility (EPR) is a popular approach. The challenge is to develop a system which is both workable in practice and provide a clear economic incentive to improve design. Take-back systems have yet to be successful in inducing substantial design shifts. One strategy is to develop take-back system which explicitly create a market over which manufacturers and reuse and recycling firms compete to deliver more efficient services. We are developing such a concept at Arizona State which we term the e-market for e-waste. The idea is that at the end-of-life firms compete to offer consumers higher levels of return on a prepaid recycling fee.

How do we encourage green engineering and thorough evaluations of material used in products? In short, I believe work is needed to build a method and modeling infrastructure which allows for a realistic assessment of the macroscopic risk associated with using different materials in products. Based on results from these macro risk assessments, stakeholder groups recommend on a product by product basis appropriate green engineering incentives such as voluntary certification, economic tools and/or regulation.

There are two aspects of managing toxics. The first is assessing the toxicity of a substance. Given the variety of new chemicals and materials being developed and in use combined with vastly more sensitive detection equipment, this assessment is a significant challenge. Computer-based modeling of substances and their biological activity will presumably better help us screen toxicity. I suggest that more resources be devoted to developing such models. This being said, for the foreseeable future we will still need empirical work on fate, exposure and epidemiological effects, which also requires research resources.

The second aspect of managing toxicity is assessing how toxics in products might actually end up with exposures and damage health. Surprisingly this is not often studied. For example, given all the attention given to the potential risks of lead leaching from CRTs, one would assume that there are many existing studies which total up the total potential lead emissions from CRTs going to landfills and show that the potential leaching is significant compared to other problems we have with lead, such as paint or pipes in legacy buildings. Apparently no one has done this yet. Much more work needs to be done to scale up the product level content of toxics to potential macroscopic levels of risk. The result of not doing this research is that regulations are liable to equate toxicity with hazard, resulting in inefficient and ineffective regulation.

Q5. In traditional undergraduate engineering curriculum, how much attention do life cycle assessments and end-of-life management receive? What types of changes can be made to encourage our future engineers to prioritize these issues?

A5. In general, very little attention is given to LCA or other sustainable engineering issues. There are exceptions where an instructor will find a way to work such material in, but currently such material is hardly ever part of an official curriculum.

I believe that in the future we need to incorporate sustainability aspects into core engineering curricula to introduce all students to basic issues and methods. In addition, we need to provide avenues for students interested in sustainability to learn in depth.

The Center for Sustainable Engineering, a joint initiative by Carnegie Mellon, the University of Texas—Austin, and Arizona State University is funded by both NSF and EPA and aims to integrate sustainability aspects including LCA into engineering curricula. It is, however, a beginning effort, and there should be much more attention paid to this requirement.

Q6. In your testimony, you propose a method to make the informal recycling of electronics safer in developing countries, where workers would be paid for targeted parts like wires, but not the actual commodities. This would discourage them from unsafely processing materials. Who should invest in evaluating and developing innovative markets to end or mitigate harmful recycling practices abroad?

A6. Who should invest in subsidy system to prevent informal recycling in developing countries? It is my view that if an organization or individual in the U.S. or another country receives economic benefit due to exporting end-of-life electronics, this should also entail an investment to ensure safe recycling abroad. Practically speaking this could mean that recycling fees collected domestically for take-back systems would involve international monetary flow if the equipment is exported. Domestic generation of e-waste in developing countries is increasing and monetary flows should be mobilized internally to ensure safe recycling.

There is in addition an economic investment associated with initial research development of knowledge and technology bases to enable the new reuse/recycling systems. There is a strong argument that much of this R&D should be undertaken by developed areas such as the U.S., Europe and Japan.

Questions submitted by Representative Ralph M. Hall

Q1. How have electronics in the waste stream changed over the past decade and what predictions can we make about changes in the coming years? How do these changes affect our ability to safely and efficiently recycle or reuse these devices?

A1. This is a very pertinent question given the rapid evolution of products in the sector. There are three main issues. One is changes in the use of precious metals in electronics over time. In the late 1980's and early 1990's products used to contain substantially more gold, silver and other precious metals, which made recycling more economically attractive. These amounts have gone down over time. There are contravening trends however. High capacity hard disks tend to contain more platinum than previous generations. At any rate, it is difficult to design recycling systems where the economic are a moving target.

The second issue is the increasing diversity of devices. E-waste is no longer only televisions, stereos and desktop computers, it is also laptops, VCR and DVD players, game consoles, cell phones and personal data assistants. Uniform waste streams are generally easier to recycle, but e-waste has become more and more diverse.

The third issue is that many of these new product types such as laptop computers and cell phones are switching to smaller more packed designs which are harder to disassemble.

One result of this trend has been the increased use of shredders. Products with valuable components such as components may be dissembled by hand but most others tend to be put into a shredder after removing certain parts of concern. Material recycling rates for shredder-based systems are reasonable but clearly the level of reuse is reduced.

Q2. Most major manufacturers claim that they do not ship e-waste oversees for recycling. Where does the e-waste found in environmentally unsound recycling operations originate?

A2. With the exception of equipment leased by the manufacturer, the end-of-life fate of electronics is in the hands of the purchaser, not the manufacturer. Reuse and recycling companies who ship abroad can often offer to pay for the equipment rather than be paid by the disposer to recycle domestically, so there is a natural economic

incentive to choose those firms which ship abroad. Looking at recycling operations abroad, reports by NGOs suggest that a substantial part of the e-waste being recycled was originally from the U.S. and other developed countries.

Q3. What are some of the toxic hazards that arise in the recycling process itself?

A3. For informal recycling the big problems are obvious. Open burning of wires to recover copper generates dioxins, furans and other toxics. Acid and cyanide leaching of circuit boards create serious pollution problems unless properly managed.

For formal recycling the situation is much less clear. Recycling circuit boards usually involves melting the boards in a copper smelter. The resulting slag is then processed to separate the different metals. The heat of the smelter releases toxic substances such as lead and mercury as well as various brominated organics. With appropriate technologies one would presume that these toxic emissions are controlled. There is a dramatic lack of information on the emissions and energy use in different stages of recycling. It is worth noting that copper smelters in the U.S. are reluctant to recycle scrap circuit boards because of the entailing difficulty to meet EPA air regulations. More research is needed to clarify the materials use and emissions associated with different recycling methods.

Q4. You lay out an ambitious agenda for what needs to be done from an R&D standpoint. However, accomplishing this work requires a skilled science and engineering workforce in green engineering. Do U.S. universities train a workforce sufficient for this task and if not how many more programs would be required in order to fulfill this need?

A4. For e-waste and other environmental issues such as climate change the U.S. needs a human workforce expert in sustainable engineering. While training of such engineers and scientists is increasing, I estimate that we are still not yet near to meeting the potential demand for sustainability engineers and scientists. This is a three pronged challenge. The first is to encourage more transdisciplinary engineering education in areas such as sustainable engineering and earth systems engineering and management. The second is to improve disciplinary education by introducing students to real world social and environmental complexity entailed in their engineering area. The third is to introduce concepts of sustainable engineering in K-12 as well as in undergraduate/graduate education, ensuring that we have a more technologically competent workforce generally.

While it is difficult to give a precise number for a desired number of programs, in green electronics the U.S. would benefit from several centers capable of research and training in different aspects of the challenge. Some centers could focus on more technical issues such as development and assessment of new materials while other could be more interdisciplinary and integrative in nature. Considering sustainable engineering more broadly, the Federal Government could play a key role in promoting sustainable engineering by increasing funding to NSF, EPA and DOE towards university research programs.

Q5. What organizations in the U.S. and abroad are capable of performing assessments on recycling, reuse, and landfilling processes and practices?

A5. I cannot here review the full set of organizations around the globe with capacity to address this issue, I mention a few of the main ones currently active on green electronics. Focusing first on the domestic situation within our universities, between myself, Braden Allenby and our collaborators and students, Arizona State University has a group which is strong at LCA and an integrative systems perspective. Timothy Townsend and collaborators at University of Florida have particular experience and capacity to study landfills issues. Hong Zhang and collaborators at Texas Tech University have been working on developing new recycling technologies. A group at University of California–Irvine has been working on engineering and assessment issues related to lead-free electronics.

Manufacturers, including U.S. based Dell and HP have personnel dedicated to green electronics issues. The groups are small and mainly focused on compliance issues. Japanese manufacturers in comparison support research and development groups devoted to life cycle assessment and development of green electronics.

The U.S. EPA Office of Solid Waste has experience and expertise related to e-waste. Claire Lindsay, Robert Tonnetti and Angie Leith have been involved in important e-waste related work such as the recent benchmark assessment of generation and disposition of end-of-life electronics in the U.S. Lawrence Berkeley National Laboratory is very active with regards to operational electricity use for electronics, though not end-of-life issues.

Looking abroad to Europe and Japan one sees a comparatively large degree of research and industry activity related to green electronics. The University of Delft has

been active in assessing take-back and recycling policies. One of the Frauenhofer Institutes in Germany is has a substantive group active in electronics manufacturing and e-waste. The Swiss federal research institute EMPA is the home to what is the largest research project addressing international issues related to reuse and recycling of electronics. Japan is very active both in terms of technology issues and larger systems assessment. The National Institute of Environment is a laboratory sponsored by the Ministry of Environment and is prominently active is characterizing international material and product flows. The Institute for Advanced Science and Technology, sponsored by the Ministry of Economy, Trade and Industry is active in both life cycle assessment of electronics and green design issues.

Questions submitted by Representative Daniel Lipinski

Q1. In 2006, the Government Accountability Office estimated that more than 100 million computers, TVs, and monitors are thrown away each year. In addition, the EPA estimates that electronic waste is growing two to three times faster than any other waste stream. Yet presently, there is no specific federal law or regulation governing the disposal of consumer electronic products in the U.S. Should there be?

A1. The short answer is yes. Various states are developing and enacting their own electronics take-back and recycling systems. A patchwork of State-level systems is inefficient and manufacturers have to devote significant resources just to keep up with the different regulations. Plus, states have fewer resources to invest in research and development to develop and assess alternatives and thus have largely borrowed much from systems abroad. As I discussed in my testimony, were based more on simple heuristic goals which may not be efficient.

Q2. The EPA estimates that at most, only 15% of products at the end of their useful lives reach a recycling or reuse program. This does not come as a shock to me. In fact, it might seem a little high given the impediments that consumers currently face.

- *First, how are average consumers to know what to do with their e-waste when it comes to the end of its useful life?*
- *This past weekend, Washington, D.C. held an e-waste recycling day. Over ten times as many residents as last year showed to recycle their gadgets, leading to over two hours wait time. The incentives to recycle just don't seem to be there right now. What do you recommend be done to fix this problem?*

A2. Municipalities are traditionally charged with informing average consumers about how to recycle. Depending on the community the level and effectiveness of this communication varies considerably. Communication may be enhanced by linking in with people's personal computers. I.e., there could be pre-installed applications on computers which hook up with databases with information on the recycling and reuse practices of different locales.

Also, if the take-back and reuse/recycling system includes a financial incentive to return machines (i.e., a returned deposit), I suspect that word of mouth becomes a more effective means of communication. One way to introduce such an incentive is a new type of take-back system we are developing at Arizona State. The basic concept of the e-market for e-waste model is that at the end-of-life firms compete to offer consumers higher levels of return on a prepaid recycling fee.

Regarding the unfortunately long wait times at the DC event, I suspect that periodic recycling events are a temporary way-station on the path to a national reuse/recycling system. In an organized system these events would not be needed. Until we get a national system however recycling events will remain one way to collect equipment. Some problems might be avoided is a manual of best practice was developed and made widely available to those planning such events.

Q3. The European Union is often ahead of the United States when it comes to the issue of recycling. Where do U.S. capabilities stand as compared to Europe on the topic of e-waste?

A3. Currently behind. Europe and Japan have advanced smelters with experience in recovering precious metals in circuit boards. The university and government research base is larger and governments have mandated take-back and recycling systems. On the other hand, the U.S. does have a fifteen year history of addressing green electronics issues through the IEEE International Symposium on Electronics and the Environment which has been held annually since 1993. This is an important base of results and expertise to draw on.

Still, I believe that the U.S. has strong potential to become a world leader in efficient reuse and recycling systems. We have excellent research universities and a tradition of partnership between universities and industry. The U.S. is more oriented towards combining environmental solutions with free market efficiencies. Given the importance of reuse in environmental performance this emphasis should serve us well. The U.S. economy has shown a particular adaptability and openness to adopting new technologies such as the Internet and its applications.

Questions submitted by Representative Bob Inglis

Q1. In your testimony you suggest that take-back systems could have an adverse effect on reuse. Can you expand upon this? If most reuse occurs in developing nations, wouldn't take-back campaigns give companies the opportunity to efficiently redistribute their wares?

A1. Yes, take-back campaigns do present an opportunity for reuse, whether reuse is helped or hindered depends on the implementation. Many existing take-back systems measure success in terms of achievement of domestic materials recycling and do not include incentives for reuse. In Japan, for example, some equipment manufacturers have a policy of disassembling any product which they receive through the take-back system regardless of its newness and condition. This practice is supported by high recycling fees paid by consumers and without the system it is more likely that some of the equipment would have been reused abroad. On the other hand, a take-back system designed with reuse in mind could enhance the collection of reusable machines in good condition for export.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Gerardo N. Castro, Director of Environmental Services and Contracts, Goodwill Industries of Southern California

Questions submitted by Chairman Bart Gordon

Q1. You mentioned that Goodwill does expect an influx of televisions due to the digital transition. Has your organization made plans for how it will handle this increased volume?

A1. Goodwill Industries of Southern California is making plans to increase our staffing and infrastructure to ensure that we are ready to accept, store, and ship an increased number of analog televisions. In addition, we are exploring opportunities that would allow us to provide people who buy working analog televisions with coupons that would enable them to purchase digital converter boxes at a reduced cost. In addition, we are exploring partnerships to expand our ability to process electronic waste. For example, after the April 30 hearing, we met with representatives from Sony to explore a partnership between Goodwill and Sony. We are still working out the details of the partnership.

Goodwill Industries International, Inc. is working to build collaborations modeled after the Dell Reconnect program and ideally would like electronic manufacturers to work collaboratively together. Local Goodwill agencies may have different plans for the transition. Some have simply chosen not to accept analog televisions; however, they still expect that they will receive analog televisions left at donation sites during hours when the sites are not staffed.

Q2. In your testimony, you mention that Goodwill is unable to resell a substantial number of the electronic products they receive. Is this mainly an issue of durability or obsolescence? What types of design changes would help in the repair and upgrade of this equipment?

A2. When Goodwill receives electronic products, we inspect them to determine whether they are working. Those that are working, we resell them in our stores. However, we often discover that the electronic product is not working. While many of the non-working computers we receive could be candidates for being refurbished, due to planned obsolescence in the design of hardware and software, we have found that replacements for non-working parts are often no longer being produced by their manufacturers.

Incentives to design standardized products and components that are universal and interchangeable would help to lengthen the life of electronic products. For example, universal chargers for cell phones or universal printer cartridges for printers would help to reduce the amount of electronic waste that we receive while extending the life of discarded working electronic products.

Q3. In your testimony, you state that about 20 percent of the products you receive are neither resold nor dismantled into salvageable and recyclable parts and are sent directly to recyclers. What prevents the dismantling of these products by Goodwill employees? Also, what type of oversight do Goodwill agencies use to ensure that they are contracting with responsible recyclers?

A3. The bulk of the products that we send directly to recyclers are CRT monitors that are not working and we are not able to resell. The proper process for dismantling and breaking down electronic products that use CRTs and other hazardous materials requires costly and expensive equipment and facilities. Acquiring the in-house capacity to process CRTs would represent a sizable investment from Goodwill Industries of California. It makes better financial sense for Goodwill Industries of Southern California to send CRT monitors directly to recyclers. Because these recyclers are authorized by the State of California, we are assured by the State of California, which audits recyclers to ensure that products are being recycled properly, that the recyclers we use are responsibly processing the CRT monitors we send.

Q4. In your testimony, you state that the Federal Government can play an important role in assisting the development and sustainability of electronics recycling and reuse infrastructure. What specifically could the Federal Government do to bolster this industry?

A4. First, the Federal Government could create a nation-wide financial mechanism to help stakeholders—including producers, recyclers, collectors, states and municipalities—to support efforts to collect, reuse, and recycle electronic products. For example, the Federal Government, by utilizing incentives, could aid and encourage

necessary private sector investment in the used electronic recycling/reuse markets. This can be done through tax credits for manufacturers who partner with social agencies, recycling grants, and other initiatives that could spur innovative solutions and help stakeholders handle this problem. A partnership consisting of government incentives, private industry and social agencies can protect the environment, create jobs and spur innovation in the environmental field. Additionally, increased federal support for pilot projects and other sustainable initiatives would be helpful in promoting the development of a recycling/reuse infrastructure.

Second, create disincentives, such as phasing in a nationwide landfill ban, for disposing electronic products, including televisions, in landfills.

Lastly, the Federal Government also can play a key role in educating consumers about how to properly dispose of their unwanted electronic products.

Questions submitted by Representative Ralph M. Hall

Q1. How have electronics in the waste stream changed over the past decade and what predictions can we make about changes in the coming years? How do these changes affect our ability to safely and efficiency recycle or reuse these devices?

A1. Goodwill Industries of Southern California is seeing a huge increase in the volume and variety in electronic products that are donated. Spurred by the production of cheaper electronics, rapidly advancing technology, and the emergence of popular electronic gadgets, the consumption of electronics is dramatically increasing while the lifespan of electronics is relatively short.

In the past, many electronic products were designed such that it made financial sense to repair them when they broke. Today, it is often cheaper to discard malfunctioning consumer electronics and to replace them with newer and more technically advanced products. Recycling begins with design. Manufactures should be encouraged to design products that are more easily refurbished and recycled.

Q2. How does Goodwill train its employees to properly disassemble electronic equipment? What are the greatest challenges to quickly and efficiently breaking electronics down into basic commodities?

A2. Goodwill Industries of Southern California's training program consists of an eight-step de-manufacturing process. People with disabilities are taught each task in the process one step at a time. When they show that they have learned that specific task and can perform it safely, we teach them the next task in the process. For a variety of reasons, such as a physical impediment, some people may not be suited to perform certain tasks in the de-manufacturing process. However, we still teach our employees about all the tasks to build teamwork and a better understanding of the complete process.

Design variety represents a significant challenge for the Goodwill employees that de-manufacture electronic products. The de-manufacturing process could be streamlined if manufacturers produced products that met certain universal design criteria.

Q3. Dr. Williams suggests that some take-back programs have an adverse effect on reuse. Do you agree with this assessment: What effect does your organization see on reuse of commodities like cell phones due to the increase in take-back campaigns?

A3. Goodwill Industries of Southern California has not experienced an adverse affect on the reuse of electronic products due to the implementation of California's law, which involves an advanced recovery fee. Goodwill Industries of Southern California is an authorized collector under California's program. Whether the donated product is a shirt or a computer, Goodwill Industries of Southern California first attempts to resell the donation in one of its retail stores. The funds we raise from the sale of the donation are used to support employment services for people with barriers to employment in the area. In the case of CRT monitors, we first test the monitor to determine whether it is working. If it is, we attempt to resell it for reuse before we send the CRT monitor to an authorized recycler. Our attempts to resell working CRT monitors are usually successful.

Questions submitted by Representative Daniel Lipinski

Q1. In 2006, the Government Accountability Office estimated that more than 100 million computers, TVs, and monitors are thrown away each year. In addition, EPA estimates that electronic waste is growing two to three times faster than any other waste stream. Yet presently, there is no specific federal law or regula-

tion governing the disposal of consumer electronic products in the U.S. Should there be?

A1. Yes. Research shows that the improper disposal of electronic waste in the United States creates serious environmental and public health concerns. It also is an opportunity to create jobs and develop designs that would help reduce the amount of electronic waste that is disposed of each year. The Federal Government should enact electronic waste laws and regulations that create jobs in the computer reuse and recycling fields; and encourage manufactures to develop products that are more amenable to being reused, refurbished, or recycled.

Q2. The EPA estimates that at most, only 15 percent of products at the end of their useful lives reach a recycling or reuse program. This does not come as a shock to me. In fact, it might seem a little high given the impediments that consumers currently face.

- *First how are average consumers to know what to do with their e-waste when it comes to the end of its life?*
- *This past weekend, Washington, DC held an e-waste recycling day. Over ten times as many residents as last year showed to recycle their gadgets, leading to over two hours wait time. The incentives to recycle just don't seem to be there right now. What do you recommend be done to fix this program?*

A2. Because Goodwill already has a strong existing infrastructure, local Goodwill agencies are in a unique position to collaborate with producers who are operating take-back programs by offering convenient locations for consumers to dispose of their unwanted electronic products. Consumers have been bringing their gently used items to local Goodwill agencies for 105 years, so people know that they can bring their gently used commodities, whether it is a shirt or a computer, to a local Goodwill and we will reuse it or recycle it. In 2007, our 168 agencies in the United States and Canada were visited 65 million times by an estimated 21.7 million household members, who donated items.

Incentives to increase the amount of electronics recycled and thus decrease the amount of electronics that are sent to landfills include:

1) Ensure that municipalities have convenient collection sites that are open year round. Nationwide, Goodwill has over 2,100 retail stores and 4,100 attended donation centers that could potentially serve as the backbone for a national collection infrastructure for the convenient collection and reuse of unwanted electronic products.
2) Increase public outreach and education about how to recycle electronic products.
3) Create disincentives, such as a zxccb nationwide landfill ban, for disposing electronic products in landfills.
4) Offer incentives that lead electronic manufacturers to develop partnerships with community-based organizations to collect and reuse their unwanted products from consumers.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Renee St. Denis, Director of Americas Product Take-Back and Recycling, Hewlett-Packard Company

Questions submitted by Chairman Bart Gordon

Q1. In your testimony you stated the need for R&D into several areas related to electronic waste, including research into applications for recycled materials, proper regulatory approaches, and the net climate impact of recycling electronics. What would be the best framework to implement these research initiatives and who should be involved?

A1. The Federal Government needs to play an active role in supporting research on key questions regarding the proper management of used electronics, including the climate impacts. This will help inform policies that will ensure that the best environmental outcome is achieved in the most efficient manner. To achieve this goal, the Federal Government should support research at major universities with expertise on these issues. A broad set of stakeholders—including the electronics industry, State and local governments, environmental groups, and others—should be engaged in working with the academic community on these issues. These groups can provide useful data, expertise, and insights in addressing these issues in an efficient manner.

Q2. How does Hewlett-Packard link recyclability and other environmental considerations to the product design process? Are engineers with these expertises integrated into all development teams or is there a separate team devoted to these issues?

A2. As stated in our written testimony, HP works to create a close link between our product design and recyclability. HP established our Design for Environment (DfE) program in 1992, and it remains central to our business strategy today. Our approach to DfE encompasses the entire product life cycle. In addition to considering important product attributes such as energy efficiency and materials innovation, design for recyclability (DFR) is one of our primary priorities for design for the environment. We believe that our experience and expertise in recycling provides an important feedback loop to designers to design future products so that they can be more readily recycled. It is this link between the product design and how it is handled at the end of its life that makes it important for manufacturers to remain engaged throughout the products' life cycle.

HP's DFR efforts include using common fasteners and snap-in features and avoiding the use of screws, glues, adhesives and welds where feasible. This makes it easier to dismantle products and to separate and identify different metals and plastics. The materials we choose can also enhance recyclability. For example, in 2007 we introduced several notebook PC models with LED technology, eliminating mercury fluorescent tubes and making the display screens easier to manage at end-of-life. These efforts have significantly improved the recyclability of HP products, and we are pleased to report the following:

- *HP notebook PC products* are now more than 90 percent recyclable or recoverable by weight (as per the definition used in the European Union WEEE regulations).
- *HP printing and imaging products* are typically 70 percent to 85 percent recyclable or recoverable by weight (as per the definition used in the European Union WEEE regulations).

We also made great progress in incorporating recycling materials into our products. For example, HP has engineered print cartridges that use recycled plastic without compromising quality or reliability. We design HP print cartridges to meet the needs of our recycling system and incorporate recycled material. Since we take back only our own cartridges, we can be certain about the material content, making it easier to process exhausted cartridges and reuse the material to manufacture new ones. More than 200 million cartridges have been manufactured using the process through 2007. HP used more than five million pounds (2,300 tons) of recycled plastic in its original HP inkjet cartridges in 2007, and the company has committed to using twice as much in 2008. HP also uses post-consumer recycled plastic recovered through our return and recycling program in the manufacture of original HP LaserJet print cartridges. This recycled plastic can represent as much as 25 percent, by weight, of the newly molded LaserJet cartridge housing. HP has also incorporated recycled content into some hardware products. For example, in 2007, we in-

troduced a speaker module made from 100 percent post-consumer recycled plastics in all HP Compaq 6500 and 6700 series Notebook PCs.

Each product team in HP includes a "product steward" that is responsible for all aspects of environmental compliance. This approach enables HP to ensure that environmental considerations are taken into account during the design of HP products.

Q3. In your testimony you state that Hewlett-Packard's efforts toward more environmentally conscious design have resulted in "HP products qualifying for a large number of global eco-labels, including EPEAT." As you know, EPEAT does not cover consumer electronics, and eco-labeling for these types of products in the U.S. is limited to the Energy Star program. Do HP consumer products favorably qualify for some of these global eco-labels? Does HP believe that these labels effectively educate consumers about products' environmental attributes and that educating consumers in this manner will result in increased U.S. sales for more environmentally sound products?

A3. HP has a long history of promoting environmentally sound design. As a result of these design initiatives, HP offers a range of products - both for consumers and businesses—that comply with global eco-labels. See *http://www.hp.com/hpinfo/globalcitizenship/environment/productdesign/ecolabels.html.*

HP believes that educating customers on the environmental attributes of the products they buy can play a significant role in shaping purchasing behavior. However, eco-labels are only one means of achieving this goal. Information on a product web-site, for example, can be a more efficient way of informing customers than a physical label, and the glue used on some labels can add to the complexity and cost of recycling electronic products. Companies should have flexibility in choosing the manner they communicate to customers. In this regard, we note that EPEAT does not require a physical label to be affixed to the product, and that Energy Star only recently mandated the labeling of products as a requirement of this program.

HP recently announced a new initiative to provide additional information on the environmental attributes of HP products. HP will begin using a "HP Eco-Highlights" label on new product packaging, web sites, and data sheets to help customers better understand the environmental attributes of the product, such as energy consumption and recycled content.

Q4. You state in your testimony that HP has established the goals of doubling the use of recycled plastics in printer cartridges in 2008 and eliminating the use of materials that contain brominated flame retardants and polyvinyl chloride. What are the challenges your company faces to reaching these goals?

A4. Incorporating greater amounts of recycled content and phasing out specific materials each pose distinct challenges. The challenge of using more recycled content presents a classic "chicken or the egg" dilemma. Our desire to use more recycled content is hindered by the limited availability of suitable materials, and the supply of suitable materials is limited by insufficient demand. Despite this problem, we have succeeded in using more than five million pounds (2,300 tons) of recycled plastic in its original HP inkjet cartridges in 2007, and the company has committed to using twice as much in 2008. HP also uses post-consumer recycled plastic recovered through our return and recycling program in the manufacture of original HP LaserJet print cartridges. This recycled plastic can represent as much as 25 percent, by weight, of the newly molded LaserJet cartridge housing.

The challenge of phasing out polyvinyl chloride (PVC) is complicated by the lack of suitable alternatives for some uses of this material. Our goal is to eliminate all remaining uses PVC from new computing products as technologically feasible alternatives become readily available. To be accepted, alternatives also must not compromise product performance or quality or adversely impact health or the environment. We expect to achieve this goal for new computing products launched in 2009.

An important component of HP's materials substitution efforts is determining that replacement substances have a lower environmental and health impact than the substances identified for possible phase-out. Many potential replacement materials are still being evaluated for environmental and health impacts. Unfortunately, standard methods to perform these evaluations do not exist, and as a result differing conclusions are sometimes drawn from the same study. To address this concern, HP engages with government agencies, such as the United States Environmental Protection Agency, and nongovernmental organizations, such as Clean Production Action, to develop standard methods for evaluating the environmental and health impacts of new substances.

Q5. In his testimony, Dr. Eric Williams mentioned several applications for using radio frequency identification (RFID) tags in the management of end-of-life elec-

tronics. From the producer's perspective, what might the advantages and disadvantages be in using RFID technology to manage used electronics?

A5. HP has played a leadership role in the development and deployment of RFID technology. We are currently using this technology to track product inventory, monitor customer returns and improve product quality, and other uses.

We agree with Dr. Williams that RFID technology could potentially play a useful role in helping to manage end-of-life electronics. It is possible that the tags could help recyclers identify the material composition of products, identify components requiring special handling (e.g., batteries), and other issues.

Certain issues need to be addressed before RFID technology could be employed on a large scale for managing used electronics. First, the cost of RFID tags are an obstacle, and it remains unclear whether the benefits of using this technology outweigh these added costs. Second, the current recycling infrastructure lacks the capability to read RFID tags and make use of the potentially valuable information on the tags. Finally, some consumer groups have raised concerns regarding potential privacy issues associated with the use of these tags on consumer products.

Questions submitted by Representative Ralph M. Hall

Q1. Does Hewlett-Packard currently publish the life cycle energy costs for all HP products? If not, would you consider providing such information to consumers in the future?

A1. HP currently publishes a considerable amount of information on the environmental and energy attributes of HP products. See *http://www.hp.com/hpinfo/globalcitizenship/environment/productdesign/products.html.* HP recently announced a new initiative to provide additional information on the environmental attributes of HP products. HP will begin using a "HP Eco-Highlights" label on new product packaging, web sites, and data sheets to help customers better understand the environmental attributes of the product, such as energy consumption and recycled content.

We do not publish "life cycle energy costs" for HP products at this time. HP products are comprised of thousands of parts, components, and materials, provided by a complex array of suppliers located around the world. This supply chain consists of many levels or steps that contribute to the final product. It would be a hugely complex undertaking to calculate the "life cycle energy costs" of the final product, and there is currently no generally accepted way of collecting this data and calculating the net energy impacts. HP is working within the international standards bodies to devise ways of improving the way such information is provided to consumers. We would consider publishing the "life cycle energy costs" for HP products once there were a clear methodology for doing so and if there were better ways of compiling the data in a standardized way.

Even in the absence of publishing this information, HP has made great strides in reducing the overall energy impacts of our products at every stage in the life cycle. In our own operations, HP is on track to achieve a 16 percent reduction in our energy consumption of our operations by 2010 from 2005 levels. We are also working with our suppliers around the world to reduce the energy consumed by the manufacturing, distribution, and packaging of our products. Finally, we are continuously achieving significant improvements in the efficiency of our products during the "use" stage by the consumer. For example, we have set a goal of reducing by the energy consumption of volume desktop and notebook computer families by 25 percent by 2010 compared with 2005 levels.

Q2. What are the liability concerns for companies that take-back electronics and reuse or recycle them? Does liability for damages to workers from exposure during recycling or liability for harm caused by refurbished equipment limit the growth of take back programs?

A2. HP takes seriously its responsibility to recycle our products in an environmentally sound manner, including the protection of workers involved in the recycling process. In addition to our obligations as a leading corporate citizen, HP seeks to limit any liability that we may incur as a result of our recycling operations. To achieve this result, HP requires our recycling vendors to comply with HP's Supplier Code of Conduct, and we monitor compliance through site audits. See *http://www.hp.com/hpinfo/globalcitizenship/gcreport/productreuse/recyclingapproach.html.* While there is an added cost to recycling in an environmentally sound manner, we believe that there are cost avoidance benefits associated with doing so.

Q3. Most major manufacturers claim that they do not ship e-waste oversees for recycling. Where does the e-waste found in environmentally unsound recycling operations originate?

A3. HP has a longstanding practice of ensuring that products and materials from our U.S. recycling programs are not shipped overseas (i.e., outside the U.S. and Canada) for processing. Unfortunately, there are numerous other entities involved in the collection and recycling of used electronics that simply serve as "waste brokers" and sell discarded products to others, or "sham" recyclers who simply utilize some profitable parts or materials and sell the rest. Thus, it appears the most materials found in the developing world that is subject to environmentally unsound practices originates from waste collectors, brokers, or "recyclers"—including municipal and other governments—that do not manage their materials properly.

According to a recent article in *National Geographic Magazine,* much of the improperly managed e-waste in the developing world originates with local collection events in the U.S. by municipalities or so-called "recyclers":

> Currently, less than 20 percent of e-waste entering the solid waste stream is channeled through companies that advertise themselves as recyclers, though the number is likely to rise as states like California crack down on landfill dumping. Yet recycling, under the current system, is less benign than it sounds. Dropping your old electronic gear off with a recycling company or at a municipal collection point does not guarantee that it will be safely disposed of. While some recyclers process the material with an eye toward minimizing pollution and health risks, many more sell it to brokers who ship it to the developing world, where environmental enforcement is weak. For people in countries on the front end of this arrangement, it's a handy out-of-sight, out-of-mind solution.

See "High Tech Trash: Will Your Discarded TV End Up in a Ditch in Ghana?" *National Geographic Magazine* (January 2008) (available at *http://ngm.nationalgeographic.com/2008/01/high-tech-trash/carroll-text/3*).

Q4. Your testimony highlights how HP is investing significantly in your "Design for Environment" and take-back campaigns. However, due to the storied history of your company you have a long tail of legacy waste as well. Does HP have a strategy for dealing with legacy waste or suggestions for the Committee on how best to tackle this problem?

A4. HP has been implementing and expanding its recycling strategy for nearly 20 years. Since 1987, HP has successfully collected and recycled more than one billion pounds of used or unwanted computer-related equipment globally. With our vast knowledge and experience, HP's goal is to recycle an additional one billion pounds of equipment (for a total of two billion pounds worldwide) by the end of 2010. HP has established a recycling service throughout the U.S. (as well as other countries around the world) that provides consumer and commercial customers with a convenient opportunity to recycle their old products in an environmentally sound manner. For more information on HP's environment and broader global citizenship activities, see: *http://www.hp.com/hpinfo/globalcitizenship/*.

HP currently partners with operators of seven large, state-of-the-art recycling facilities in the U.S. and Canada, as well as operating our own technologically-advanced facility used to recycled print supplies. Our recycling facility for printer supplies is located outside of Nashville, Tennessee. This facility consists of a 40,000 square foot building, including separation and recycling technology. The facility employs approximately 50 full time employees and processes all of the material returned to HP through our different print supplies programs in the U.S., Canada and Latin America.

Q5. Can you describe for us how the current system of print supply recycling came to be? What obstacles or successes have characterized this system and can be translated to the broader e-waste problem?

A5. HP recognized early on that print supplies posed unique recycling opportunities and challenges, and we promptly took steps to provide customers with a solution for their recycling needs. Unlike computer hardware products that can be used for many years, print supplies are "consumables" that are used for a more limited period. In the absence of a convenient recycling system, many of these print supplies would be disposed. To avoid this result, and given the relatively small size and weight of these products, HP determined that these products could be readily shipped through the mail or other shipping services to a recycling facility. HP recognized that customers wished to avoid disposing of these products, so HP developed a simple product return system that has been in place for almost two decades. Many

of our new print supplies come with a return envelope or label that allows customers to return their products quickly and easily. HP is also expanding its recycling offering by partnering with retailers to allow customers to drop-off their used cartridges. Once HP receives the used cartridge, HP recovers plastics that are then used in the production of new products. Other materials, such as metals, are recycled and made available on the commodity markets for use in other products.

The success of our recycling system for pint supplies demonstrates the viability of cost-effective, market-based systems for recycling used products. However, each product category necessitates a tailored approach. Just as the collection and recycling system for other common recyclables—such as appliances, tires, car batteries, and others—are each different, the system established for computers, TVs, or other electronic products may likely be different than the system of returning used print supplies through the mail. In addition, print supplies use a limited number of different types of plastics that makes recycling more feasible, many hardware products use a complex assortment of types of plastics that adds to the cost and complexity of recycling.

Questions submitted by Representative Daniel Lipinski

Q1. In 2006, the Government Accountability Office estimated that more than 100 million computers, TVs, and monitors are thrown away each year. In addition, the EPA estimates that electronic waste is growing two to three times faster than any other waste stream. Yet presently, there is no specific federal law or regulation governing the disposal of consumer electronic products in the U.S. Should there be?

A1. HP has long supported the adoption of federal e-recycling legislation as a means of encouraging harmonized national approaches to the challenge of e-recycling. Other major markets, including the EU and Japan, have adopted legislation on this topic, and we believe it is appropriate for the U.S. to act as well. In the absence of federal legislation a growing number of states have enacted their own laws. But the emerging patchwork of divergent State laws does not serve the interests of environmental protection and needlessly increases costs. HP believes that federal legislation is needed to establish a more efficient, effective harmonized national system.

Q2. The EPA estimates that at most, only 15 percent of products at the end of their useful lives reach a recycling or reuse program. This does not come as a shock to me. In fact, it might seem a little high given the impediments that consumers currently face.

A2. The 15 percent figure is consistent with the results of HP's recycling program and reflects the challenges of influencing consumer behavior. Including remarketed equipment, we achieved a total reuse and recycling rate in 2007 of 15 percent of relevant hardware sales. We cannot assess the accuracy of this number for other manufacturers.

Q2a. First, how are average consumers to know what to do with their e-waste when it comes to the end of its useful life?

A2a. Recycling opportunities for average consumers typically vary by product category and locality. This is likely to be the situation for e-recycling as well. Under the State programs currently in place, the options on the ground for consumers vary in terms of drop-off at retail establishments, municipal collection sites, one-day collection events, or other collection mechanisms. Consumers typically become aware of these opportunities by company or government websites or local advertising. Given that consumers will only look for these recycling opportunities on an infrequent basis, this approach is probably appropriate.

Q2b. This past weekend, Washington, D.C. held an e-waste recycling day. Over ten times as many residents as last year showed to recycle their gadgets, leading to over two hours wait time. The incentives to recycle just don't seem to be there right now. What do you recommend be done to fix this problem?

A2b. The significant wait time for consumers at local collection events is relatively common, particularly when it is a one-time event. Consumers may have a number of used devices in storage and they are looking for an opportunity to recycle a number of these devices at once. We believe that this "backlog" will dissipate once collection opportunities increase in frequency and convenience, as consumers find outlets for the devices they currently have in storage. Legislation can play a significant role in achieving this outcome. Legislation should establish a framework to create a more frequent and available system of collection points or events.

Q3. The European Union is often ahead of the United States when it comes to the issue of recycling. Where do U.S. capabilities stand as compared to Europe on the topic of e-waste?

A3. The electronics recycling infrastructure is better developed in Europe than it is in the U.S. In most countries, collection of products is facilitated by municipal governments and retailers, thereby creating an efficient and convenient way for consumers to drop off unwanted products. Also, there are a larger number of recycling vendors to conduct recycling operations in an environmentally sound manner. HP played a leading role in the development of a consortium of companies to conduct recycling operations. For more information, see *www.erp-recycling.org.* HP is working to develop the recycling infrastructure in the U.S. as well by partnering with leading metals recyclers, developing technologies, and auditing outside vendors to ensure compliance with environmental and other requirements.

Questions submitted by Representative Bob Inglis

Q1. Many manufacturers support a national solution to deal with e-waste; a federal law that would preempt the patchwork of State and local laws that are beginning to crop up. Are there any aspects of those State laws that would/should be expanded to the national level? What provisions of State laws in place now would be detrimental to efforts dealing with e-waste if ramped up to a national scale? Can you give an example or two of each?

A1. The costs of the emerging patchwork of State recycling laws will impose significant overall costs on companies. A study by the National Electronics Recycling Infrastructure Clearinghouse (NERIC) has estimated the manufacturer compliance costs in 2010 for all 14 jurisdictions having enacted mandatory e-waste financing requirements. According to the study, even if no other State or local legislation is passed, the NCER estimates that manufacturers will spend approximately $71 million in 2010 to comply with the U.S. patchwork of State e-waste mandates. See *www.ecyclingresource.org.* This emerging patchwork of differing State laws is adding significant new costs and impeding the development of an efficient nationwide infrastructure, while creating the potential for consumer confusion. A consistent national approach is necessary and appropriate.

A major goal of federal e-recycling legislation should be the achievement of a high degree of harmonization among the states and the elimination of unnecessary duplicate activities. Manufacturers of covered products are currently facing a variety of State laws that have differing approaches, product scope, and administrative requirements. These inconsistent State programs do not improve environmental outcomes, but instead simply add complexity and cost. Driving greater consistency among the State programs should be a key priority of federal legislation.

An important area that demands greater consistency is laws and regulations governing collection and transport of discarded electronics. As long as even a few states interpret their authority as allowing them to impose their own requirements on interstate transport of these discarded products, be they requirements to transport the products as hazardous wastes or some other special classification, and these products must be transported to recycling centers through these states, efforts to develop a national recycling system will be stymied. The State of Maine is one example of a state acting to impose unique requirements for certain discarded electronic products. In various cases, Maine regulation requires shippers to use a hazardous waste manifest or shipping papers similar to a hazardous waste manifest, and to use transporters with special plans and programs in place. In our experience, we have found it to be extremely difficult to find interstate transporters prepared to meet Maine's unique requirements. For these and other reasons, we currently do not offer one of our hardware take back programs in the State of Maine. [Optional: We do retain a recycling company nearby to Maine that operates their own transport vehicles to meet legislated take back obligations in Maine, but we do not have the same flexibility as in various other states to hire any common carrier to transport products to our various chosen recycling contractors. If we wished to, we would have to attempt to have the local recycler collect the material and take it to a neighboring state, then transfer the load to a common carrier there to enable it to be transported to one of our more distant U.S. recyclers managing large volumes for us.]

Another approach adopted in one state—California—that would be detrimental if expanded would be the imposition of point-of-sale fees on the sale of new products to finance the recycling of old products. Fortunately, California is the only state that has adopted that approach. Our experience and data from other recycling programs indicate that these fees (which are, in fact, taxes) result in higher overall costs than producer responsibility models that enable innovation and incentives for efficiency.

See, e.g., Gregory and Kirchain, "A Comparison of North American Electronics Recycling Systems."

ANSWERS TO POST-HEARING QUESTIONS

Responses by Eric Harris, Associate Counsel/Director of Government and International Affairs, Institute of Scrap Recycling Industries

Questions submitted by Chairman Bart Gordon

Q1. In your testimony you mentioned the need for research and development into new markets for plastic and glass, and recycling technologies for plastics. What would be the best mechanism to fund and prioritize this research? What would be the best mechanism to facilitate technology transfer to the recycling industry?

A1. It would seem that the best means to fund and prioritize plastic and glass research would be to include in the Appropriations Interior, Environment, and Related Agencies bill an appropriation directed to the U.S. EPA Office of Research and Development.

The research and development for new markets and technology related to glass and plastic would assist manufacturers in developing new technologies and uses for recyclable materials. And it would make more efficient existing uses of recyclable materials in the manufacturing process. Subsequently, manufacturers would develop additional requirements to utilize the recyclable material in their manufacturing processes.

Q2. You mention the difficulties associated with recycling the leaded glass from cathode ray tube televisions and monitors. Are there end-of-life challenges associated with flat panel displays? Is there a market for this glass?

A2. Yes. The new technology in flat screen displays utilizes a system of cylindrical lamps that contain mercury powder. These mercury lamps are very time consuming and costly to remove or replace, which also makes these products difficult to recycle.

The Institute of Scrap Recycling Industries Inc., (ISRI) has long advocated working with manufactures to design their products to be easily recycled at the end of their useful lives, including eliminating hazardous, toxic constituents, or creating other impediments that can hinder the recycling of those products. Design for Recycling® (an ISRI program established to encourage manufacturers in all industries to design their products, from the outset, with recycling in mind) will help to avoid these additional costs and improve recycling efficiency.

The best market for flat panel screens and cathode ray tubes is resell. In today's market, the resell value for flat panel displays is strong. Similar to the lead in cathode ray tubes, the mercury in the flat panel screens reduces the cost effectiveness of processing flat panel displays.

Q3. Now that producers are designing products to eliminate hazardous substances under Europe's Restriction on Hazardous Substances (RoHS) Directive, what more needs to be done to increase product recyclability?

A3. Rather than prescriptive changes, ISRI suggests that more collaborative opportunities are needed to think through some of these design issues before these products reach the market. For example, EPEAT is an electronic product design standard adopted by the Environmental Protection Agency that has been very successful in the marketplace. Most major computer manufacturers are using EPEAT as their measure of environmental product design, and are competing to gain additional credits from EPEAT by going beyond what other OEMs have done. For example, some manufacturers have incorporated significant amounts of recycled plastic in their products. This creates an increased demand for recycled plastics from computers. Additional programs could be encouraged by the Congress such as the EPEAT program.

Q4. You mention in your testimony that the recycling industry has called upon producers to adopt a Design for Recycling® philosophy but thus far they have met with only limited success. How do recyclers presently engage with electronic producers? Are there other industries with stronger partnerships that the electronics industry could learn from? Is there evidence from the electronics industry, or other industries, which shows producers will design products for easier recycling if they are financially or physically responsible for the product at the end of its life?

A4. Recyclers have had some success working with electronics manufacturers regarding design issues but such interactions have been limited.

ISRI has presented its Design for Recycling© award to HP for its leadership in designing its products for recycling. Certainly, HP is a good example of a manufac-

turer that promotes producer responsibility and is committed to Design for Recycling© because it makes good environmental and economic sense.

Another example focuses on the use of mercury switches in the automobile industry. That industry began to use convenience light switches and ABS brake sensors that contained mercury. Because of concerns about the hazards of mercury, especially to children and pregnant women, most non-American auto makers ended the use of mercury-containing switches in vehicles in 1993. The American manufacturers, however, continued to use mercury switches in vehicles built for the American market—until 2003. It was then that various states began requiring the removal of mercury switches from end-of-life vehicles at the expense of the manufacturers. That economic disincentive caused the auto makers to end the use of mercury switches and to seek a national program to support such switch removal.

Some years ago, ISRI worked with the Association of Home Appliance Industries (AHAM) to eliminate the use of cadmium paints in the manufacture of new appliances. Cadmium is a hazardous substance. And, ISRI works with the Vehicle Recycling Partnership (VRP), an entity created by the American auto manufacturers to develop ways and means to increase a vehicle's overall recyclability. In addition to ISRI and the auto manufacturers, other VRP participants are the auto dismantlers and the steel industry.

Q5. You state in your testimony that export of electronics can be safe and is an important part of the recycling industry. You also mention that in places like China there are legitimate and responsible recyclers. How should we close the loop on used electronics shipped overseas so that once they reach true end-of-life they are handled by legitimate recyclers?

A5. In today's market, buyers and brokers around the world are paying for scrap electronics as compared to recyclers in the U.S. having to charge to recycle the same material. This is due to the fact that some electronic equipment, such as monitors and televisions, has a net-negative cost to recycle; that is, the costs outweigh the value of recoverable material. However, at the same time, there is a thriving reuse market outside of the United States that allows foreign buyers to pay a premium for monitors and TVs.

ISRI advocates recognizing and giving contractual preferences to responsible recyclers anywhere in the world that can demonstrate that they are 'legitimate' recyclers. In fact, for the past two years ISRI has represented electronics recyclers in a multi-stakeholder process to develop responsible recycling practices (R2) for electronics recyclers. The Environmental Protection Agency has convened and facilitated this effort. Once completed, ISRI intends to incorporate this set of specific performance practices into its Recycling Industry Operating Standard (RIOS) for electronics recyclers.

ISRI developed RIOS as an integrated management system standard designed specifically for the scrap recycling industry and the ANSI–ASQ National Accreditation Board will oversee the third party registrars who will audit recyclers. It provides electronic recyclers with an affordable tool to monitor their quality, environmental, health and safety goals. Few industries worldwide have endeavored to undertake such a huge step, but the recycling industry in the United States has always been, and intends to remain, the global leader in recycling technology, environmental protection, worker safety and the production of high quality materials. RIOS plus R2 are tools for recyclers to accomplish those goals. This will help to build needed confidence in the market place and reward responsible recyclers that are willing to be audited to a set of requirements in an open and transparent process.

Questions submitted by Representative Ralph M. Hall

Q1. What are the liability concerns for companies that take-back electronics and reuse or recycle them? Does liability for damages to workers from exposure during recycling or liability for harm caused by refurbished equipment limit the growth of take-back programs?

A1. As with any business decision, there is always some risk associated with choosing strategic business partners. However, companies can dramatically reduce their potential risks associated with recycling electronic equipment (like re-selling hard drives with sensitive data or mismanaging material like mercury, batteries or leaded glass) by selecting a recycler that correlates to their risk tolerance. Companies need to educate themselves as to the differences of recyclers on the market. There is a wide disparity of services being offered from a wide variety of recyclers. As with other prudent business decisions, conducting appropriate due diligence and then

contracting with a responsible recycler based on individual needs can significantly reduce if not eliminate a companies potential liabilities.

Q2. How has electronics in the waste stream changed over the past decade and what predictions can we make about changes in the coming years? How do these changes affect our ability to safely and efficiently recycle or reuse these devices?

A2. The precious metal quantities have decreased on a per unit basis, which has decreased the per unit recoverable value of electronic equipment. However, the overall volumes have increased. Recyclers are simply seeing more electronic equipment coming into their facilities. The biggest challenges are finding end-markets for leaded glass and mixed-plastic resin.

Another emerging challenge is smelting capacity. Globally, the lead and precious metal smelters are quickly running out of capacity to recover the world's growing supply of electronic scrap. For example, there are only two major lead smelters left in North America. Lack of smelting capacity could significantly impact the sustainability of this market.

Q3. Most major manufacturers claim they do not ship e-waste overseas for recycling. Where does the e-waste found in environmentally unsound recycling operations originate?

A3. As scrap commodities and new and used electronic equipment is traded globally, the material is being generated from all over the world, which includes from the importing countries themselves. For example, China and Southeast Asian countries are the largest growth markets to sell new and used electronic equipment. Once that equipment reaches its end-of-life, artisan communities are purchasing and processing that material as well as material imported from developed countries. Since demand is so high, Asian brokers are able to pay more for the obsolete electronic equipment than in Europe and the United States. Thus, countries like China continue to purchase obsolete electronic equipment from countries all over the world, including the United States.

Q4. In your testimony you state that, "electronics recycling yielded approximately 1.3 billion pounds of recyclable materials" in 2006. How much of this material was subsequently used as raw manufacturing inputs?

A4. ISRI asserts that most, if not all, of the 1.3 billion pounds is absorbed back into the manufacturing process.

Q5. You state that much collected equipment has a net-negative cost to recycle. What are some examples of goods that generally cannot be recycled efficiently? How much of the current electronic waste stream is comprised of these goods?

A5. Unlike central processing units that yield a positive value of around 10 cents a pound and can be resold as a usable device for $50–$70 dollars, and 99 percent of laptops that are resold in their entirety and yield between $300 and $550 a unit, most electronics recyclers must charge their customers to recycle televisions and monitors containing cathode ray tubes (CRTs) to off-set the negative costs. Recyclers generally charge between 20–30 cents a pound, relative to truckload bulk equations for televisions and monitors with CRTs.

Televisions and monitors with cathode ray tubes pose the biggest challenge to municipal landfills and for-profit recyclers. The hard reality is that many consumers are not prepared or willing to pay an additional fee to responsibly recycle their old TVs and monitors.

It is worth mentioning that experts estimate that 30 percent of Americans currently throw televisions in the garbage (permitted under existing federal law) rather than recycle or donating them. That is the equivalent of 67,698,877 televisions. By recycling those televisions, according to the EPA's WARM model[1] environmental benefits calculator, 753,072.68 metric tons of carbon equivalents would be prevented from entering the atmosphere.

Q6. What are the most difficult components to safely and cost-effectively recycle? Other witnesses have raised plastics, mercury lamps, and lead content as having the potential to negatively affect environmental and public health. What is the state-of-the-art for recycling or reuse of these items?

A6. We would generally agree with your aforementioned list. Mixed plastic resin, mercury lamps, batteries, and leaded glass are the most difficult items to cost-effectively recycle. However, if responsibly recycled these materials pose little to no risk

[1] United States Environmental Protection Agency WAste Reduction Model (WARM), *http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_home.html*

to the environment or to public health. Each of these materials are sorted and then sent to appropriate material recovery facilities. For example, leaded glass is sent to either a glass-to-glass manufacturer or to a lead smelter. Depending on the quality of the sort, mixed plastic is either sold to a plastic manufacturer or for energy recovery. Mercury lamps are sent to facilities that specialize in mercury recovery and then to retort facilities.

Questions submitted by Representative Daniel Lipinski

Q1. In 2006, the Government Accountability Office estimated that more than 100 million computers, TVs, and monitors are thrown away each year. In addition, the EPA estimated that electronic waste is growing two to three times faster than any other waste stream. Yet presently, there is no specific federal law or regulation governing the disposal of consumer electronic products in the U.S. Should there be?

A1. ISRI supports a national solution that promotes a sustainable, market-based recycling infrastructure. We also support a system that improves Design for Recycling®, promotes responsible recycling and allows the free and fair trade of scrap commodities globally. ISRI is concerned that a multiplicity of 50 different laws and regulations will inhibit economies of scale and market efficiencies, thereby hindering the development of a sustainable recycling infrastructure, and slowing the development of end-use consumer markets for these valuable raw materials.

However, private sector electronics recyclers are already recycling under a host of applicable environmental, health and safety, commercial and import/export regulations; such as permitting requirements in the CAA, CWA and storm water provisions, RCRA (solid and hazardous wastes provisions), OSHA, more stringent State requirements, federal and State transportation laws, U.S. export laws and import requirements of foreign countries, such as those administered by China's General Administration on Quality Supervision, Inspection and Quarantine (AQSIQ). We are doubtful that a set of new regulations are needed to address electronics recycling. At the same time, we recognize that a few "sham" recyclers may be spoiling the concerted efforts of most responsible recyclers to adhere to high standards and applicable law. ISRI asserts that more precise enforcement efforts targeted at "sham" recycling, and making certain that governmental entities involved in electronics recycling are fully complying with the current statutory and regulatory regime, is more appropriate than creating new laws and regulations.

Q2. The EPA estimates that at most, only 15 percent of products at the end of their useful lives reach a recycling or reuse program. This does not come as a shock to me. In fact, it might seem a little high given the impediments that consumers currently face.

A2. First, how are average consumers to know what to do with e-waste when it comes to the end of its useful life? This past weekend, Washington, D.C. held an e-waste recycling day. Over ten times as many residents as last year showed up to recycle their gadgets, leading to over two hours wait time. The incentives to recycle just don't seem to be there right now. What do you recommend be done to fix this problem?

One of the primary benefits of having OEMs and retailers participating in producer responsibility and take-back programs is their access to consumers. Educating consumers about were they can recycle their household electronics is essential to furthering a sustainable infrastructure. Recyclers do not have the same access to consumers as do the OEMs and retailers. ISRI strongly believes, for this type of reason, that OEMs, retailers, collectors, transporters and recyclers must work together to educate consumers in order to utilize the existing reuse/recycling infrastructure.

As far as incentives, one of the primary challenges is to reeducate the consumers to think of household electronic equipment as a recyclable and not a waste. It is very important to distinguish between scrap and waste as well as recycling and disposal. Simply stated, scrap is the opposite of waste. Processed scrap materials are commodities that have a significant value on domestic and international markets as raw material feed stocks that substitute for virgin materials in the manufacture of new basic materials such as copper, steel, and plastics. Unlike scrap, waste has no value and is typically buried in a landfill.

Electronics scrap, like scrap paper, glass, plastic, metal, textiles, and rubber, is not waste when recycled. Defining scrap electronics as waste undermines and overlooks the value that these electronics retain, if properly recycled. Saddling them with the moniker of "waste" imposes a whole host of unwarranted regulatory bur-

dens that will undermine the ability to allow the recycling system to operate effectively and efficiently.

ISRI is confident that making the connection between recycling and climate change will provide an extra incentive to recycle household goods. Scrap recycling is one of the world's most climate friendly activities. The use of recycled scrap materials to manufacture new products sustains the earth's natural resources, while at the same time, conserves impressive amounts of energy in the manufacturing process, and thereby significantly reduces greenhouse gas emissions from those facilities.

In addition, the market is also responding with new incentive approaches. For example, Sam's Club stores has a program that will allow consumers to redeem unwanted electronics for a Sam's Club gift card, the value of which is determined by the quantity and quality of electronics traded in. These types of programs coupled with the public's desire to recycle more due to climate change will likely provide extra incentives into the marketplace.

Q3. The European Union is often ahead of the United States when it comes to the issue of recycling. Where do U.S. capabilities stand as compared to Europe on the topic of e-waste?

A3. ISRI is perplexed by the notion that the European Union is presumably "ahead of the United States" when it comes to recycling. In the minds of many, recycling in the United States is a phenomenon that began in the 1970's following the original Earth Day celebration. For others, awareness dates to the late 1980's following the infamous voyage of the "garbage barge" and the ensuing fears that landfill capacity had reached a crisis stage. It may interest the Committee to know that the scrap recycling industry actually dates back to the beginnings of our nation, when a statue of King George III was toppled in NYC and its metal was used to make bullets for the Continental Army. Our members are in the business of recycling, and have formed the basis of the established recycling infrastructure that exists in this country today.

ISRI is now the largest trade association of recyclers throughout the world. With approximately 1,500 member companies that process, broker and industrially consume scrap commodities, including metals, paper, plastics, glass, rubber, electronics and textiles. Our members operate at over 3,000 locations in the United States alone. More than 20 percent of ISRI's membership is involved in electronic scrap processing and industrial consumption of scrap material generated by electronics recyclers. In 2007, the domestic industry manufactured approximately $71 billion of specification grade commodities that were used in lieu of virgin materials to manufacture basic products, including over 81 million tons of iron and steel, five million tons of aluminum, 1.8 million tons of copper, and two million tons of stainless steel, just to name a few. Of the $71 billion, nearly $22 billion worth of material was exported to 152 countries worldwide, making a significant positive contribution to the United States balance of trade with other nations.

Recyclers' capacity in the United States to responsibly recycle electronic equipment is comparable if not superior to European operations. Approximately 2.8 billion pounds (1.4 million tons) of electronic equipment were recycled in 2006, including 65 million units of computer equipment (CPUs, monitors and printers). The electronics recycling process yielded approximately 1.3 billion pounds of recyclable materials, more than half of which were metals.

Questions submitted by Representative Bob Inglis

Q1. Many manufacturers support a national solution to deal with e-waste; a federal law that would preempt the patchwork of State and local laws that are beginning to crop up. Are there any aspects of those State laws that would/should be expanded to the national level? What provisions of State laws in place now would be detrimental to efforts dealing with e-waste if ramped up to a national scale?

A1. Short-term Financial Mechanism

ISRI supports a federal approach over a patchwork of State laws. As with most of the existing State laws, until such time as the market for recyclable electronics becomes economically viable, ISRI's policy supports holding producers responsible for the collection, transportation and recycling of *household electronic equipment that has a net-negative cost to recycle,* such as cathode ray tubes in monitors and televisions. ISRI firmly believes that producer responsibility will provide manufacturers with the needed incentive to design their products with an eye to the future, incorporating design changes that maximize recycling at the end-of-life.

We strongly encourage the Congress and the states to *end any financial mechanism as soon as markets for recyclable electronics become economically viable.* We are not an industry that seeks government subsidies, and we believe markets must ultimately stand on their own based on solid business principles. However, whatever financial mechanism the Congress and the states might decide to adopt in order to sustain this market, ISRI suggests that a portion should be applied to the *research and development of end-use markets* for the scrap materials recovered from electronics products, particularly mixed plastic resins and leaded lass.

Concentrate on Household Monitors & Televisions

Many states are asking OEMs to pay for the costs to recycle electronic equipment that has a positive value to recycle. This makes no sense. Recyclers do not need help covering the costs of recovering positive valued electronics, like central processing units, laptops and cell phones. ISRI suggests that the federal bill only begin with *consumer generated monitors and televisions with cathode ray tubes.* You may recall that EPA in recent years finalized a federal rule for CRTs, and their action was very timely in light of the digital transition. That action may help to alleviate consumers' reluctance to pay to responsibly recycle these devices.

Electronic Scrap Must Be Allowed To Move

States lack the jurisdiction to regulate exports. Nevertheless, ISRI contends that the stigma associated with "exporting" is misguided and exports should be viewed from the prism of the realities of the global economy. The focus should be to promote responsible recycling globally and concentrate efforts towards enhancing and promoting environmentally capable facilities that will receive and properly handle recycled materials anywhere in the world.

Reasonable Performance Requirements

OEMs, in association with interested stakeholders should determine the best process performance requirements placed on their businesses; however, there is a growing concern in Europe that performance requirements that are too aggressive can distort the collection market and ultimately the long-term sustainability of electronics recycling. Many in Europe (and a growing number in the U.S. concerned about domestic programs with high quotas such as Minnesota's) now argue that performance quotas which are too high can distort the price of collection by forcing OEMs to compete for a limited supply of electronic devices. Nevertheless, any quota system should track the available supply as it relates to the phased-in landfill ban.

Include Transportation Costs

ISRI suggests that transportation costs need to be included with the OEM obligations because the transportation expense associated with moving old computer monitors and TVs into the recycling stream is one of the largest costs of electronics recycling. Without addressing this important consideration, it is likely many of these older and heavier products will not be returned to the recycling stream by their owners. Therefore, any collection system must cover all the costs of transportation in order for the program to be effective.

Landfill Ban for Recyclable Material

As with most states, keeping these materials out of the landfill is an important component to ensuring enough supply is available to enable an economies of scale business model. Under existing federal law, consumers can dispose of their household electronic equipment legally. In order to ensure adequate supply for positive-valued electronics equipment, ISRI supports a national land-fill ban for recyclable material that cannot be safely and economically recycled using existing technologies and methods.

Reasonable Recycling Standards

ISRI promotes the benefits of comprehensive, integrated environmental, health and safety and quality management systems, such as ISRI's Recycling Industry Operating Standard (RIOS), implemented by electronics recyclers as a means to promote and to ensure the proper handling of electronic products destined for recycling.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Ted Smith, Chair, Electronics TakeBack Coalition

Questions submitted by Chairman Bart Gordon

Q1. In your testimony, you suggest a National Sustainable Electronics Initiative. Which federal agency or agencies should oversee this initiative? How should industry be involved?

A1. We propose that Congress establish a new National Sustainable Electronics Initiative which would be composed of a National Clean Electronics Council (a governing body) and a National Clean Electronics Research and Development Fund (funded by Congress.) Rather than house this new Initiative in any one federal agency, we propose that it be a collaborative effort that would include several federal agencies as well as participation from industry, academia and non-governmental organizations. We have looked at the National Nanotech Initiative and the National Renewable Energy Laboratory's (NREL's) Science and Technology Organization as potential models. Both include broad representation of federal agencies with outside stakeholders and serve as good models to address other major federal needs. Our proposal is for an "initiative" rather than a new single agency "center" and the inclusion of the National Clean Electronics Council is similar to the governing structure established for the National Nanotech Initiative.

We believe that it would be most effective if it includes a broad range of expertise from federal agencies which could include the Department of Commerce, Department of Energy, Department of Health and Human Services, National Institute for Occupational Safety and Health, Environmental Protection Agency, Department of Labor, Occupational Safety and Health Administration, National Science Foundation, the National Labs, Consumer Products Safety Commission, and other agencies and departments with appropriate expertise. Representatives from industry will need to be significantly involved—especially those who are already involved in research and development, as well as in environmental and occupational health and safety.

Another arena that we believe should be assessed is the model of the Centers for Excellence in the semiconductor industry (through SEMATECH) as well as for nanotechnology, which provide for collaboration between academia and industry. Another example is the Center of Excellence for Photovoltaic Research and Education.

One of the key issues that will need to be addressed, however, is the need for real transparency and effective public participation, which often present challenges when dealing with the electronics and scrap industries. It is also essential that 'customers' who generate e-waste (such as corporations, universities, municipalities, etc.) are valued stakeholders in the process of defining a solution to this problem, as they have needs around data security, CRCLA liability, brand name protection, etc.

We believe that a real public/private partnership between the Federal Government and industry experts—with full collaboration from universities and NGOs—is necessary to address these concerns in a comprehensive manner. We look forward to working with the Committee to further define and give shape to this initiative as it moves forward.

Q2. In your testimony you stated that 50 to 80 percent of the electronics products taken in for recycling are instead shipped to developing countries where they are de-manufactured in unsafe and environmentally harmful conditions. What accounts for the range in your estimate?

A2. The 50 percent to 80 percent figure is an estimate that we have developed through extensive discussions with experts in the industry. We initially developed this estimate when we were researching and writing the first report on the hazards of exporting electronic waste—"Exporting Harm: The Toxic Trashing of Asia" by Basel Action Network and Silicon Valley Toxics Coalition, February 25, 2002. See *http://www.computertakeback.com/docUploads/Exporting_*Harm.pdf for the full report. In doing this research, we discovered that the Federal Government does not collect data on hazardous waste exports so it is unable to measure or monitor this growing problem. Since there is no effective federal oversight of e-waste exports, the only way that we are able to make this estimate is by surveying the experts in the industry. It is a significant fact that the U.S. does NOT have any definitive quantities and destinations for exports of electronic waste. All other developed countries, and a total of 170 nations are legally bound to control and monitor their exports of toxic waste, as a result of ratifying the Basel Convention. The U.S. (the largest

generator of e-waste globally) has no system in place to quantify—much less restrict—where our toxic waste ends up.

The reason most electronic waste collected for recycling is exported is that waste generators here is the U.S. (such as corporations, universities, municipalities, individuals, etc.) are faced with a choice between **paying** for their e-waste to be responsibly managed in the U.S./developed world versus **generating revenue** by selling their e-waste to a broker or 'recycler' who exports it to the highest bidder globally, usually China.

For example, many municipalities across the country want to keep these toxins out of their landfills and would like to offer free recycling to the public so that there is no disincentive for the public to bring equipment in, but this can be very expensive for local governments. Because of these pressures, less savvy solid waste officials frequently contract with exporters to either take all the equipment for free or even buy it for a few cents on the pound. These exporters usually do nothing other than repackage the e-waste into international shipping containers, exporting everything from sensitive data on hard drives to toxic waste (which is illegal for many nations to import from the U.S.). On the other hand, responsible U.S. recyclers with permitted warehouse facilities, providing data security, worker protections, U.S. wages, etc., must charge customers for managing this toxic waste. Even though the metals market currently has a high market value, responsible recyclers in the U.S. repeatedly tell us that proper management of the leaded glass, mercury lamps, etc., results in a net cost for the overall labor and administration of this complex waste stream.

In our unregulated U.S. arena, not only are there no hard numbers quantifying exports, but there is a very wide range of recycling practices in an often unscrupulous industry. This eaves it up to the waste generators to navigate a complex, multitiered world of brokers and middle men, all looking to make a profit on this problematic waste stream.

An additional factor that encourages export of e-waste is that some U.S. based companies that call themselves recyclers are unscrupulous. They engage in outright bribery in sending shipments of hazardous waste to foreign countries, since it is illegal for about 140 countries—the non-OECD Basel Parties—to trade in toxic waste with the U.S. In one of the most notorious cases documented, Mark Dallura of Chase Electronics explained how the system works:

"Mark Dallura, head of Chase Electronics Inc. of Philadelphia, which buys discarded computers in the United States and then ships them to China via Taiwanese middlemen based in Los Angeles, said he has been in the trade for 15 years and has not been slowed by the [Chinese] ban.

"I sell it to [the Taiwanese] in Los Angeles and how they get it there is not my concern," Dallura said. "They pay the customs officials off. Everybody knows it. They show up with Mercedeses, rolls of hundred-dollar bills. This is not small time. This is big-time stuff. There's a lot of money going on in this."

Dallura said his company gets many of its old computers from recyclers scattered across the United States. They pick them up from well-intentioned citizens and businesses that hand them off at events organized by cities and counties aimed at keeping e-waste out of landfills. He acts as a broker, consolidating container shipments that he then hands off to the middlemen. Most weeks, he ships at least one container bearing 45,000 pounds of such waste.

A container full of computer monitors brings him a fee of $2,600, he said. During a recent week, he planned to ship four containers. Two were bound for Hong Kong, the other two for Nanhai, bearing mainframe computers not covered by China's ban.

"I could care less where they go," Dallura said. "My job is to make money."

"China Serves As Dump Site For Computers" *Washington Post,* Monday, February 24, 2003.

http://www.etoxics.org/site/PageServer?pagename=svtc_washpost_2_24_2003

Since these early stories of exporting toxic e-waste were published, there has been tremendous consolidation and growth in the U.S. e-waste recycling industry. Yet, most of these U.S. companies face frustration as they are well under capacity. In contrast, exporters offer cheaper or free service, subsidized by human health and the environment in developing countries.

In recognition of the seriousness of the impact of exporting hazardous e-waste, the GAO is currently investigating the extent of the problem, at the request of late Chairman Tom. Lantos. The GAO is expected to report back to Congress this fall.

Q3. You stated that electronic waste "would not be an issue if the products themselves were not so toxic." Does Europe's Restriction on Hazardous Substances (RoHS) Directive sufficiently address the toxicity issue for electronics? You also

state that electronics products are "poor[ly] designed" in terms of recyclability. With the increased adoption of extended producer responsibility legislation, have producers made any changes to their products to make them easier to recycle?

A3. While the RoHS Directive will help address the toxicity issue to some degree, it is really only a drop in the bucket when assessing the overall problem. The current version of RoHS addresses only 6 of the more than 1000 substances that are involved in the manufacture of electronic products, many of which are toxic—carcinogens, reproductive toxins, neurotoxins, tetratogens, etc. With that said, the European Union is set to revise RoHS over the next twelve months and include additional substances since there was recognition that RoHS version 1 was a small first step towards greening the supply chain of the electronic sector. This is another area where the U.S. needs to become more active.

An important recently published epidemiological study published by Richard Clapp of Boston University found high rates of cancer among manufacturing workers at IBM plants in the U.S. See Mortality among U.S. employees of a large computer manufacturing company: 1969–2001, *http://www.ehjournal.net/content/5/1/30.* The study, which evaluated the cause of death for over 30,000 IBM workers, concludes:

"Mortality was elevated due to specific cancers and among workers more likely to be exposed to solvents and other chemical exposures in manufacturing operations. Due to lack of individual exposure information, no conclusions are made about associations with any particular agent."

Some product designers tell us that manufacturing of new products happens in China and other developing countries because Original Equipment Manufacturers (OEMs) demand the use of chemicals (e.g., to achieve specific surface treatments) that are no longer allowed in U.S. manufacturing facilities.

It is clear that the issue of toxicity is pervasive in electronics products—from manufacturing through disposal. This is why we need a major R&D initiative that helps major OEMs—many of which have headquarters and research and development operations based in the United States—to replace chemicals and materials that are problematic throughout the life cycle of their products with safer more innovative alternatives. Enhanced research and development of environmentally improved chemicals and materials can also be an important step toward improved global competitiveness.

It is also true that electronic products are poorly designed in terms of recyclability. Since manufacturers have not been financially or physically responsible for end-of-life treatment historically, they have not felt the need to design for recyclability. For example, recyclers tell us that one electronic device may have 6–8 different types of screws or fasteners needed to de-manufacture a single piece of equipment, requiring workers to change tools multiple times, increasing ergonomic stresses and slowing efficiency. This is beginning to change with the recent implementation of the Waste from Electronics and Electrical Equipment (WEEE) directive in Europe (2006) and similar new initiatives in many other countries, and this is the principle reason that we are supporting similar legislation here in the U.S. However, it is still too early to see much direct impact from product re-design in response to these new initiatives, as most of the current waste stream doesn't include these new products. In fact, one of the most significant technological innovations—the development of flat panel monitors and TVs to replace Cathode Ray Tube (CRT)—has resulted in the creation of new problems for recyclers. While the large amount of lead in CRTs has presented one of the most significant challenges for recycling, the transition to flat panel Liquid Crystal Displays (LCD) monitors which contain mercury lamps has created new challenges, since most of these monitors were not designed for ease of removing the mercury before shredding or recycling. To make matters worse, many manufacturers are not inclined to re-design these monitors to increase the ease of disassembly. To do so would include costly design changes at a time when most manufacturers are developing the next generation of products based on light emitting diode (LED) technology. This is a good example of how rapid technological change invariably outpaces the ability of government, workers, communities, and recycling communities to keep up and why we need a major new initiative to require some baseline minimums for toxic inputs and design for recycling, and to better integrate the advances in technological change with society's need for improved health and environmental protections.

I am providing links to the following articles from Clean Production Action that further elaborate on these issues:

1. How Producer Responsibility for Product Take-back Can Promote Eco-Design, *http://www.cleanproduction.org/pdf/cpa_ecodesign_Apr08.pdf*

2. Why promote Green Chemistry, *http://www.cleanproduction.org/Green.php*

Q4. What responsibility should the consumer bear for the end-of-life management of electronics? How can consumers be better educated about recycling and who should do this? Do you believe that an eco-label or eco-rating system for consumer electronics would motivate consumers to buy products that were more environmentally friendly?

A4. There is a very significant need for better consumer education about the myriad challenges of dealing with end-of-life electronics. Most consumers still are not aware of the hazards resulting from disposal of their old electronic products. Even for those who are, there are no free and convenient options readily available in most cases. Some consumers who are more aware of the irresponsible disposal of e-waste are hesitant to recycle their e-waste for fear it will not be responsibly recycled. The Federal Government needs to act to stop low-end practices of dumping e-waste on developing countries and federal prisons so that all those with e-waste—consumers and institutions—can do so without fear of contributing to the poisoning of other people.

However, there needs to be a combination of massive public education and increase in consumer options in order to address the role and responsibility for consumers. One without the other simply does not work. Yet, with appropriate attention to education and convenience, it will be possible to make major changes in the way that consumers deal with their obsolete products, much in the same way that many consumers have significantly changed their behavior with respect to recycling paper, aluminum and plastic over the past few years. To create an effective infrastructure for collecting e-waste from consumers for recycling or reuse, we need to undertake a major expansion of options for consumers, including return to retail stores, return to nearby collection centers, free mail back, etc. There is a need to encourage people to get their equipment into reuse streams when the equipment has the most value for another user.

Eco-labels can be a part of this needed cultural change, as has been shown in several European countries. The TCO eco-label in Sweden, for instance, has a consumer awareness and acceptance of over 80 percent. Thus, many manufacturers design their products to meet the requirements of the European labels in satisfaction of consumer demands. While the U.S. lags far behind Europe in this regard, there is reason for optimism with the experience of the Energy Star label, as well as with the early interest with the EPEAT labels. Again, the increased availability (and affordability) of eco-label branded products combined with greater public education will help to motivate more consumers to purchase more environmentally friendly products, and more manufacturers to make them.

Questions submitted by Representative Ralph M. Hall

Q1. How have electronics in the waste stream changed over the past decade and what predictions can we make about changes in the coming years? How do these changes affect our ability to safely and efficiently recycle or reuse these devices?

A1. One of the most important changes in the electronics waste stream over the past decade is the enormous growth rate, both in the number of new products and in the decreasing life span of new products. Electronics innovation is largely driven by Moore's law (named for Gordon Moore, inventor of the semiconductor and one of the founders of Intel, who predicted in the 1970s that each new generation of electronic products would be twice as fast and twice as small as the previous generation (a generation of electronic products is about 18 months to two years). This prediction has held true for more than three decades and has been the source of the enormous innovation driver for the industry. It has also been the underpinning of the rapid obsolescence that underlies the rapid growth of e-waste. This phenomenon, when combined with the development of entirely new electronic products—such as mobile phones, portable music players, flat panel displays, electronic games, etc.—has led to the explosive growth in e-waste which is creating the crisis that we are now attempting to address. Just as the growth rate for technological developments predicted by Gordon Moore is exponential, so too is the growth rate of e-waste.

The rapid increase in e-waste makes it extremely challenging to develop comprehensive reuse and recycling systems that are capable of keeping pace. We need to address the huge stockpile of "historic waste" that has accumulated over the past few decades while at the same time expanding our infrastructure to address the new growth in future e-waste. That is why setting effective goals and timetables for manufacturers to meet is so important, since they need to develop the capacity to properly collect and recycle not only their fair share of their historic waste but also

to collect and recycle *all* of their newly created e-waste. When the leading companies acknowledge that they are only collecting about 15 percent of their waste products when compared to new sales, it is a compelling argument that we need enforceable goals and timetables in order to catch up to the rapidly escalating problems. We need to get to the point where companies have successfully reduced their historic or legacy waste to zero *as well as* implemented an effective program to collect and process all of their future e-waste.

Q2. Most major manufacturers claim that they do not ship e-waste oversees for recycling. Where does the e-waste found in environmentally unsound recycling operations originate?

A2. Most e-waste that gets into the "recycling stream" (as opposed to the waste stream) is currently collected and recycled by municipalities (in collection events and permanent facilities), recyclers, asset recovery operations, and independent waste haulers—not by the manufacturers. The sources of the e-waste that is being disposed of in unsound operations are many and varied—from discards by public agencies to corporate disposal to household hazardous waste. The old TV that a well-meaning consumer hauls down to his city sponsored e-waste collection event on Earth Day very likely ends up being exported to Asia, Africa, or Latin America where it is causing great harm. In fact, the report by the Basel Action Network—"The Digital Dump: The Export of Reuse and Abuse to Africa" which documents such abuses includes an appendix that lists the origin of e-waste found in Nigeria, based on the asset tags. See *http://www.ban.org/BANreports/10-24-05/documents/ListofAssetTags.xls.* The report includes photos of 90 asset tags which identify the many diverse original owners of the equipment such as the Department of General Services, St. Mary's Hospital, City of Houston, Headquarter of U.S. Army Corps of Engineers, Trinity College, IBM, U.S. Government Property, Wauwatosa School District, San Mateo Union High School District, Illinois State Police, Kansas Department of Transportation, Michigan Dept. of Natural Resources, and Federated Systems Group, INC. The link to the full report is at *http://www.ban.org/BANreports/10-24-05/index.htm* and the link to the Asset Tag appendix is at *http://www.ban.org/BANreports/10-24-05/documents/ListofAssetTags.xls.* **Tax payer supported public institutions (such as universities, school districts, etc.) are under enormous pressure to select "low bid" recycling contractors to dispose of their e-waste, so it no surprise that much of the e-waste that ends up being exported to developing countries originates from these institutions.** This is another reason why we need to prohibit the export of hazardous e-waste to developing countries in order to protect public institutions from having to do business with low-bid exporters.

While manufacturers (and others) frequently claim that they do not ship e-waste overseas for recycling, there are four important facts to understand:

a. The U.S. has shut down all of its secondary smelters except one (which does not process circuit boards) and therefore the U.S. companies currently export their circuit boards to other countries. Some companies, however, ship these obsolete circuit boards to state-of-the-art smelters in Canada and Europe where they are processed in a responsible manner. Circuit boards clearly do not need to be exported to developing countries where they continue to cause great harm to health and environment. The question is not whether hazardous e-waste is exported, since much of it is, but rather *exported to where.*

b. Leaded glass has two primary types of destinations (other than landfills), which are to lead smelters (like the one remaining in the U.S., which has limited capacity and charges for accepting the glass), and to manufacturers of new CRTs, which are no longer located in the U.S., and are almost exclusively located in developing countries now. So any U.S. company sending old CRT glass into the "glass-to-glass" market, for 'recycling' into new CRTs, must export the leaded glass out of the U.S. Unfortunately, there are not currently other, better options available for CRT glass.

c. Many companies exporting e-waste simply label the volumes as going for 'reuse' (not recycling), regardless of the end destinations or usage. This is the central theme of BAN's second documentary film, "The Digital Dump."

d. Many unscrupulous companies will frequently say that they do not export any electronic materials, when they turn it over to brokers or others who do the exporting. This is a very common 'white lie' in the industry.

Q3. Your testimony focuses on the potential harms of exposure to toxic chemicals in electronics. However, doesn't exposure primarily occur during the recycling and waste disposal stages? Since average consumers have little risk of exposure from

their electronic products, shouldn't we focus our efforts on the end-of-life environmental concerns?

A3. While there is exposure to toxic substances throughout the life cycle of electronic products, the two most toxic phases in the life cycle of electronics are in the manufacturing and in recycling of the products. The most significant exposures to toxic chemicals occur in the manufacturing stage of the electronics life cycle, even more than in the waste disposal stages. Hundreds of thousands of people are involved in electronics manufacturing, far more than are involved in recycling, and the variety of toxic chemical exposures are also more extensive, since many of the chemicals used in manufacturing do not end up in the products but rather end up as hazardous waste or released into the environment. I have attached two articles that further elaborate on these health hazards: the "Cancer and Reproductive Risks in Semiconductor Industry" by Dr. Joseph LaDou and John Baillar and published in the *International Journal of Occupational and Environmental Health* (2007) and a paper that assesses the health hazards in the circuit board industry entitled "Printed circuit board industry" by Dr. Joseph LaDou from *International Journal of Occupational and Environmental Health* (2006). A long awaited study of chronic health issues among semiconductor industry workers (funded by the Semiconductor Industry Association) is due to be published in 2009 by researchers at Vanderbilt University.

In addition, recent studies have emerged indicating that people are being exposed to toxic chemicals during the use of these products in our homes and workplaces. Fire retardant chemicals that are used in electronics, including the outer enclosures of TVs, can migrate out of consumer products and find their way into our bodies. A study by Dr. Arlene Blum (*http://greensciencepolicy.org/files/standards/MASTERWhitepaper.pdf*) revealed that fire retardants are being "found in rapidly increasing levels in dust, the food chain, pets, wild animals, and human fat, body fluids and breast milk worldwide. The United States has much higher levels of fire retardant chemicals in dust, food, and breast milk than Europe where fire retardants are less used. The average U.S. woman's body and breast milk contains fire retardant levels approaching those that cause adverse reproductive and neurological health problems in animals."

The Boston University School of Public Health just published an article on April 30, 2008 showing that bromine levels in TVs can be related to decaBDE levels in dust in homes. Those homes with more occupants, and therefore presumably more TV usage, demonstrated higher levels of decaBDE in the dust. It is believed that as the temperature of the plastic TV enclosure increases due to usage, the rate at which the decaBDE migrates from the TV into the dust is also increased (*http://pubs.acs.org/cgi-bin/abstract.cgi/esthag/2008/42/i11/abs/es702964a.html*). The presence of fire retardants in household dust is especially worrisome because children take in approximately seven times more pentaBDEs each day than adults (Lorber, M. 2007, Exposure of Americans to polybrominated diphenyl ethers. *Journal of Exposure Science and Environmental Epidemiology,* published online April 11, 2007). Flame retardants are one example of a chemical contained within electronics that poses hazards throughout its entire life cycle, including the household and workplace use phase.

Q4. Are worker and environmental safety protections in the U.S. adequate for e-waste recyclers? Would you support a system whereby U.S. recyclers handled only certain commodities, like CRT monitors?

A4. Worker and environmental safety regulations pertaining to this waste stream are patently inadequate in the U.S. In fact, many of the toxic materials are exempt from RCRA definitions of hazardous waste, such as the mercury lamps in LCD screens, circuit boards, and all e-waste generated by households. While some recyclers have established state-of-the-art health and safety protections for their workers, going far beyond compliance, most do not. The lack of meaningful OSHA regulations and enforcement, or other worker health and safety standards for recycling workers adds to the hazards. The recycling industry is still relatively new and has not had (to the best of our knowledge) any comprehensive health assessments or industrial hygiene assessments done. At the same time, there have been isolated studies done suggesting that recycling workers are being exposed to hazardous materials in the processing of e-waste. One of the leading such studies conducted in the U.S. is entitled "Occupational risks associated with electronics de-manufacturing and CRT glass processing operations and the impact of mitigation activities on employee safety and health" by Peters-Michaud, N.; Katers, J.; Barry, J. from Cascade Asset Management, LLC, published in *Electronics and the Environment,* 2003. IEEE International Symposium, Volume, Issue, 19–22 May 2003 Page(s): 323–328. For the

full report which evaluates specific emphasis on the impact of operational and training improvements to mitigate exposure to potential harm from airborne contaminants and other environmental hazards, see *http://ieeexplore.ieee.org/Xplore/login.jsp?url=/iel5/8575/27162/01208098.pdf?arnumber=1208098.* Another widely cited health study of e-waste recycling workers is Flame Retardant Exposure: Polybrominated Diphenyl Ethers in Blood from Swedish Workers by Andreas Sjodin, et al., *Environmental Health Perspectives* Volume 107, Number 8, August 1999, *http://www.ehponline.org/docs/1999/107p643-648sjodin/abstract.html.*

Similar health concerns have been documented at e-waste recycling facilities managed by UNICOR in federal prisons. See "Corporate Strategies for electronics recycling: A tale of two systems" published by Silicon Valley Toxics Coalition and Computer TakeBack Campaign, 2003, *http://www.etoxics.org/site/DocServer/prison_final.pdf?docID=201.* This is particularly important since the U.S. Government is the single largest customer for UNICOR, which has been investigated by the U.S. Department of Justice due to complaints of toxic exposure to prison guards, prison staff and inmates. In fact, when Leroy Smith, a safety manager for United States Penitentiary Atwater in California tried to address the health and safety hazards inside the prison where he worked, his warnings were ignored, he was subjected to retaliation by his superiors, and he was subsequently recognized by the U.S. Office of Special Counsel as a Public Servant for his actions as a whistleblower. For further information, see *http://www.peer.org/news/news_id.php?row_id=687; http://www.peer.org/news/news_id.php?row_id=746; http://www.osc.gov/documents/press/2006/pr06_16.htm*

We *do not believe* that *only* CRT monitors should be handled within the U.S. since that serves to push our problems off onto others around the world.

Q5. What is an appropriate metric for recycling? Should we calculate by the weight of material that is recycled or should we measure by the number of units that are disassembled but not entirely recycled?

A5. This is an important question and one that is at the center of a major debate now taking place amongst the e-waste recycling stakeholders. Many favor using weight as the metric because of its relative ease in measuring and widespread usage in industry practices already; others favor the use of units since it is the best way of measuring the number of units recycled compared to the number of units sold as a way of measuring a company's progress toward its overall fair share goal. Weight is a less burdensome requirement, and the definition of a 'unit' can get complicated with components and subassemblies arriving from consumers. Likewise, it is not useful to compare a large TV console with a small cell phone for recycling purposes, even though each is "one unit." The other major debate at this time is whether "fair share" metrics should be evaluated compared to "market share" or to "return share." Companies that currently hold a small or no market share (such as IBM) favor a market share approach, while companies that hold a growing market share but a relatively small return share favor the alternative approach (newer market entries). Since a main purpose of effective metrics is to drive the development of a comprehensive recycling system which apportions financial responsibility fairly, it is important to develop metrics that can be used to help measure both weight and units. There is a significant need to improve the data collection across the board—from collection, to processing, to export—in order to help develop a more robust and effective e-waste recycling infrastructure.

Q6. Does the Electronics Take-Back Coalition collect statistics on recycling by individual manufacturers? Do you know what the average recycle rate of manufacturers is in the U.S. for the following products: CRT monitors, televisions, computers, car batteries, and cell phones?

A6. While ETBC has attempted to collect such statistics, it is very difficult since only the manufacturers themselves have this data and until recently they have not made it public. Based on recent environmental reports by Hewlett-Packard and Dell, we have the following information available:

- There are low overall recycling rates when compared to sales:
  - — 2007—HP had reuse/recycling rate of 15 percent compared to sales seven years ago (including remarketed equipment). That's up from 10 percent in 2006.
  - — Dell had a reuse/recycling rate of just over 12 percent in 2006.
- Companies don't state annual goals compared to sales—just overall volumes.
- There is no common way companies track information comparing to sales.

- There is little transparency in reporting—it is difficult to really understand how we are doing in addressing this problem.
- There is no reliable data available by manufacturer that describes the recycling rate by product such as CRT monitors, TVs, computers, cell phones, etc.
- Dell breaks down recycling volumes by avenue of return (HP does not):
  - — Asset Recovery Services End-of-lease Returns
  - — Consumer Recycling Programs and Goodwill End-of-life Parts
  - — Asset Recovery Business and Dell Factory
  - — Outlet—Consumer returns and exchanges less than thirty days
  - — Recycling Events and Tours

This is another area where there is a significant need for better data.

Q7. Is there a full array of non-toxic substitutes currently available for use by electronic manufacturers?

A7. There is not a "full array of non-toxic substitutes currently available" which is one of the main reasons why we are promoting the National Sustainable Electronics Initiative and why we need to significantly increase the research and development funding for green engineering and green chemistry. Many currently essential compounds used in electronics production are toxic; they currently do not have readily and easily available and effective alternatives that have been demonstrated to be safer. There are some recent examples of success stories for the substitution of certain materials—such as the replacement of lead solder and brominated flame retardants in response to the RoHS directive in Europe. A small set of market leaders within the industry are working to establish chemical/material standards, but this is very difficult to do without government regulations that level the playing field for the entire sector. Also, there are still significant questions about which substitutes are the "most" sustainable, when evaluating not only toxicity but also persistence, bio-accumulation, greenhouse gas potential, etc. That is why we presented information about the "Green Screen" which can help companies make informed choices. See *http://www.cleanproduction.org/Green.Greenscreen.php* for more information. It is also true that for many other toxic chemicals used in electronics, there has not been significant research done to evaluate safer alternatives—at least not that has been made public.

Questions submitted by Representative Daniel Lipinski

Q1. In 2006, the Government Accountability Office estimated that more than 100 million computers, TVs, and monitors are thrown away each year. In addition, the EPA estimates that electronic waste is growing two to three times faster than any other waste stream. Yet presently, there is no specific federal law or regulation governing the disposal of consumer electronic products in the U.S. Should there be?

A1. Yes. We do not believe that solid waste (non-hazardous) landfills and incinerators are an acceptable final disposition for known toxins, such as lead, mercury, cadmium, arsenic, hexavalent chromium, polybrominated diphenylethers, etc. In addition to questions about long term leaching from plastic lined landfills, solid waste officials are increasingly worried about future liability for allowing these immortal heavy metals and chemicals into non-hazardous landfills and incinerators. Already, studies show that 70 percent of heavy metals in landfills come from electronic waste.

Several states have already banned at least some electronic components from disposal in solid waste facilities, frustrated that the Federal Government has not addressed this complex and partially toxic waste stream. In addition, countless cities and counties across the country have also banned such disposal, even ahead of their State legislatures. The amount of scientific literature on the toxic impacts of lead alone ought to be enough to convince anyone that putting them in landfills make no sense whatsoever.

We believe that there is a real need to establish ground rules for addressing hazardous e-waste, similar to what the Europeans did with the WEEE directive. But we also believe that the states have an important role to play in serving as the incubators of effective policy. Thus, any federal initiative must build on the experience of the states rather than undermine them. In particular, we believe that the Federal Government should first ban the export of toxic e-waste to developing countries Perhaps, in the future there should be a strong federal solution that is modeled on the best State laws, but a weak federal effort that undermines the states and preempts

them with weaker language that sets a low bar as a ceiling would be a major setback. A federal law that sets minimum standards and allows and encourages states to go beyond those standards would be a good model and one which works well in many other arenas. It is also important to remember that traditionally waste policy and practice has been the province of local (and State) governments that are closest to the problems, and that it is imperative that national legislation support this model and not undermine it.

Q2. The EPA estimates that at most, only 15 percent of products at the end of their useful lives reach a recycling or reuse program. This does not come as a shock to me. In fact, it might seem a little high given the impediments that consumers currently face.

Q2a. First, how are average consumers to know what to do with their e-waste when it comes to the end of its useful life?

A2a. We need a comprehensive, well financed public education campaign to better inform consumers about what to do with their obsolete electronics—starting with the importance of reuse as a first priority. At the same time we need a comprehensive, convenient and accessible and affordable e-waste recycling and reuse infrastructure so that consumers who are informed will be able to access it. We need to make recycling of electronic products just as easy as it is to buy new products. We have been engaged with many companies at the highest level urging them to engage their customers to inform them about the importance of recycling—at the point of purchase, on the new products or packaging themselves, through utility billing, solid waste official websites, as well as at convenient end-of-life recycling sites. The sales and marketing ingenuity of companies like HP, Dell, Sony, Apple, etc. to educate consumers about how and why to purchase new products has been demonstrated conclusively. They can also use those skills to educate their consumers on how to properly recycle their equipment. The tobacco industry and the alcohol industry have invested significant amounts of funds in robust advertising campaigns to promote responsible consumer behavior; there is no reason why the electronics industry can't do the same. These efforts, of course, should be done in close collaboration with other stakeholders to help make sure that the both the messages and the delivery of the messages, are effective.

Q2b. This past weekend, Washington, D.C. held an e-waste recycling day. Over ten times as many residents as last year showed to recycle their gadgets, leading to over two hours wait time. The incentives to recycle just don't seem to be there right now. What do you recommend be done to fix this problem?

A2b. This exact same phenomena has occurred in many places around the country for the past several years, due to the pent up demand by consumers to find accessible recycling options. In fact, in some cases the lines of cars waiting to recycle e-waste were so long that they created major traffic jams and had to be shut down. The solution is not to keep holding individual events, although they can be useful to initiate public discussion. What is really needed, however, is a permanent, ongoing, convenient system that makes it easy for consumers to recycle their old products so that it becomes a normal habit, much the same way that people now are in the habit of recycling cans, bottles and newspapers. Yet, because recycling electronic products is more complicated and potentially hazardous than these other products, a curb-side collection model is not favored. Likewise, there is a much more important reuse market and potential for electronic products, and putting them into curbside collection containers could undermine their reuse potential. Developing policies that promote a major expansion of e-waste recycling collection sites and methods is the real key to developing an effective infrastructure—a wide variety of sites and methods that include retail stores, charities like Goodwill, shopping malls, schools, offices, community centers and senior centers, apartment complexes, transfer stations, mail back programs, etc. Sony has developed a good model, for a start, by announcing that their goal is to establish a recycling drop off site within 20 miles of most of the U.S. population; ultimately we will need a model that provides for even closer proximity. While we are a long way from meeting that goal, it is important that we get there as quickly as possible and then improve it so that it is even more convenient. It ought to be recalled that when consumers had to travel five to 10 miles to drop off their household recycling, the participation rate was very low, but when collection became convenient, the rates of participation went way up. It ought also to be noticed that many electronic products are much heavier and more difficult to transport than are other household goods that are recycled.

One additional development of note is that some of the producers—such as Sony, Dell, Hewlett Packard, Apple, etc.—as well as some retailers—such as Best Buy—

have been experimenting with incentives to encourage consumers to bring back their old electronics when purchasing new products and their experiences have been generally favorable. Consumers have responded well to coupons that provide discounts on purchases of new products when they return older ones.

Q3. The European Union is often ahead of the United States when it comes to the issue of recycling. Where do U.S. capabilities stand as compared to Europe on the topic of e-waste?

A3. The U.S. is behind Europe in e-waste recycling in several significant ways:

- European laws have been on the books for several years—at the national level going back more than 10 years, and at the EU level since 2005. Electronics manufacturers, governments, recyclers, and consumers have all been involved in developing effective recycling systems and infrastructure for many years and therefore have a big head start over the United States. Many other countries in Asia and elsewhere are also ahead of the U.S. in this area, having passed their own versions of producer take-back laws. With the passage by some states of e-waste legislation, there is a growing awareness and acceptance as well as a developing infrastructure in some parts of the U.S., but it is still in its infancy.
- In Europe, leading brand name electronics companies established the European Recycling Platform several years ago to get ahead of the recycling initiatives that they saw coming, but many of these same companies have been slower to take such a proactive stance in the U.S. in the absence of national legislative leadership.
- The U.S. is finally beginning to develop a growing recycling infrastructure, with capital venture coming into the industry and therefore consolidation occurring. Some well funded, large recyclers in the U.S. are currently operating under capacity, and would love nothing more than to shut down the mass export of this waste stream from the U.S. (The one exception is that shredded e-waste goes to smelters for further reclamation of materials, and the U.S. has shut down all secondary smelters but one.)
- It is also important to note that the EU has not only passed laws requiring manufacturers to collect and pay for recycling of their electronic products, but the EU has also ratified and enforced a UN treaty (the Basel Convention and the Amendment to the Convention) making it illegal for EU countries to ship toxic waste to any developing country for recycling or disposal. Keeping their e-waste within the EU not only builds their businesses, but provides an incentive for the EU to find safer alternatives to toxins they must manage themselves, unlike the U.S.
- The political climate in Europe is also quite different from that in the U.S. Whereas the U.S. was the global environmental leader several decades ago, that mantle of leadership has been assumed by the EU which has now become the global environmental leader, as evidenced by the passage of the WEEE directive, RoHS directive, the REACH directive, etc. Consumers as well as companies have come to accept that leadership in Europe while we are still trying to develop that culture within the U.S.

Q4. As the country transitions to digital television next year, I am concerned that this will divert potentially millions of old analog TVs into the waste stream. Are we prepared for this wave of old technology? Should a system be put in place to educate consumers on how to dispose of their TVs, especially our seniors who will be most impacted by this change and probably least likely to know how to recycle?

A4. We agree that this is one of the most pressing issues that we face as the digital transition will greatly exacerbate what is already a major environmental crisis. The U.S. does not have in place anything remotely needed to meet this impending deadline—either in terms of the capacity to properly collect and responsibly recycle the millions of old TVs that will be discarded or in terms of the public education necessary to inform people about what to do. Again, it is a two fold issue—the need for appropriate and convenient infrastructure combined with massive public education to help people better understand what their options are. Education with out accessible infrastructure is just as frustrating and ineffective as infrastructure without public education.

We believe that there needs to be a substantial effort to reach out to seniors who are disproportionally linked to the older, analog TVs and who seem to be less likely to be connected to cable or satellite TV. They are also less likely to be comfortable

with purchasing and installing a new digital converter box and more likely to be intimidated by the prospect of having to do so. This seems to be an area that is ripe for a major new initiative by the industry in conjunction with the FCC. We urge Congress to prod the Consumer Electronics Association to work with the FCC to help avert a major injustice to seniors to make sure that they do not end up as collateral damage of the digital conversion.

In addition, we are also very concerned that with the anticipated increase of older televisions being discarded due to the digital television conversion, there will be a significant increase in the amount of lead coming into the waste stream, which will have several significant impacts. First and foremost, the increased environmental loading of lead to the environment for older CRT televisions that end up in waste sites will result in millions of pounds of lead being added to the environment. Since older CRT televisions contain several pounds of lead—estimates range from four to eight pounds an up, depending on the size of the unit—and since current projections estimate that tens of millions of televisions will be discarded, the environmental loading will be enormous. All of this will be happening without proper governmental oversight, since in most states it is still legal to simply discard old electronic products into landfills.

In addition, for those CRT televisions that do get recycled, the amount of lead recovered will also be so substantial that it will likely cause a significant decrease in the price of lead when it is recycled. This will likely increase the amount of lead that is used in making new, cheap consumer products. Thus, another unintended consequence of the digital conversion will likely be the increase in dangerous materials in cheap consumer goods that will be imported into the U.S. and potentially harm the children who will be exposed to them. This problem will continue to grow until the Federal Government gets firm control over the lead and other toxic materials contained in obsolete electronic products.

For all of these reasons, we urge Congress to adopt a comprehensive ban on the export of hazardous e-waste, including lead, and applaud the House for passing H.R. 1534, the *Mercury Export Ban Act* (Rep. Allen (D) ME and 14 co-sponsors) which is an important step in the right direction.

Q5. In your testimony, you address the EPEAT program, which I think sounds like a great idea in the wake of the Energy Star Program's success. Can you tell us a little bit more about this program? Why has the EPEAT board postponed plans to develop standards for televisions? Energy Star has been immensely successful and I would predict EPEAT could be equally successful by providing a viable rating tool for consumers.

A5. We agree that EPEAT has the potential to match the success of the Energy Star program. For computers alone, EPEAT has already influenced over a billion dollars worth of purchasing decisions. Expanding EPEAT to include other product categories has been met with staunch resistance from television manufacturers, however. We believe that this is because EPEAT has a provision that encourages company-side product take-back programs, and with the important exception of Sony, the rest of the TV industry has not developed comprehensive national take back programs, unlike many of the computer companies. ETBC has urged EPA and others to move forward with EPEAT for TVs and attended the recent scoping meeting in Washington, DC to urge them to do so. We made the point that this is of paramount importance given the impending digital deadline for conversion, but the decision to develop standards for TVs was postponed due to lack of support from the TV companies as well as due to the lack of full financial support from EPA, which would have only required $115,000. There have also been efforts to restrict the scope of EPEAT to apply only to institutional purchasers. By not targeting the consumer market, we are fail to address a large part of the e-waste problem. This important purchasing tool should be expanded to cover consumer products, particularly in the case of TVs.

We would like to see the EPA fully fund to the development of this standard. Right now they partially fund it and have to raise remaining resources from whatever product sector is affected by the developing standard.

Questions submitted by Representative Phil Gingrey

Q1. In September of 2007 the House passed H.R. 2850, the Green Chemistry Research and Development Act of 2007, *which undertakes many of the recommendations in your testimony. Does the Electronics Take-Back Coalition agree with the goals and policies in H.R. 2850 and have you supported passage of the companion bill, S. 2669, in the Senate?*

A1. The Electronics Take Back Coalition supports green chemistry application in the electronic sector and believes it is one of the most promising ways to green the supply chain of the electronics industry. One of ETBC's coalition partners, Clean Production Action has actively worked to build support for the legislation. With that said, this legislation has an indirect influence on the electronic sector. Authorizing $84 million is a small investment compared to other major government research and development programs such as the National Nanotechnology Initiative worth more than a billion dollars. ETBC will continue to leverage support for Green Chemistry application in the electronic sector, but the scale of investment for new research and development will need to meet the scale of production of electronic products.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Michael T. Williams, Executive Vice President and General Counsel, Sony Electronics Inc.

Questions submitted by Chairman Bart Gordon

Q1. You state in your testimony that Sony has long been an industry leader in environmentally friendly design. What are some of the design changes Sony has made that have resulted in greener products? Have any of these increased either the recyclability of the product or the use of recycled materials in the product?

A1. (a). **ENVIRONMENTAL DESIGN:** Sony has pioneered the elimination of hazardous materials in its products and the creation of more energy efficient devices. We have, among other things: (1) eliminated the use of lead in solder; (2) eliminated the use of brominated flame retardants; (3) developed numerous products that use less energy and/or can be powered by rechargeable batteries; (4) created new lithium-ion, rechargeable battery technology that eliminated the need for nickel or cadmium in most batteries; (5) led the change in display technology from cathode ray picture tube (CRT) televisions that used lead to liquid crystal display (LCD) displays that use no lead; (6) developed the organic light-emitting diode (OLED) television which can result in reduced power consumption of up to 40 percent per panel square inch as compared to other television technologies. In addition, Sony has reduced the types of plastic we use and reduced the amount of packaging materials, thus, substantially eliminated the need or use of ozone depleting chemicals. And finally, by reducing the number of screws that hold the products together and the other non-recyclable or incompatible materials in our products, Sony has developed products specifically designed to make it easier to recycle.

(b). **USE OF POST-CONSUMER MATERIALS:** In the long-term, the elimination of hazardous materials in covered products will make recycling easier and more cost-effective, consequently, making more post-consumer material available for new products. In the short-term, it is difficult to reuse old post-consumer recycled material in new products, because of concerns about incidental contamination of toxic metals and flame retardants in the recycled material.

Q2. How does Sony advertise its take-back program? You state in your testimony that Sony's goal is to increase the amount of products collected through your take-back program to 600 million pounds per year within five years. Since the program started in September of 2007, you report that Sony has collected seven million pounds. How does Sony plan to increase the amount collected so substantially? How much does Sony's recycling program currently cost?

A2. (a). **CONSUMER EDUCATION:** Sony is using a wide range of methods to promote its Take Back program, including the use of print, television, and radio media. We also use our 50 regional "recycling events" to educate consumers and retailers about our program as well as our many fixed recycling locations. Sony is also committed to cross-marketing and promotion with our national Take Back partner, Waste Management, Inc. ("WMI"), and various government and nongovernmental organizations.

(b). **SONY'S PROGRAM GOALS:** Presently, Sony has, in conjunction with WMI, almost 150 locations in which a consumer can drop off a product. To achieve our goal of recycling 600 million pounds per year, we will need to establish roughly 10,000 drop off locations that would feed into the WMI recycling network. Candidly, we cannot reach this benchmark without the active participation of other e-waste stakeholders. We are, therefore, actively seeking the participation of retailers, other manufacturers, and non-profits. Indeed, as a direct result of the Committee's e-waste hearing, Sony has entered into discussions with Goodwill Industries. And by way of example, we have worked to help create a similar successful program for rechargeable battery collections. Through the non-profit "Rechargeable Battery Recycling Corporation" (of which Sony is a part owner and present Chairman of the Board) we have established 50,000 locations in the United States that will accept batteries for recycling.

(c). **PROGRAM COSTS:** Sony treats the cost of its Take Back program as a confidential trade secret.

Q3. You state in your testimony that some recycled plastics will be purchased and used to make new electronics products. Approximately how much post-consumer

recycled plastic does Sony use in its products now? How much of that is plastic recovered from electronic waste?

A3. **USE OF POST-CONSUMER MATERIALS:** Sony products manufactured in the United States use approximately five percent post-consumer recycled plastics. At this point, little of those plastics come from recovered electronic waste because of some of the concerns identified above in 1(b). We do expect, however, that both the amount of post-consumer material Sony uses and the amount of such material related to waste electronics will increase dramatically as our program achieves even greater success.

Q4. In your testimony you mention "'no name' brands (that) are made of lower quality materials, which can contain higher levels of toxic chemicals and may be more difficult to recycle." You also mention the need for consumer education about recycling. Would an eco-ranking system for consumer electronic products help educate consumers about the environmental impacts of these products?

A4. **ECO-RANKING SYSTEM:** An "eco-ranking system" for consumer electronic products would be a good idea. To be helpful to consumers, however, it would have to employ clearly understandable criteria and be consistently administered by the Federal Government. Presently, there are many ranking systems from various organizations and countries which employ different criteria. The end result of this patchwork of ranking systems is largely only consumer confusion.

Questions submitted by Representative Ralph M. Hall

Q1. What is the total life cycle energy cost of Sony's e-Reader? What is the equivalent to this energy usage in pages printed from a typical printer? Does Sony currently publish the life cycle energy costs for all your products? If not, would you consider providing such information to consumers in the future?

A1. **LIFE CYCLE COSTS:** Sony does not currently publish the life cycle energy costs for its products but would be willing to do so provided that the proper metrics for such a measurement can be developed and standardized.

Q2. What are the liability concerns for companies that take-back electronics and reuse or recycle them? Does liability for damages to workers from exposure during recycling or liability for harm caused by refurbished equipment limit the growth of take-back programs?

A2. **LIABILITY ISSUES:** Sony cannot comment on liability issues related to recycling of waste electronics since we do not handle the actual recycling, but rather, use the country's leading recycler, WMI, to manage that part of our Take Back program. Please note, however, that Sony firmly believes and supports stringent worker and environmental protection requirements for the recycling industry. Indeed, to the best of our knowledge, Sony is the only electronics manufacturer to sign the Electronics Take Back Coalition's "Pledge of True Stewardship" (the "Pledge") which prescribes strict, environmentally- and socially-conscious limitations on how and where electronics waste can be recycled.

Q3. Most major manufacturers claim that they do not ship e-waste overseas for recycling. Where does the e-waste found in environmentally unsound recycling operations originate?

A3. **OVERSEAS RECYCLING:** Sony has no direct knowledge about the products that are recycled overseas. But as noted above, as a signatory to the Pledge, we have committed that all products that are collected through the Sony Take Back program will be recycled using the strictest and highest environmental standards. Moreover, we provide full, public accountability of how and where our products are recycled.

Q4. How does Sony treat products from other manufacturers at your recycling centers in terms of cost to the consumer and disposal?

A4. **SONY PRODUCTS VS. OTHER PRODUCTS:** Sony pays for the recycling of all Sony-branded products, but the consumer must pay the cost to recycle any other brands.

Q5. Can you give us some examples of how Sony has had to tailor its recycling programs to meet different State requirements? Considering that e-waste recycling already occurs under a variety of legal frameworks in the U.S., why should federal legislation preempt States from experimenting with different collection systems or fees?

A5. (a). **STATE PREEMPTION:** State preemption is necessary to create a single, consistent e-waste recycling program that will develop the economies of scale required to make recycling cost-effective and to create enough recycled material to make re-using large quantities of such material in new products realistic. The recycling of e-waste is not a traditional local or State issue that can or should be treated differently based on the particularities of each jurisdiction. Rather, e-waste is exactly the opposite. That is, the same products that are sold in Tennessee are sold in Texas and the means to recycle those products are the same across jurisdictions. Society will not benefit from the traditional notion of allowing the states to serve as incubators of new and novel approaches. And even if this were the case, there have certainly already been enough states that have enacted different e-waste laws that Congress can benefit from any and all available "lessons" learned from these various State "experiments."

(b). **THE CONTRADICTORY STATE LAWS:** The disparity between the starkly differing State e-waste laws inherently creates inefficiencies and complications in how Sony runs its Take Back program. For example, we cannot operate our program in the State of Maine; that state chooses the recyclers to be used and charges manufacturers a tax based upon the amount of products collected. In contrast, Minnesota and Washington have identified the number of manufacturers that must have programs and/or pay fees, even though manufacturers sell consumer electronics in every state. Indeed, to operate a recycling program in the State of Washington, we must have fixed collection locations in each of the 80 counties.

Q6. How would you describe the influence of other countries' recycling and waste laws—such as Japan—on your Take Back and Recycle programs? Do these laws affect your global operations?

A6. (a). **OTHER COUNTRIES:** The recycling laws of other countries have a limited impact on what Sony is doing in the United States. Our Take Back program is the result of over 15 years of experimenting and testing by Sony's U.S. operations.

(b). **SONY'S GLOBAL RECYCLING GOAL:** Sony is a global company, and as such, all laws affect our global operations. Sony has as a goal to globally conform to the most stringent environmental regulations world-wide. In the case of our U.S. Take Back recycling program, Sony believes that we are well ahead of that goal.

Q7. You argue that e-waste legislation should cover all products with certain components or chemicals. How do the recycling processes differ between a Sony laptop and a Sony LCD or plasma television?

A7. **RECYCLING OF VARIOUS PRODUCTS:** The actual recycling of various electronic products does not differ much. When recycling our products we look at three components: glass, metal, and plastics. It matters little what type of products these components come from. Indeed, it is not the actual recycling of different types of products that creates issues, but rather the logistics and costs associated in the collection and management of products as these can vary substantially as to weight and size.

Q8. How much does it cost Sony to collect and recycle all their legacy waste? What are the benefits—other than the obvious environmental ones—to your company? How has the program impacted your ability to compete within the global marketplace?

A8. **COSTS AND GLOBAL COMPETITION:** Sony treats the cost of its Take Back program as a confidential trade secret. The goal of the program, however, is to make electronics recycling a cost-effective, profitable business. If Sony succeeds in our efforts, we will have created a low-cost, efficient source of post-consumer plastic and metals for our new products, thus making Sony more competitive in the global marketplace.

Questions submitted by Representative Daniel Lipinski

Q1. In 2006, the Government Accountability Office estimated that more than 900 million computers, TVs, and monitors are thrown away each year. In addition, the EPA estimates that electronic waste is growing two to three times faster than any other waste stream. Yet presently, there is no specific federal law or regulation governing the disposal of consumer electronic products in the U.S. Should there be?

A1. **A FEDERAL LAW.** Sony urges you to adopt legislation that supports our existing efforts and extends the environmental stewardship we have demonstrated to all

electronics manufacturers and retailers. While we are confident that Sony's voluntary e-waste recycling program will make great strides forward, only a truly comprehensive and consistent program will allow all interested parties to achieve our shared recycling goals. Sony, therefore, respectfully requests that any legislation reflect the following:

- **Preemption**

  Although it is of course a significant event when Congress preempts State regulation on a particular point, Sony believes that electronics recycling is an issue on which State preemption is essential. We and other stakeholders already have to comply with numerous, and sometimes contradictory, State and local e-waste laws. The inconsistency between these programs inevitably creates inefficiencies in the system and minimizes any economies of scale that could be achieved. And since Sony (and likely no other manufacturer) does not build products to be sold in a particular state, adding a federal bill without State preemption merely adds more complexity rather than simplifying and streamlining the process. In the end, a patchwork quilt of different and ultimately contradictory State and municipal laws will only serve to undermine everyone's shared goal of recycling as much electronic waste as efficiently and cheaply as possible.

- **Producer Responsibility**

  Sony believes that it is the individual manufacturer's responsibility to assure that any product that bears its name is properly recycled using the highest standards possible at the end of the product's life. That said, other stakeholders who directly benefit from the sale or enjoyment of electronic products must also bear some responsibility. More specifically, retailers—at the very least—must take an active role in the collection of e-waste and consumers must be encouraged to take the extra step necessary to properly dispose of their products.

- **Market Share**

  In order to create a level playing field, any manufacturer obligation should be based upon present market share and not on historical activities or waste collected. Systems based upon the amount of waste collected will give a cost advantage to those companies that are new to the market. Such companies can avoid any recycling cost by simply staying in business and changing their brand or company name every year. Many of these "no name" brands are made of lower quality materials, which can contain higher levels of toxic chemicals and may be more difficult to recycle. Any mandate not based upon today's market share will give those companies a "free ride" on recycling. This will lower their costs when compared to responsible companies by rewarding manufacturers who avoid their environmental obligations and penalizing responsible companies by putting environmentally-advanced products at a competitive cost disadvantage.

- **Products Covered**

  Our recycling program covers all of our branded products from movies (i.e., DVDs), to professional equipment used to project movies in theaters, to laptops or televisions used to watch movies at home.

  Sony, therefore, respectfully urges you to adopt one program with one set of requirements which will require full producer responsibility for all products manufactured. The advancement of technology has enabled manufacturers to create an array of products using the same chemicals and metals that are used in the products commonly covered in e-waste recycling mandates. Given this, Sony suggests adopting legislation to target all products that contain these same internal and external components and chemicals.

- **Cost**

  Sony internalizes the cost of recycling and requests that any mandate require the same. Currently, Sony pays to recycle our old products. While there are several financing mechanisms that allow for recovery of this cost, Sony believes that internalizing the cost is the most effective and fair method for funding a comprehensive electronics recycling program. Such funding mechanisms create market incentives for manufacturers to *ex ante* design and produce the most environmentally-friendly products possible. In addition, it encourages manufacturers to develop and implement the most efficient and cost-effective recycling procedures. Indeed, it is Sony's ultimate goal through design improvements, the growth of the recycling industry, and economies of

scale to drive these recycling costs down, thus making recycling cost effective. Until that time, Sony considers the cost of recycling as part of the cost of doing business.

Q2. The EPA estimates that at most, only 15 percent of products at the end of their useful lives each a recycling or reuse program. This does not come as a shock to me. In fact, it might seem a little high given the impediments that consumers currently face.

Q2a. First, how are average consumers to know what to do with their e-waste when it comes to the end of its useful life?

A2a. **CONSUMER EDUCATION:** Consumer education is a necessary component of any successful e-waste program, and that is why Sony uses, as noted above, a wide range of methods to promote its take back program, including the use of print, television, and radio media. We also use our 50 regional "recycling events" to educate consumers and retailers about our program and our various fixed recycling locations. Sony is also committed to cross-marketing and promotion with our national take back partner, WMI and various government and non-governmental organizations.

Q2b. This past weekend, Washington, D.C. held an e-waste recycling day. Over ten times as many residents as last year showed to recycle their gadgets, leading to over two hours wait time. The incentives to recycle just don't seem to be there right now. What do you recommend be done to fix this problem?

A2b. **OPTIMIZING RECYCLING:** Sony's goal is to make it as easy to recycle our products as it is for our consumers to purchase them. Indeed, we want to make recycling as effortless as throwing a product away. Simply stated, every additional step that we require the consumer to take will result in a decrease in the recycling rate. To optimize consumer recycling, we need curb-side collection of electronic waste just as we do with other types of waste. This collection should be incorporated seamlessly into the existing municipal waste collection system. Once collected and consolidated, recyclers can efficiently process this electronics waste, thus creating a stream of post-consumer material for reuse by manufacturers.

Q3. The European Union is often ahead of the United States when it comes to the issue of recycling. Where do U.S. capabilities stand as compared to Europe on the topic of e-waste?

A3. **THE UNITED STATES VS. EUROPE:** The United States has a greater capability to handle e-waste than does Europe. The issue is in the collection of electronics waste, not in the processing.

Q4. You mentioned in your testimony that Sony teamed up with Waste Management to implement a national recycling initiative in the U.S. for e-waste. Many waste companies out there have been caught throwing away recyclables in the past. What guarantees do you have from the company that the waste is actually being recycled?

A4. **PERCENT OF MATERIAL RECYCLED:** As part of its contract with Sony, WMI guarantees that at least 95 percent of the material collected will be recycled. Sony also has the right to audit WMI's physical locations and WMI's books to ensure that this goal is achieved. Lastly, as noted above, Sony will make the results of its recycling effort fully transparent to the public.

Questions submitted by Representative Bob Inglis

Q1. Many manufacturers support a national solution to deal with e-waste; a federal law that would preempt the patchwork of State and local laws that are beginning to crop up. Are there any aspects of those State laws that would/should be expanded to the national level? What provisions of State laws in place now would be detrimental to efforts dealing with e-waste if ramped up to a national scale? Can you give an example or two of each?

A1. (a). **SONY'S FUNDAMENTAL RECYCLING PRINCIPLE:** Sony believes in "full producer responsibility" in which a producer takes the responsibility for the recycling of all the products that bear its brand name. Full producer responsibility, however, must be augmented by participation in the process by other stakeholders and by reasoned application of the law. More specifically:

- Since manufacturers do not in most cases directly sell their products to consumers, the collection of waste products is often best served by those who initially distribute the products (i.e., retailers).
- The recycling responsibility must be forward-looking rather than backward-looking, and as such, any obligation must be based upon a manufacturer's present market share. As explained above, collection requirements based upon return share would give a significant advantage to those companies that are new to the business.

(b). **POSITIVE LESSONS LEARNED FROM THE STATES:** Sony generally supports the recycling performance standards provisions that are incorporated in the Minnesota and Washington State laws. More specifically, Sony believes that performance standards should be based upon actual past performance instead of an arbitrarily selected percentage. We feel that, similar to the Energy Star program, performance standards should reflect the best of what the industry is actually doing. Although we do not support advanced recovery fees, we do believe that much can be learned from the California State law. It has resulted in the development of one of the most mature recycling and collection infrastructures in the United States and has identified a role and responsibility for retailers which many of the other State laws tend to omit.

(c). **NEGATIVE LESSONS LEARNED FROM THE STATES:** At least two aspects of the Maine law should not be replicated in a federal bill. Maine bases the collection responsibility on return share, thereby giving the new "no name" brands that flood the market an advantage over companies like Sony who were in business 40 years ago and who plan to stay in business for at (Past another 40 years. Maine also runs the program as a tax on manufacturers who have no say in how or who recycles our products; we simply get invoices from recyclers selected by the State which we must pay in order to sell products in that state.

Q2. You state in your written testimony that Sony believes that internalizing the cost of recycling in the price of your products is the most effective mechanism for recycling electronics. Am I correct to say that this means that a small amount of the cost to consumers would be directly related to your recycling efforts? If this is the case, how much does this internalization cost your customers?

A2. **THE COST OF RECYCLING:** The cost of electronics recycling and collection today generally ranges from 25 to 50 cents per pound. Sony believes, however, that if a single, consistent national e-waste program is created electronics recycling can become profitable. That is, a uniform program will establish economies of scale that will dramatically improve the efficiency of e-waste recycling. This, combined with the rise in the price of commodities, likely means cost internalization—and thus the need to pass any such costs along to consumers—will be a short-term issue.

Appendix 2:

Additional Material for the Record

STATEMENT OF PARKER E. BRUGGE
VICE PRESIDENT, ENVIRONMENTAL AFFAIRS AND
CORPORATE SUSTAINABILITY
THE CONSUMER ELECTRONICS ASSOCIATION

Introduction

Mr. Gordon, Mr. Hall and Members of the Committee:

My name is Parker Brugge and I am the Vice President, Environmental Affairs and Corporate Sustainability for the Consumer Electronics Association (CEA). CEA is the preeminent trade association promoting growth in the $161 billion U.S. consumer electronics industry. CEA sponsors and manages the International CES—the Nation's largest annual trade event. More than 2,200 companies enjoy the benefits of CEA membership, including legislative advocacy, market research, technical training and education, industry promotion and the fostering of business and strategic relationships. Moreover, CEA's members include manufacturers of consumer electronics products, as well as many of the largest retailers. CEA commends the Committee for holding this hearing on the important issue of electronics recycling and we appreciate the opportunity to provide the views of our membership.

By extending information and entertainment to everyone—regardless of income or geographic location—our members' products have improved lives and changed the world. Meanwhile, America stands as the global leader in innovation, ingenuity and creativity. In addition, the competition and falling prices characteristic of our industry continue to confer benefits to consumers. As our products become increasingly affordable, it is often more economical for consumers to replace a product with a new one rather than repair older equipment.

Electronics Recycling is Primarily a Resource Recovery and Management Issue

CEA concurs with the longstanding view of U.S. EPA officials that electronics recycling is primarily a resource issue, not a toxicity issue. At a 2005 conference EPA's Director of the Office of Solid Waste said it succinctly:

> *EPA is confident that properly managed, modern landfills are safe for disposal of electronics, but there are a couple of problems: electronics waste doesn't always make it to safely run disposal sites, and more important, we don't simply believe it makes good sense to landfill or throw away these materials. Certainly, there are different views on the risks of electronics (or in the municipal solid waste stream)—but why would we want to bury heavy metals like lead or cadmium in landfills, where they will remain forever, at the same time as we unearth these materials elsewhere in the world? We don't have to agree how imminent the hazards are from our landfills here in the U.S. to agree that this practice just doesn't make sense in the long-term.*
>
> *Instead this is an issue of resource conservation. We need to capture valuable materials to use them again, and to reduce the upstream environmental impacts of extracting and refining virgin materials. . .*[1]

CEA's view of electronics recycling as a resource concern in no way diminishes our call for good public policies to facilitate recycling of used electronics. But recognizing this point does shed light on what policy approaches are most suitable to address this problem. Existing regulatory command and control programs such as RCRA Subtitle C are not appropriate for facilitating the collection and recovery of used electronics, and the components therein, for which we are advocating today.

CEA Supports Shared Responsibility for Recycling

CEA advocates strongly for a shared financial responsibility among all stakeholders—manufacturers, retailers, consumers and local, State and Federal governments—for electronics recycling at all levels of government. Placing the financial burden entirely on any one stakeholder is contrary to the concept of shared responsibility which CEA believes is the best option for recycling financing.

A primary responsibility of manufacturers lies in product design. Most consumer electronics manufacturers have reduced and, in most cases, greatly minimized the use of potentially hazardous substances in their products. Additionally, manufacturers have developed new ways to incorporate recycled components and design for responsible end-of-life. CEA supports market-driven environmental design initiatives,

[1] Address by Matt Hale to RECCON 05: Global Electronic Recycling Solutions, November 29, 2005, Radisson Hotel and Conference Center, Morgantown, West Virginia.

including Federal and State government programs that give preference towards purchasing of environmentally preferable technology products.

CEA's Members Are Committed to Electronics Recycling

CEA and its member companies have been and will continue to be fully supportive of the safe and appropriate recycling and reuse of consumer electronics products. A number of our member companies, both manufacturers and retailers, have initiated voluntary take-back activities to collect and recycle televisions, computers, monitors and other consumer electronics.

CEA Supports Responsible Free Trade of Used Electronics

CEA also concurs with conclusions of U.S. EPA officials regarding the export of used electronics, electronic parts and materials. First, CEA concurs that most reuse markets are export markets—that is where most of the demand for used electronic products resides, not in the United States. Similarly, CEA concurs that many recycling markets are also located primarily abroad for a variety of economic and logistical reasons, including strong foreign demand for raw materials and the lack of U.S. smelting and glass furnace capacity.

Rather than cutting off the export of used electronics, CEA supports the development of responsible reuse and recycling systems both domestically and abroad. Used consumer electronics, even scrap electronics, are not the industrial wastes for which the Basel Convention was created. Used consumer electronics are old household appliances that consumers no longer use in their homes. These are not wastewater treatment sludges or distillation bottoms that are appropriately regulated by RCRA, Basel Convention and similar command and control systems. Rather they are remnants of past consumer technology breakthroughs made up primarily of aluminum, steel, silicon, copper, plastic and glass. Whether that used product is a waste or a bargain-priced product depends on the individual consumer. Common sense suggests that addressing the e-waste problem calls for a different approach that acknowledges these facts and facilitates responsible commerce.

CEA also concurs with U.S. EPA's conclusion that as collection of used electronics in the U.S. increases, exports will increase on several levels: export of intact units for reuse, used parts for reuse, used equipment for refurbishment, intact equipment for dismantling, partially processed materials for further processing, and fully processed materials for use as raw materials in manufacturing. To ensure proper reuse and recycling of used electronics here and abroad, CEA supports efforts to increase the monitoring of environmental performance at reuse/recycling facilities to increase the transparency of used electronics management. CEA looks forward to working with other interested stakeholders in developing environmentally responsible systems for the export of used electronics for reuse and recycling. CEA does not support, whether in the U.S. or abroad, any electronics recycling that presents unacceptable risks to human health or the environment.

Impact of DTV Transition

With the DTV cut-off date fast approaching (February 17, 2009), the topic of its impact on televisions entering or leaving the home has been on the mind of many. First, it's worth a broad look at consumer expectations for removing TVs from their home over the next few years. Results from CEA's recent consumer survey "Trends in CE Reuse, Recycle and Removal" published earlier this month are illuminating.

In 2008, consumers expect to remove 43.5 million televisions from their home. Based on consumer reported plans, the removal will take place in the following way: 56 percent of the TVs will be given away/donated, 25 percent will be recycled, 13 percent will be sold and six percent will be thrown in the trash. The expected behavior follows the very encouraging trend of fewer units trashed and more units recycled.

Beyond 2008, consumers expect to remove 41.9 million TVs in 2009 and 34.3 million 2010. These figures are significantly lower than the 2005 and 2007 aggregates (64.6 million and 72.2 million respectively). Two factors may help explain this downward trend. With a large percentage of consumers already making the transition from analog to digital, it may suggest a large volume of unwanted TVs have already been removed from homes and we are now settling into an equilibrium period where the number of TVs entering and leaving the home is roughly balanced. The other possible explanation centers around the difficulty consumers have in predicting their behavior over an extended time frame. It's not so much that consumers know whether or not they will remove a TV from their home, but rather the timing of the removal.

Finally, CEA research underscores that the DTV cut-off will impact a relatively small portion of the U.S. population—the 11 percent of households that rely exclusively on over-the-air television reception. Most households subscribe to cable or sat-

ellite, so the DTV cut-off is not really an issue for this segment (although some may have secondary sets in their home that rely on over-the-air that will require some action to be taken).

With consumers projecting fewer televisions to remove during the next two years compared with previous calendar years, and with earlier CEA research showing that the DTV cut-off will directly affect only a small fraction of U.S. households, the logical conclusion is that the DTV cut-off will have little impact on the waste stream.

CEA Supports Consumer Education Initiatives

Consumers need reliable, up-to-date information to make the right environmental choices about electronics. And, industry has a role to play in providing such information.

CEA recognizes that the recycling of electronics products is essential as we work to do our part to contribute to a more sustainable world. Recycling must be made convenient, cost-effective and easy for individuals, businesses, community centers, schools and government agencies to participate. In order to educate consumers about options for electronics products at the end-of-life, CEA launched *myGreenElectronics.org* at the 2007 International CES. *MyGreenElectronics.org* empowers consumers by providing online resources regarding responsible use, reuse, and recycling of electronics with the use of an online searchable database of electronics recyclers, a database of green products and tips for saving energy with electronics. CEA works with our members to make these resources available and transparent to all interested stakeholders. We will continue to buoy our education effort and have plans to expand upon this website throughout 2008.

CEA Supports a National Approach to Electronics Recycling

CEA strongly believes that a national solution is the most appropriate means to addressing this significant public policy challenge, primarily as a means to provide consistency in recycling opportunities to consumers and for uniform requirements for manufacturers along with other key stakeholders. Without a uniform national requirement, an ad-hoc array of State regulation imposes unnecessary financial and administrative burdens on global technology companies, which will ultimately increase costs to consumers. Each state and municipality that creates a new authority with a new governing body, or creates a new administrative or enforcement structure, is duplicating many of the implementation struggles already underway in other states around the country. Electronics recycling is a national issue that warrants a national solution.

A national end-of-use framework should apportion responsibility among all of the stakeholders and ensure a level playing field, while promoting a widespread and adequately financed electronics recycling solution.

Conclusion

Finding a solution to this public policy challenge is a priority for CEA. As we continue to make strides in eco-friendly design initiatives, lead the consumer electronics industry on environmental issues and be a part of the effort to educate consumers about electronics recycling, CEA stands ready to work with Congress and all interested parties to reach a common-sense, national solution that makes recycling as convenient as possible for all Americans.

Thank you again for the opportunity to share CEA's position on this important public policy issue.

STATEMENT OF MEGGAN L. EHRET
SENIOR COUNSEL AND SECRETARY
THOMSON INC.

Thank you Mr. Chairman and distinguished Members of the Committee for inviting me to testify today. I am Meggan Ehret and I am Senior Counsel and Secretary of Thomson Inc. Thomson Inc. is committed to developing a workable and environmentally sustainable solution for electronic recycling, which, according to the EPA, is the fastest growing portion of the municipal solid waste stream. We applaud this committee for holding this hearing to explore the appropriate treatment for electronic recycling and to ensure that the solution is a workable one that accomplishes the goal. We appreciate the opportunity to participate in this discussion.

Thomson is committed to complying with all environmental, health, and safety laws and regulations applicable to our business activities. We are equally committed to preventing deterioration of the environment and minimizing the impact of our operations on the land, air, and water. These commitments can only be met through the awareness and cooperation of all stakeholders. Today, Thomson is a world leader in digital video technologies. Thomson provides technology, services, and systems and equipment to help its Media & Entertainment clients—content creators, content distributors, and users of its technology—realize their business goals and optimize their performance in a rapidly-changing technology environment. The Group is the preferred partner to the media and entertainment Industries through its Technicolor, Grass Valley, RCA, and Thomson brands. As background, RCA's stock was acquired by General Electric in 1986, and shortly thereafter Thomson bought certain consumer electronics assets from GE and eventually acquired the RCA trademark (in most classifications) and today licenses the trademark to a number of different companies that make RCA televisions and other RCA-branded products. In 2004, Thomson sold its television manufacturing assets and now licenses the RCA trademark to a television manufacturer.

When considering the appropriate approach to electronic recycling, we ask the Committee to recognize and implement two key and important principles: first, computers and televisions warrant different treatment and, second, financing the costs associated with recycling televisions based on market share is the only approach that levels the playing field for television manufacturers.

First, based on our experience, we have learned that each product is different and, of direct relevance here, there are the differences between televisions and computers. The different product life expectancies, market economics, residual values, and product portability necessitate different approaches to recycling to each product.

- **Different Product Life Expectancy—**Televisions have an average useful life of 15 to 17 years and have been available on the market since the late 1920's. Computers, on the other hand, have only been widely available to consumers since the 1980's and have an average life expectancy of at least 10 years less than the average television. Because televisions have been in existence much longer and have a much longer life, many of the manufacturers of the televisions entering the waste stream are either no longer in business or are no longer manufacturing televisions.
- **Different Market Economics—**It is estimated that over 30 million TVs will be sold in 2008 (*U.S. News & World Report,* 12/31/07). Of these, many will be sold by value brands that have only been established in the past few years. ("Flat Panels Have Poor Fundamentals," 03/26/2007 stating "The rampant competition from value brands like Vizio and Westinghouse has undercut prices of brand names like Sony, Philips and Panasonic by as much as 40 percent. . .Sustaining healthy returns on capital in such an environment is almost impossible.") Far East manufacturers are flooding the market. "China. . .has emerged to build consumer electronics. . .as a new manufacturer. Any company with the resources and a market entry point can deliver product relatively quickly by contracting with the original design manufacturers." (The Consumer Electronics Industry in Flux, Gartner Inc. Research Report, November 16, 2005.). According to an article in *Smart Money Magazine* ("Behind the Glass," March 2005), 70 percent of the television manufacturers were not in business ten years ago. By the time a new market entrant must pay to recycle its products (approximately 15 years from today), it is likely no longer in business. Thus, requiring present-day TV manufacturers to fund a TV recycling program based on their current market share ensures they are not given a free pass until their branded products begin to appear in volume in the State's recycling stream more than 15 years later and, in some instances, at a time they are no longer in business.

- **Different Residual Value—**A computer's residual value is much greater than the typical cathode ray tube television. Computers contain precious metals and other valuable and easily recycled or reused materials. This significantly impacts the economics of recycling a television versus recycling a computer. A recent study demonstrates that computer recycling creates profit or costs a few cents per pound while televisions require thirteen to sixteen cents a pound to process (not including costs of collection or transportation). (NERIC 2008 Recycler Pricing Study, *www.ecyclingresource.org*).
- **Different Product Portability—**Computers are lighter and easier to handle, thus different opportunities exist for collection and recycling. Those opportunities do not exist for television manufacturers. Thus, "take-back" programs that require consumers to send equipment to a manufacturer is more workable for computers than televisions.

These important differences support separate approaches to recycling programs for each product. Many computer manufacturers have already implemented "take-back" programs and thus requiring take-back programs is the most logical and workable approach for computer products. For televisions, which is my focus today, the only approach that levels the playing field and maintains the competitive marketplace is allocating the costs of a recycling program to the present day manufacturers based on each manufacturer's respective current share of the market. It is a fairer approach for the following reasons:

- The television market is an easy-entry and easy-exit industry, making short-term competitive advantages the rule. According to an article in *Smart Money Magazine* ("Behind the Glass," March 2005), 70 percent of the television manufacturers were not in business ten years ago. By the time a new market entrant must pay to recycle its products (approximately 15 years from today), it is likely no longer in business.
- Far East manufacturers are flooding the market. "China. . .has emerged to build consumer electronics. . .as a new manufacturer. Any company with the resources and a market entry point can deliver product relatively quickly by contracting with the original design manufacturers." (The Consumer Electronics Industry in Flux, Gartner Inc. Research Report, November 16, 2005.). History has proven that they will not be in business by the time televisions they sold/manufactured enter the waste stream and, given their location, enforcement or collection (particularly after they are out of business) will be difficult if not impossible, unless a barrier to entry to the market is contributing to the costs of recycling televisions now.
- It is difficult—if not impossible—to estimate today the costs associated with recycling televisions 15 years from now (e.g., collection, transportation and recycling) and market share allocation ameliorates this concern. Thus, allocating the actual costs to recycle products today among today's market participants is fair and permits today's market participants to plan accordingly.

A market share approach requires each current manufacturer to pay for a share of the recycling of discarded televisions based on its respective share of the market and account for these costs in the price of their product. Any other alternative will give a free ride to new market entrants as they will not be required to pay any costs for recycling today and history has demonstrated that they will be out of business in 15 years (which is when their products enter the waste stream). Thus, new market entrants will likely never pay for recycling electronics. Importantly, as a result of not having to factor in the cost of electronic recycling, they are able to price their products lower than the long standing market participants and increase their share of the market. This is the same conclusion reached by the Council of State Governments NE region, Minnesota, New Jersey, and Oregon. (See *http://www.csgeast.org/pdfs/RegionalDraft7-06_—revised.pdf*). In fact, to date, there are only two states that have adopted electronic recycling laws that allocate the costs of recycling televisions based entirely on return share. Those are Connecticut and Maine. Connecticut's Senate and House recently passed an amendment to change the financing for the costs associated with recycling television to market share and the bill awaits the Governor's signature.

In summary, Thomson respectfully asks that this committee consider allocating the costs of recycling televisions to the current market participants based on their respective share of the market, thereby leveling the playing field for all television manufacturers and maintaining the competitive marketplace for television manufacturers. Thank you for allowing me the opportunity to provide my comments to you.

STATEMENT OF THE OFFICE OF SOLID WASTE
AND EMERGENCY RESPONSE
U.S. ENVIRONMENTAL PROTECTION AGENCY

Mr. Chairman and Members of the Committee, thank you for the opportunity to provide testimony on electronics and the U.S. Environmental Protection Agency's (EPA's) efforts to encourage more environmentally preferable electronics product design and recycling.

EPA's Resource Conservation Challenge (RCC) seeks to renew the emphasis on resource conservation under the *Resource Conservation and Recovery Act* (RCRA) and the emphasis on preventing pollution and conserving natural resources under the *Pollution Prevention Act.* The RCC brings greater urgency to EPA's message of reducing, reusing, and recycling valuable materials habitually discarded by American industry and the general public by linking the importance of these activities to energy conservation and greenhouse gas (GHG) reductions. One key area of focus under the RCC is electronics.

WHY WE CARE ABOUT ELECTRONICS AT EPA

EPA has been actively helping to improve the design and recovery of electronics for more than ten years. Our interest in electronics stems from four primary concerns:

1) rapid growth and change in this product sector, leading to a constant stream of new product offerings and a wide array of obsolete products needing appropriate management;
2) energy consumption by these products (the Energy Information Agency's Annual Energy Outlook 2006 projects that electronics will a count for 19 percent of residential energy use by 2020, compared with 14 percent of home energy consumption in 2006);
3) the presence of toxic substances in many products which can cause problematic exposures during manufacturing, recycling or disposal, if not properly managed—the presence of these constituents has sparked the search for workable substitutes and development of better management practices; and
4) the need to ensure widespread, convenient and affordable reuse/recycling infrastructure for electronics (with initial emphasis on TVs, PCs and cell phones) and, in doing so, to conserve and recover the large amount of embodied energy and valuable materials inherent in used electronics.

THE CHANGE IN TV TECHNOLOGY AND TRANSMISSION

Change is about to happen in the TV world. First, as prices come down for newer models, consumers are upgrading from the old cathode ray tube style of TV to newer, flat screen, high definition models (such as LCD and plasma). In addition, the "Digital Transition" is around the corner. On February 17, 2009, all full-power television stations will broadcast only in digital.[1] Nielsen estimates that more than 13 million households have TV sets that only receive over the air (OTA) analog broadcasts and an additional six million households have at least one OTA analog television set.[2] Households that receive free over the air television broadcasts on analog TVs must take action by connecting their TV to a digital-to-analog converter box, purchasing a digital television, or subscribing to a paid TV service.

Both of these changes are raising questions about how many old TVs will find their way to the recycling/disposal path in the near future. Some are predicting a "tidal wave" from the digital transition. More likely, however, the increase will be gradual over a several year time frame as consumers take advantage of falling prices for new TV technologies. The digital transition, by itself, is unlikely to cause a large spike in TV disposal. This is because fifty percent of homes already have digital TV so will receive programming after the changeover, without doing anything additional.[3] In addition, those that have analog TV only, or other analog TVs in the home, can either obtain digital-to-analog converters or cable service to extend the life of their analog TVs. Furthermore, some homes will keep analog TVs to use for gaming or movies, or hand them off to someone else who may want to use them this way. There are many options, and it is unlikely that a sudden wave of TVs will find their way to the recycling/disposal path due primarily to the digital transition

[1] *See* 47 U.S.C. §§ 309(j)(14)(A), 337(e).
[2] The Nielsen Company. Press Release "13 Million U.S. Households Not Yet Ready for Digital Television Conversion, Nielsen Says." February 15, 2008.
[3] Consumer Electronics Association. *Market Research Report: Trends in CE Reuse, Recycle and Removal.* April 2008.

in February 2009. Still the digital transition, plus the move to adopt new TV products, will mean that greater collection and recycling infrastructure will be needed to properly handle these TVs as they emerge from homes over the next few years.

WHAT ARE WE DOING ABOUT ELECTRONICS?

EPA is engaged in several broad scale partnerships with manufacturers, retailers, other federal agencies, State and local governments, recyclers, non-government organizations (NGOs) and others to encourage and reward greener design of electronic products, to help develop the infrastructure for collection and reuse/recycling of discarded electronics, and to promote environmentally safe recycling of used electronics. More detail about each of these efforts is provided below.

1) GREENING DESIGN OF ELECTRONICS

EPEAT: EPA funded and participated in a multi-stakeholder and consensus-based process, involving electronics manufacturers, large government IT purchasers, NGOs and others, to develop the Electronics Product Environmental Assessment Tool (EPEAT). Now codified as IEEE Standard 1680, EPEAT was launched in 2006 to meet growing demand by large institutional purchasers for a means to readily distinguish environmentally-preferable desktop and laptop computers and monitors in the marketplace. Modeled on other environmental rating tools like the Leadership in Energy and Environmental Design's (LEED's) Green Building Rating system, EPEAT includes environmental criteria encompassing the product life cycle. EPEAT also provides a system for registering and verifying equipment that meets its criteria. EPEAT-registered computers and monitors have reduced levels of toxics, are more energy efficient, easier to upgrade and recycle, and use more sustainable packaging than conventional equipment. EPA supported the development of EPEAT, and it is now a self-sustaining system operated by the Green Electronics Council.

EPEAT has been a tremendous success. Even with recent upgrades to the EPEAT criteria, there are more than 550 products from 26 manufacturers registered to the EPEAT standard. In the first six months the system was in place, manufacturers reported selling more than 36 million EPEAT-registered products. EPEAT is now the official environmental standard for electronics in all federal purchasing. More than six states and many other public and private purchasers are specifying EPEAT equipment.

There is increasing demand for EPEAT to expand to additional products. This year, EPA is funding a neutral organization to convene stakeholders to develop standards for additional electronic products, including possibly TVs. EPA has committed resources to help develop four new standards. Interest is growing in using EPEAT to promote greener electronics purchases by consumers.

ENERGY STAR: Starting as early as summer 2008, consumers will be able to purchase ENERGY STAR qualified TVs covering all of today's screen technologies, in all sizes. The ENERGY STAR label will mean these products are up to 30 percent more energy efficient in both standby and active (when they are on) modes than conventional models. The approximately 275 million TVs currently in use in the U.S. consume over 50 billion kWh/year—or four percent of all households' electricity use. When coupled with digital video recorders, they account for about 13 percent of an individual household's electricity bill.

Energy consumption can vary greatly among different models. In general, the larger the TV, the more energy it will consume. However, when similarly sized products are compared, projection units use the least energy, followed by LCD products, with plasma products using the most energy. EPA will make available on the ENERGY STAR Web site an estimate of the annual kilowatt-hours (kWh) for all qualified TVs, so consumers are aware of the amount of energy the TV they are considering for purchase will use each year. On average, under the new requirements, an ENERGY STAR qualified TV will save $35 off a consumer's utility bills over the life of the TV. If each TV purchased in the U.S. in one year were ENERGY STAR qualified, we would prevent more than three billion pounds of greenhouse gas emissions per year. This equals a savings of over two billion kWh and $250 million in energy costs and reduces greenhouse gas emissions equal to taking about 300,000 vehicles off the road annually.[4]

On April 24, 2008, EPA announced a new specification for "boxes" that deliver television and video content, also called set-top boxes. Effective January 1, 2009, new cable, satellite, and telecom set-top boxes that carry the ENERGY STAR will be at

[4] Energy Star uses standard assumptions for converting energy savings to greenhouse gas (GHG) reductions and dollars saved. For GHG conversions used by the Energy Star program, please see *http://www.epa.gov/cleanenergy/energy-resources/refs.html*

least 30 percent more energy efficient than conventional models. If, after this new specification goes into effect, all set-top boxes sold in the United States meet the Energy Star requirements, the savings in energy costs will grow to about $2 billion each year and greenhouse gas emissions will be reduced by the equivalent of taking about 2.5 million vehicles off the road annually.

Furthermore, EPA recently made the ENERGY STAR available for digital-to-analog converter boxes (DTA's). ENERGY STAR qualified DTAs are eligible for purchase under the National Telecommunications and Information Agency's TV Converter Box Coupon Program. This program provides consumers coupons to save on the purchase of DTA's so older TVs can continue to receive over-the-air broadcasting after February 17, 2009. Consumers are encouraged to check that a product is both a coupon-eligible converter box and ENERGY STAR qualified model prior to purchasing. Savings from an ENERGY STAR qualified DTA over a conventional model are estimated to be up to 37 kWh annually or $4.

DESIGN FOR THE ENVIRONMENT (DfE): Over the years, EPA's DfE Program has worked with the electronics industry to help green the manufacturing of electronics, as well as electronics products themselves. DfE has worked with the industry on ways to green the manufacture of printed wiring boards, assess the life cycle impacts of CRTs and flat panel displays, and assess substitutes for tin-lead solder that have acceptable engineering performance yet are less toxic, and pose the fewest risks over their life cycle. The solder life cycle assessment generated data to help manufacturers, users, and suppliers incorporate environmental considerations when choosing replacements for the 176 million pounds of leaded solder used annually in the United States.

DfE also recently completed a life cycle assessment for various kinds of wire and cable products (including network and low voltage cables). The study results will help companies make environmentally-informed product and material choices and will identify the relative contributions of various processes and materials to the overall impacts of the wire and cable products.

2) ENCOURAGING MORE REUSE AND RECYCLING

PLUG-IN TO eCYCLING: Plug-In to eCycling is working, through partnerships, to expand infrastructure for collection and safe recycling of e-waste nationwide. In 2007, EPA's Plug-In partners collected more than 47 million pounds of electronics. The energy conserved through these recycling efforts is equivalent to the annual GHG emissions of taking nearly 24,000 cars off the road annually.[5] Since the partnership began in 2003, Plug-In partners have recycled more than 142 million pounds of unwanted consumer electronics. All Plug-In partners, whether they recycle electronics directly or contract with others for recycling services, are required to abide by the Plug-In Guidelines for Materials Management. These Guidelines spell out preferred recycling practices for used electronic products.

Plug-In partners continue to demonstrate innovation and creativity in sponsoring collection events and take-back programs and reaching out to consumers. As an example, Dell has expanded its Reconnect partnership with Goodwill Industries to include select cities in six states. Reconnect, a comprehensive electronics recovery, reuse, and environmentally responsible recycling opportunity for consumers, is now providing electronics donation opportunities to several million households. Dell also has a free, online computer recycling program for consumers who own Dell computers.

In 2007, Staples, Office Depot, Hewlett Packard, and Sony also launched nationwide eCycling efforts. The Staples program, launched in May, lets consumers drop off their computers and other electronic office equipment at any of the company's 1,400 U.S. retail locations. Sony's Take Back Recycling program, launched in September 2007, allows consumers to take, free of charge, their unwanted Sony-branded electronic products at 138 drop-off centers across the country run by Waste Management eCycle America.

As part of its Plug-In to eCycling program, EPA teamed up with cell phone manufacturers, service providers, and retailers in 2007 to increase America's cell phone recycling and donation rate. EPA distributed public service announcements and podcasts and increased publicity about available partner recycling programs.

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[5] EPA calculates these greenhouse gas (GHG) equivalent emissions reductions based on the WARM model (Waste Reduction Model), following a life cycle assessment methodology using estimation techniques developed for national inventories of GHG emissions. See *Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks* (EPA530–R–06–004). To convert GHG equivalent emissions to more easily understood metrics, such as cars off the road, gallons of gasoline, etc., EPA uses the Greenhouse Gas Equivalencies Calculator developed by the U.S. Climate Technology Cooperative.

These and other initiatives sponsored by industry, states, and recyclers are generating critical data which will inform policy-making on electronics recycling. These innovations are crucial to learning what works, what does not, where collaboration is possible and where it is not, what kinds of opportunities really get the attention of the consumer and what kind of material the consumer wants to recycle. And very importantly, these projects clarify what it costs to get electronics from the consumer into responsible recycling under varying circumstances.

FEDERAL ELECTRONICS CHALLENGE: The Federal Government is a very large purchaser of IT products. To help the Federal Government lead by example in buying green electronics and managing them appropriately at the end of their useful life, the Federal Environmental Executive and the EPA launched the Federal Electronics Challenge (FEC) in 2004. The FEC is a voluntary partnership program designed to help federal agencies become leaders in promoting sustainable environmental stewardship of their electronic assets. As FEC Partners, federal agencies work towards goals in all three of the electronics life cycle phases—acquisition & procurement; operations & maintenance; and end-of-life management.

In 2007, the President signed Executive Order (E.O.) 13423, "Strengthening Federal Environmental, Energy, and Transportation Management." E.O. 13423 consolidates and strengthens five executive orders and two memorandums of understanding related to Federal Government environmental, energy, and transportation performance and accountability, including electronics stewardship by federal agencies. CEQ and OMB implementing instructions for the E.O. were issued later in 2007 requiring that all federal agencies and their facilities participate in the FEC, or an equivalent program.

Today, the FEC has 16 federal agency partners and 184 facility partners. Facility partners reported many successes in 2007. These included 1) 80 percent of computer desktops, laptops and monitors purchased or leased were EPEAT registered,[6] 2) 86 percent of monitors and 69 percent of computers had ENERGY STAR features enabled, and 3) 99 percent of non-reusable computers were recycled in an environmentally-sound manner.

The Recycling Electronics and Asset Disposition (READ) services program assists Federal agencies in assuring environmentally sound management of their electronic discards. Managed by EPA, the READ program offers federal agencies access to recycling and asset disposition services providers that have been evaluated to ensure that they recycle and properly dispose of excess or obsolete electronics in an environmentally responsible manner.

3) WORKING TO IMPROVE ELECTRONICS RECYCLING

RESPONSIBLE ELECTRONICS RECYCLING PRACTICES: A broad group of stakeholders, including states, electronics manufacturers, electronics recyclers, trade associations and public interest groups, have been convened to develop voluntary "responsible recycling" (R2) practices for electronics recyclers, and a process for assessing conformity of recyclers with these practices. We expect that these practices will be implemented by private organizations, and not EPA. The dialogue began in 2006 and has resulted in a set of draft practices that has been reviewed by experienced facility auditors and will be undergoing field testing in the next few months. However, it should be noted that these draft practices have not been agreed to by the stakeholders and are likely to be further modified after field testing and further discussions.

The current draft includes provisions for recyclers to 1) comply with all applicable environmental, health, and safety legal requirements, 2) manage used and end-of-life electronic equipment based on a "reuse, recover, dispose" hierarchy of responsible management strategies, 3) utilize practices at their facilities that protect worker health and safety and the environment, 4) manage the R2 "focus materials" that pass through their facilities or under their control in a manner protective of worker health and safety, public health, and the environment, and 5) perform due diligence on downstream vendors to which it ships these materials, including those that are exported from the United States. "R2 focus materials" are materials in end-of-life electronics equipment that warrant greater care because of potential hazards during recycling, refurbishing, materials recovery, energy recovery, incineration, and/or disposal.

After the practices have been field tested, the stakeholder group expects to revisit and revise the practices based on information and recommendations gathered dur-

[6] The Federal Acquisition Regulations requirement that 95 percent of applicable federal information technology purchases meet the EPEAT took effect in December of 2007. As a result, it is anticipated that more federal purchases will be EPEAT-compliant in FY 2008.

ing the field testing process, and to make other changes as appropriate. EPA is also conducting research on electronics recycling that includes environmental sampling and characterization of an electronics recycling facility. Data from this testing will assist the stakeholders in adopting practices to comply with applicable environmental requirements.

EXPORTS MANAGEMENT: It is well known that electronics material collected in the United States and other developed countries is exported to foreign countries. Some are concerned that this amounts to "exporting harm," because electronics materials have been mishandled in some of the receiving locations. Those that object to exports of used electronics point to the coming digital transition and consumer upgrading to new TV technologies (e.g., LCD, plasma, flat screens) and the insufficient infrastructure in the U.S. to process these materials as evidence that abuses abroad will only worsen. However, it must be recognized that while there have been demonstrated problems, export of electronics collected is a necessary and useful function, and important work is underway to ensure that these exports are managed appropriately at their destination. Also, it should be understood that without export of electronics as an option, most of the electronics in the United States would be disposed.

Used electronics can be exported to other countries for the purpose of continued use or recycling. It is difficult to generate good estimates of how much used and scrap electronics are exported for reuse and recycling, because data on export volumes is not always required to be reported. However, EPA has attempted to quantify the amount of CRT TVs and monitors that are exported for reuse or recycling. We estimate that more than 80 percent of CRT devices (including materials such as processed glass resulting from processing CRTs in the U.S.) that are collected for reuse or recycling are sent to foreign markets.

Given the concerns expressed by some about improper handling of electronics abroad, should there be any export at all? There are examples of unsafe recycling practices in some areas of the world where dismantling occurs in unregulated and uncontrolled cottage industry conditions. However, there are also benefits associated with export of this material. Much of what goes abroad is whole equipment or components for reuse. This reuse avails many people in developing countries with information technology that would otherwise be unaffordable for them. Materials such as plastics or metals derived from electronics and processed in the United States make up another large portion of the amount exported. These "scrap" commodities are in high demand overseas as raw materials for manufacturing. Because most electronics are manufactured abroad, using materials from discarded electronics in the manufacture of new electronics cannot occur unless the raw materials are sent back to where the products are manufactured.

Without international markets, many of the efforts currently underway in the United States to divert obsolete electronics away from disposal and toward reuse and recycling could not be sustained. For example: 1) there are no smelters/refiners in the United States to convert copper and precious metal (gold, silver, palladium) bearing electronics into metals that are pure enough for use; 2) there are no longer any cathode ray tube (CRT) glass furnaces in the Western Hemisphere for use of recycled CRT glass; 3) nearly all markets for plastics from electronics are overseas, primarily in Asia; and 4) the major markets for reuse (of both whole equipment and components) are outside the United States, mostly in developing countries.

At the same time, EPA is taking steps to improve the management of electronics sent abroad for management. This is particularly relevant to concerns that evolution to new TV technologies which will increase the number of old TVs available for end-of-life management. EPA's new CRT rule requires exporters of CRTs for reuse to file a one-time notification with EPA stating that they plan to export CRTs for reuse. The rule also requires persons who export CRTs for reuse to keep, for not less than three years, copies of business records demonstrating that each shipment of exported CRTs will be reused. This requirement provides United States regulatory authorities the opportunity to inspect these records in order to verify that the CRTs were actually sent to legitimate reuse or refurbishment entities. For export of CRTs and unprocessed CRT glass for recycling (as opposed to reuse), the rule requires both notification to EPA of the intended export and consent by the receiving country. These regulations are relatively new, and we are still in the process of implementing the requirements. These new requirements promise to ensure significantly better control over CRTs exported for recycling.

We also have several initiatives that promote safe management of used electronics exported for recycling, including the Plug-In guidelines for sound reuse and recycling of electronic products and the multi-stakeholder dialogue to issue "responsible recycling" practices for incorporation into a certification program for e-waste recy-

clers, both of which have previously been discussed in the testimony. EPA also led the development of international guidelines on the sound use and recycling of personal computers by the Organization for Economic Cooperation and Development (OECD). We participated in a Basel Convention partnership effort with industry that is developing guidelines for the safe reuse, recycling and transboundary movement of used and scrap mobile phones. Finally, we are a participant in a working group of international stakeholders of academia, trade associations, industry and governments—called the StEP initiative—to identify voluntary activities that promote sound reuse and safe recycling, especially concerning the transboundary flows of electronics.

With global markets being essential to sustainable and sound management of electronics, the key is to continue to work towards assuring that management of electronics at their end-of-life is protective of human health and the environment whenever and wherever it takes place. EPA is committed to continuing its ongoing efforts in this regard.

Conclusion

EPA appreciates the Committee's interest in this issue and the opportunity to discuss the Agency's electronics goals, what efforts are currently underway, and how EPA works with partners throughout the product chain to achieve shared responsibility for a greener, recovery-oriented product cycle.

FOLLOW-UP QUESTIONS FOR WRITTEN SUBMISSION
BY THE ENVIRONMENTAL PROTECTION AGENCY (EPA)

Questions submitted by Chairman Bart Gordon

Q1. How much funding has EPA allocated for the development of the Electronics Product Environmental Assessment Tool (EPEAT) standards for televisions and when will this funding be given to the Green Electronics Council to develop these standards?

A1. The Green Electronics Council is not the developer of EPEAT standards. The Council maintains the EPEAT Product Registry and conducts verification to help ensure products meet the EPEAT Standard criteria and markets EPEAT to purchasers. Rather, EPA will be awarding a $300,000 four year cooperative agreement, which will pay for 50 percent of the costs of managing the process of developing four new product standards—imaging equipment, televisions, servers, and cell phones/PDAs: The recipient of this cooperative agreement will facilitate the development of these new standards through a multi-stakeholder voluntary consensus process. EPA provided partial funding under the Pollution Prevention Program/Project (502C95) in EPA's Environmental Programs Management appropriation for this work due to limited resources and a belief that other stakeholders needed to jointly-fund the development of standards which meet their needs. The EPA cooperative agreement is in the final stages of obtaining Agency approval, and is scheduled to be awarded in the summer of 2008.

Q2. EPA states in its testimony that "starting as early as 2008, consumers will be able to purchase ENERGY STAR qualified TVs." Is ENERGY STAR available now for televisions?

- *EPA states in its testimony that ". . . they [TVs and digital recording devices] account for about 13 percent of an individual household's electricity bill." Given this high energy usage, why has the ENERGY STAR program been so slow to expand the program to televisions?*
- *The Committee heard testimony at the hearing, that the production of an electronics product uses considerably more energy than the energy use over the product's lifetime. Why hasn't EPA added a provision to ENERGY STAR that would help consumers assess and compare the embodied energy of electronics products?*

Q2a. Is ENERGY STAR available now for televisions?

A2a. EPA has had ENERGY STAR requirements for TVs since 1998. Version 2.2 of these requirements is in place now and more than 2,200 TV models have earned the ENERGY STAR label. In November 2008, EPA's new Version 3.0 requirements for TVs will go into effect. These new requirements ensure that TVs are more energy efficient in all modes of operation. In order to qualify for ENERGY STAR, TVs must be tested using the internationally vetted and supported On Mode test procedure for TVs (IEC 62087).

Q2b. EPA states in its testimony that ". . . they [TVs and digital recording devices] account for about 13 percent of an individual household's electricity bill." Given this high energy usage, why has the ENERGY STAR program been so slow to expand the program to televisions?

A2b. ENERGY STAR has addressed what was the significant contribution TVs historically made to a household's electricity bill (i.e., standby power consumption). As TV technology and usage patterns have changed, EPA contributed to the development of an internationally accepted "On Mode" test procedure and incorporated requirements into ENERGY STAR to address power consumption across all modes of TV operation. With these new requirements, if all TVs sold in the United States met ENERGY STAR requirements,[1] the savings in energy costs would grow to about $1 billion annually.

Standby power consumption remains a focus of the ENERGY STAR program as U.S. households spend $100 per year to power devices while they are in a standby power mode—roughly eight percent of household electricity costs. Consumer electronics, including audio, video and telephone products account for 40 percent of low power mode consumption (roughly $40 per household per year).

[1] As of 2015 and thereafter.

Q2c. The Committee heard testimony at the hearing that the production of an electronics product uses considerably more energy than the energy use over the product's lifetime. Why hasn't EPA added a provision to ENERGY STAR that would help consumers assess and compare the embodied energy of electronics products?

A2c. EPA has, to date, focused on the savings available to consumers by reducing the power draw of products they use in their homes and workplaces. Through this focus, Americans, with the help of ENERGY STAR, prevented 40 million metric tons of greenhouse gas emissions in 2007 alone and saved more than $16 billion on their utility bills.

The program is committed, however, to achieving additional savings. For example, ENERGY STAR initially focused on achieving greater efficiency while products were in low power mode as there was an opportunity to deliver significant savings in a cost effective manner. In recent years, EPA has turned its attention to On Mode power consumption for many product categories as their power consumption in this mode has become a more significant portion of the products' overall consumption and meaningful savings were measurable and achievable. A sister program to ENERGY STAR, EPA's Climate Leaders program, has challenged partners to reduce their carbon footprint, including that which is associated with the manufacture of products like TVs.

EPA is considering how the Agency can weigh products' embodied energy, as well as the product's in-use performance against a range of other environmental criteria when recognizing products as environmentally preferable. This effort, underway now, will align with ENERGY STAR's guiding principles—engaging key stakeholders, and building on existing data.

Q3. When did EPA begin its Design for the Environment (DfE) program? How much funding has gone to the initiative since its inception (by year) and how much has been specifically devoted to electronics products (by year)? How much funding did EPA request for these activities in FY 2008 and FY 2009?

- *Please list the electronics producers EPA has worked with through the DfE program. How has EPA worked with electronics recyclers or facilitated dialogue between electronics producers and electronics recyclers through the DfE program?*
- *How are tools like the solder life cycle assessment and the wire and cable life cycle assessment used by manufacturers? Can you please provide us with some specific success stories from the WE program?*

Q3a. When did EPA begin its Design for the Environment (DfE) Program?

A3a. The Office of Pollution Prevention and Toxics' Design for the Environment (DfE) Program was established in 1992. More information on the DfE Program is available at *www.epa.gov/dfe*.

Q3b. How much funding has gone to the initiative since its inception (by year) and how much has been specifically devoted to electronics projects (by year)? How much funding did EPA request for these activities in FY 2008 and FY 2009?

A3b. Year-by-year funding for DfE and for DfE electronics projects is provided in Attachment A. The attachment also provides the President's budget request for DfE for fiscal years 2008 and 2009. All DfE resources are housed in the Pollution Prevention Program/Project (502C95) in EPA's Environmental Programs Management appropriation.

Q3c. Please list the electronics producers EPA has worked with through the DfE Program.

A3c. Attachment B includes the electronics manufacturers who have played a significant role in DfE partnerships. Also in this list are suppliers to electronic manufacturers who have provided input in the dialogue. These include manufacturers of printed circuit boards, flame retardants, and resins. After the industry partners, we list other significant participants.

Q3d. How has EPA worked with electronics recyclers or facilitated dialogue between electronics producers and electronics recyclers through the DfE Program?

A3d. Multi-stakeholder engagement is central to DfE's approach; DfE engages industry, environmentalists, and others. These stakeholders help EPA to define project goals and scope, and enable EPA to understand and account for the broad range of concerns and issues associated with exploring alternative, safer chemicals, more efficient processes, and preferable product end-of-life scenarios.

Recyclers have shown great interest in DfE projects. For example, in the case of the ongoing EPA *Flame Retardants in Printed Circuit Boards Partnership,* copper smelters participated in scoping and design of the partnership and are now working with us to conduct the work. Copper smelters have helped DfE and the full stakeholder group to understand how the smelting process works, and the printed circuit board constituents that may cause concern for the industry. The smelters have been very helpful in designing a study to understand the unintended byproducts that may result from combustion.

Based on our partnership work involving their industry, the Institute of Scrap Recycling Industries, Inc., gave DfE their Design for Recycling® Award in 2007.

Q3e. How are tools like the solder life cycle assessment and the wire and cable life cycle assessment used by manufacturers?

A3e. DfE Lead-Free Solder Partnership

The study results have provided the industry with an objective analysis of the life cycle environmental impacts of leading candidate alternative lead-free solders, and have allowed the industry to redirect efforts towards products and processes that reduce solders' environmental footprint. The electronics industry has substantially reduced the use of lead in electronics since this study began. More information can be found at *www.epa.gov/dfe/pubs/projects/solder/index.htm*.

DfE Wire & Cable Partnership

Opportunities for improvement of environmental performance in wire and cable products were identified in the Life Cycle Assessment, focusing primarily on energy efficiency, and recycling of chopped cable resin. For example, electricity generation for raw material production and cable extrusion were a large part of the environmental burden of wire and cable products. Finding opportunities to reduce energy inputs would likely have a large effect on the overall environmental burden of wire and cable products. Also, increased recycling of chopped cable resin, although an energy-intensive process, would decrease the potential impacts associated with landfilling and incineration. The draft final LCA is now posted on the DfE web site for public comment. Please see: *www.epa.gov/dfe*.

Q3f. Can you please provide us with some specific success stories from the WE Program?

A3f. Below are success stories from the DfE Program.

Informed Substitution: Safer Flame Retardants for Furniture and Printed Circuit Boards

DfE's Furniture Flame Retardancy Partnership was initiated in response to stakeholder concerns with the occurrence of pentabromodiphenyl ether (pentaBDE) in the environment and human tissues. PentaBDE was the primary flame retardant in the manufacture of low-density, flexible polyurethane foam for furniture, with production levels of approximately 19 million pounds per year.

To ensure that decisions were made based on the best information available, and to minimize the chance of unintended consequences, DfE brought together a multi-stakeholder group to consider the move to alternative chemicals. In consultation with this group, DfE developed an alternatives assessment methodology for evaluating alternative flame retardants based on the tools and expertise of the Office of Pollution Prevention and Toxics.

DfE evaluated 14 commercially-available alternative flame retardant formulations. The outcome of the partnership was a move to alternative flame retardant formulations. The results from this partnership were used by foam manufacturers, in the period leading up to the voluntary December?2004 phase-out of production of pentaBDE, in choosing alternative flame retardants. These efforts complemented an EPA Significant New Use Rule (SNUB) under the *Toxic Substances Control Act*—a regulatory backstop to require notification to EPA before restart of U.S. manufacture or import of pentaBDE for any use.

Please see: *http://www.epa.gov/dfe/pubs/projects/flameret/index.htm* for more information.

DfE's Printed Circuit Board Partnership

DfE is now working with the electronics industry, the chemical industry, and environmental groups to adapt the technical methodology described above to electronics applications. The Printed Circuit Board Flame Retardancy Partnership was convened to better understand the environmental health and safety aspects of com-

mercially available flame retardants that can be used to meet fire safety requirements for the type of printed circuit board that dominates the industry.

A draft report for public comment will be available later in 2008. Please see: *http://www.epa.gov/oppt/dfe/pubs/projects/pcb/index.htm* for more information.

DfE Formulator Safer Product Recognition Program

EPA allows safer products to carry the Design for the Environment (DfE) label. This mark allows consumers to quickly identify and choose products that can help protect the environment and are safer for families. When you see the DfE logo on a product it means that the DfE scientific review team has screened each ingredient for potential human health and environmental effects and that—based on currently available information, EPA predictive models, and expert judgment—the product contains only those ingredients that pose the least concern among chemicals in their class.

Product manufacturers who become DfE partners, and earn the right to display the DfE logo on recognized products, have invested heavily in research, development and reformulation, to ensure that their ingredients and finished product line up on the green end of the health and environmental spectrum, while maintaining or improving product performance.

More than 100 manufacturers have met DfE's criteria for displaying the logo on more than 500 products, including: Clorox, Method, SC Johnson and Son, Colgate Palmolive, Dial Corporation, SYSCO, and Corporate Express. Additionally, retailers such as WalMart and Home Depot ask their suppliers to work with DfE. Visit *http://www.epa.gov/oppt/dfe/pubs/projects/formulat/label.htm* for more information and a listing of safer products.

Please also see Design for the Environment Partnership Highlights at *http://www.epa.gov/dfe/pubs/about/index.htm*.

Q4. When did EPA begin its Plug-In To eCycling program? Since its inception, how much funding has EPA requested for this program (by year) and how much has been allocated (by year)? What specific activities are funded under this program, and what activities does EPA carry out?

- *In its testimony, EPA states that these "initiatives sponsored by industry, states, and recyclers are generating critical data which will inform policy-making on electronics recycling." Please provide some examples of the critical data generated and how it will inform policy-makers. What is EPA's role in collecting and processing this information?*

A4. In 2003, EPA launched the Plug-In To eCycling partnership program to work with electronics manufacturers and retailers to offer consumers increased opportunities to donate or recycle—"eCycle"—their used electronics. The program's initiatives are intended to reflect shared responsibility among manufacturers, retailers, governments and consumers. These initiatives seek to demonstrate how voluntary, industry-led models or public-private partnerships can complement existing state or municipality-led collection and recycling efforts. Plug-in initiatives also inform policy-making on electronics recycling by demonstrating what works and what does not (e.g., how best to encourage consumer participation, what various approaches cost). Over the past five years, the Plug-In program has grown to include 25 industry partners. Through their collective, voluntary efforts, partners have recycled more than 142 million pounds of unwanted consumer electronics.

Since its inception, Plug-In To eCycling has been allocated approximately $742,000[2] in funding ($207,000, $125,000, $100,000*, $100,000*, $100,000, and $110,000 for fiscal years 2003–2008, respectively).[3] The Plug-In program is not included as a separate item in our program budget requests, but it is one of the many activities over the years that we implement during the budget year to foster improved end-of-life management of electronics, as described in our Congressional Justifications.

With these funds, Plug-In To eCycling carries out the following functions: 1) providing information to educate and encourage the public to increase participation in electronics recycling, 2) facilitating partnerships to increase opportunities for consumers to recycle their used electronics; 3) researching ways that manufacturers can collaborate to help manage collection and recycling of e-waste; and 4) supporting ef-

[2] In FY07 and FY08 we funded this out of 301DA2—Waste Minimization and Recyling funds.
[3] For FY 2005 and 2006, Plug-In was not itemized in the operating plan budget. It was included within the $275,000 allocated to the Office of Solid Waste's activities on management of end-of-life electronics and received an estimated $100,000 in both FY05 and FY06.

forts to quantify the environmental benefits of electronics recycling. Specific activities that have been undertaken include:

- To increase public awareness of the opportunities to donate and recycle used electronics and the environmental benefits of doing so, Plug-In has created a variety of outreach tools, including: an eCycling event toolkit, brochures, flyers, web pages, public service announcements, podcasts, and a short video promoting computer reuse. Earlier this year, Plug-In launched the *Recycle Your Cell Phone. It's an Easy Call.* campaign to highlight the many opportunities for consumers to recycle their cell phones. In just two weeks, the campaign received over 10,000,000 media impressions from national outlets, such as AP, the *New York Times,* NPR and Reuters and this earned media valued at over half a million dollars. Outreach activities help to raise public awareness of the importance of electronics recycling and stimulate participation in existing recycling programs.
- Plug-In has supported the development, implementation, and evaluation of four pilot projects to assess different approaches to effective collection techniques for end-of-life electronics. These pilots included retail take-back pilots involving Staples, Good Guys, Office Depot, and Best Buy and researched the creation of manufacturer-led third party organizations to coordinate collection and recycling. The lessons learned and data collected from participating in the pilot projects enabled the retail partners to test the feasibility of collecting used electronics in a retail setting and understand the degree to which the reverse distribution collection approach could be part of the company's sustainable business model. For example, based on the experience gained and the success of its pilot project, Staples has since expanded their program nationwide. The retail pilots have demonstrated that retailers are potent partners in educating and incentivizing consumers to recycle by providing them with convenient drop-off outlets and offering them attractive rebates and discounts on the purchase of new products when they bring in an old product for recycling. The research on manufacturer-led third party organizations illustrates how consortia of manufacturers can pool their resources and business expertise to provide efficient and effective take-back services. These lessons are being applied in such states as Washington and Minnesota, two states that are encouraging manufacturer collaborations on take-back. All of these pilots have helped to expand collection and recycling not only in states that have electronics recycling requirements, but states that do not.
- EPA created the *Plug-In To eCycling Guidelines for Materials Management,* which serves as national guidance for the safe management of used electronics. These Guidelines have allowed EPA and Plug-In partners to gain experience and information about what practices, will most effectively protect human health and the environment, while at the same time enabling practicable programs for the management of used electronics. The Guidelines have also served as a basis for the development of the ongoing effort to formulate consensus "Responsible Recyclers Practices."[4]
- EPA has collaborated with the National Center for Electronics Recycling (NCER) to help populate NCER's database on electronics collection. Plug-In To eCycling partners are being asked to share their data with NCER. The centralized database, designed by a range of key stakeholders in conjunction with the NCER and EPA, is intended to provide recycling program designers and managers, as well as policy-makers, with information on electronics recycling program structure, costs, and results.
- Plug-In has contributed to the broader EPA effort to develop the Electronics Environmental Benefits Calculator (EEBC). The Calculator estimates the benefits of environmentally sound management of electronic equipment from purchase to use to end-of-life management. With this tool, a user can quantify and articulate the environmental benefits of their electronics recycling activities in terms of greenhouse gas reductions and energy savings.

Q5. Regarding the export of used electronics, EPA's testimony states, ". . . it should be understood that without export of electronics as an option, most of the electronics in the United States would be disposed." Does this mean disposed of in

[4] EPA is working with stakeholders (i.e., states, electronic manufacturers, recyclers, trade associations and public interest groups) to develop one agreed upon set of practices that can be used in a voluntary certification program which assures the environmental performance of electronic recyclers. This certification program is expected to be run by private organizations, not EPA.

a landfill, incinerated; or by some other means? Is the recycling infrastructure in the U.S. sufficiently robust to handle the volume of used electronics generated in this country?

- *EPA also states in its testimony that "important work is underway to ensure that these exports are managed appropriately at their destination." What are the specifics of this work and who is responsible?*
- *Lastly, EPA's testimony describes the Cathode Ray Tube (CRT) Export for Re-Use Notification Rule that went into affect in January of 2007 and states that the "new requirements promise to ensure significantly better control over CRTs exported for recycling." How much funding has EPA requested for the oversight and enforcement of this rule, and how much has been allocated, for FY 2007, FY 2008, and FY 2009 (requested)? How will this new rule ensure better control of the export of CRT televisions and monitors? Will this rule be expanded to cover other electronic devices, like computers, cell phones, and flat panel displays?*

A5. When we say that without export most electronics discarded in the U.S. would be disposed, it refers to the limited U.S. markets for reuse of this equipment, as well as for use of recycled raw materials in manufacturing. Thus, without international markets, many of the efforts currently underway in the U.S. to divert used electronics away from disposal (land-filling and/or incineration) and toward reuse and recycling could not be sustained.

Our study on electronics management in the U.S. estimates that between 15–20 percent of used electronics collected in the U.S. are reused or recycled—with much of this material exported as described below. The remaining 80–85, percent are disposed of domestically. We estimate that most of the disposal is in landfills, based on the fact that the vast majority of waste disposed of in the U.S. is managed in landfills, as opposed to incinerators or waste-to-energy facilities (80 percent landfilled, versus less than 20 percent in incinerators or WM facilities).[5] We hope that the amount of electronics destined for reuse and recycling will grow as a percentage, but this will necessarily mean that more electronics will be destined for reuse or recycling abroad for the reasons discussed below.

The worldwide demand for used electronic equipment and components is both very high and extensive. Many used electronic components are marketed globally, with the highest demand in Asia, where these components are often used in the production of refurbished or remanufactured electronics. Although there are some U.S. markets for used electronic components and whole equipment, these are limited compared to export markets, where these materials generally have a much higher value. U.S. consumers also are much less likely to purchase used electronic goods than consumers in poorer countries.

Although hundreds of recyclers dismantle and process used electronics in the U.S., the primary markets for many of the derived materials are foreign ones. For example, because there no U.S. smelters equipped to recover copper and precious metals from circuit boards, all circuit boards must be exported. Likewise, all CRT glass furnaces are outside the U.S., primarily in Asia. Thus, most CRT glass is exported to glass manufacturing furnaces in Asia, where new CRTs are made using recycled glass. Virtually all plastics derived from processing used electronics in the U.S. are exported to Asia.

In general, the recycling infrastructure in the U.S. is adequate for the preliminary processing of electronics (e.g., separating out parts and some of the material streams, such as metals, plastics and glass). Numerous recyclers have positioned themselves to provide even greater U.S. processing capacity as an increasing number of state recycling mandates take effect. However, many factors affect *where* processing, and recycling will ultimately occur—that is, whether certain stages of processing are performed in the U.S. or outside the U.S. These factors include, among others, proximity to markets and manufacturing, labor rates and regulation.

With regard to our statement that "important work is underway to ensure that these exports are managed appropriately at their destination," we were referring to: 1) developing responsible recycler practices; and 2) actively participating in international dialogues focused on developing international guidelines for the sound management of e-waste. We are also implementing the new CRT rule which is intended to provide better control over CRTs exported for reuse and recycling.[6]

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[5] U.S. EPA, Office of Solid Waste. *Electronics Waste Management in the United States: Fact Sheet, Management of Electronic Waste in the United States.* April 2007. EPA530–R–07–004a. *www.epa.gov/ecycling/manage.htm*

[6] The new CRT rule requires exporters of CRTs for reuse to file a one-time notification with EPA stating that they plan to export CRTs for reuse. The rule also requires persons who export

For implementation of the CRT rule, EPA's Office of Solid Waste expended 0.4 FTE in FY 2007 and 0.3 FTE in FY 2008. We project a need of 0.3 FTE in FY 2009. No extramural funds were used by OSW during this time period. We do not have plans to expand the coverage of the CRT rule to the export of other forms of used and scrap electronics. EPA's Office of Enforcement and Compliance Assistance has not specifically requested any funding for enforcement of the CRT rule and has no plans to do so for 2009. As with other rules, this office will devote resources as necessary to address identified cases of noncompliance, but will not request resources specifically for that purpose.

To enable businesses and organizations to verify that electronic recyclers are employing environmentally responsible practices, we are working with stakeholders (i.e., states, manufacturers, recyclers, trade associations and public interest groups) to develop an agreed upon set of practices that can be used in a voluntary certification program to assure responsible environmental performance by electronic recyclers. Draft recycling guidelines have been reviewed by experienced facility auditors, and field testing of these guidelines is now underway. The draft certification guidelines place a great deal of emphasis on "downstream due diligence" to assure that e-waste is handled properly in the U.S., as well as outside the U.S., and specifically address the need to ensure that exported equipment and materials comply with the requirements of importing and transit countries.

Also, as we mentioned in our testimony, we have led the development of international guidelines on the sound use and recycling of personal computers by the Organization for Economic Cooperation and Development (OECD). We participated in a Basel Convention partnership effort with industry that is developing guidelines for the safe reuse, recycling and trans-boundary movement of used and scrap mobile phones. We are also involved in the early stages of a similar Basel partnership regarding personal computers. Finally, we are a participant in a working group of international stakeholders of academia, trade associations, industry and governments—called the StEP initiative—to identify voluntary activities that promote sound reuse and safe recycling, especially concerning the trans-boundary flows of electronics.

Questions submitted by Representative Ralph M. Hall

Q1. How have electronics in the waste stream changed over the past decade and what predictions can we make about changes in the coming years? How do these changes affect our ability to safely and efficiently recycle or reuse these devices?

A1. Over the past 10 years, both the quantity and composition of electronics in the waste stream have changed dramatically. From 1997 to 2007, the number of TVs, computers, keyboards, hard copy devices, and cell phones that Americans generate increased by 220 percent,[7] although the percentage of end-of-life electronics compared to municipal solid waste is still relatively low—less than two percent.[8] There have been many changes in the types of products entering the market and subsequently the waste stream. Portable computers now comprise over a quarter of the, computers generated for end-of-life management, whereas a decade ago they were only beginning to take a stronghold in the market.[9] The number of cell phones that were generated in 2007 increased by nearly 20 fold compared to 1997.[7] Additionally, cell phones have continued to become smaller and lighter. Flat screen monitors and

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CRTs for reuse to keep, for not less than three years, copies of business records demonstrating that each shipment of exported CRTs will be reused. This requirement provides U.S. regulatory authorities the opportunity to inspect these records in order to verify that the CRTs were actually sent to legitimate reuse or refurbishment entities. For export of CRTs and unprocessed CRT glass for recycling (as opposed to reuse), the rule requires both notification to EPA of the intended export and consent by the receiving country.

[7] Preliminary results from our analysis *Electronics Waste Management in the United States: Approach 1.* Updated May 2008.

[8] U.S. EPA. *Municipal Solid Waste Generation, Recycling and Disposal in the United States: Facts and Figures for 2006.* EPA–530–F–07–030.

[9] The new CRT rule requires exporters of CRTs for reuse to file a one-time notification with EPA stating that they plan to export CRTs for reuse. The rule also requires persons who export CRTs for reuse to keep, for not less than three years, copies of business records demonstrating that each shipment of exported CRTs will be reused. This requirement provides U.S. regulatory authorities the opportunity to inspect these records in order to verify that the CRTs were actually sent to legitimate reuse or refurbishment entities. For export of CRTs and unprocessed CRT glass for recycling (as opposed to reuse), the rule requires both notification to EPA of the intended export and consent by the receiving country.

TVs (featuring liquid crystal displays or plasma screens) are displacing cathode ray tubes (CRTs).[7] Sales of flat panel TVs outstripped CRTs in 2007.[7]

These changes in the composition of the electronics waste stream have implications for recycling markets. For example, as more and more CRTs are returned for recycling, but, fewer CRTs are produced, new markets for leaded CRT glass will be needed. While there continue to be markets for reusable/refurbishable CRTs and CRT glass in developing countries (where CRT glass recycling capability is available), this will only last until the markets in those locales change too. Then, alternative uses for CRT glass will be necessary, as old CRTs will still be disposed of even after new CRTs are no longer made.

Some of the newer products entering the market are smaller and serve multifunctions. For example, the new cell phones are lighter and more compact than earlier models, reducing the amount of packaging and the number of trucks needed to transport the finished product. On the other hand, some new products are significantly larger, such as new TVs which are significantly larger than the TVs they are replacing, suggesting that there will be more material to manage when these products reach the end of their useful life. There has been relatively little focus on how to recycle these new products (e.g., LCDs and plasma screens), suggesting a need for more information on how to manage these products properly.

It also is likely that rapid innovation and product convergence will continue. Many "stand-alone" products, such as PDAs, cell phones, MP3 players, and digital cameras, are merging into single multi-function products, in some cases rendering the single function products less desirable, although there still seem to be markets for stand-alone products. Many products will be capable of doing more in smaller sizes. As a result, they will be made of less material that needs recycling. Recyclers will be faced with continually changing streams of materials and configurations to deal with.

Worldwide, there has been increasing pressure for the electronics industry to adhere to stricter materials restrictions, such as the Reduction of Hazardous Substances (RoHS) Directive in the European Union, California's version of RoHS and EPEAT (which incorporates the RoHS requirements into its standards). New generations of electronics (including TVs, computers and mobile phones/PDAs) are being designed to meet these requirements through use of fewer toxic inputs and greater use of recyclable materials. These requirements will reduce certain substances of concern and substitute new constituents and materials not used before in electronics. More research will be needed on new constituents and additives to replace banned substances to make sure that the substitutes will both ensure product performance integrity without introducing new environmental problems.

Demand is increasing on the part of the electronics industry for more secondary materials (e.g., plastics, metals) to use in new products. However, bans on certain chemicals and constituents in electronics are making it harder to do this. This is because many materials recovered from older electronics contain banned constituents (e.g., plastics impregnated with certain brominated flame retardants, lead). As a result, new sources of secondary materials will be needed for the electronics industry as well as ways to remove banned substances from the materials currently being recovered from electronics so that they can be used in the manufacture of new electronics.

Finally, as electronic products continue to change and evolve, it will be necessary to support continuing research on how to make recycling of these products more cost-effective and safe. Research will be necessary on how best to design products to facilitate dismantling, how to identify toxic components for separation and safe processing, as well as methods to minimize worker exposures during recycling.

Q2. Dr. Williams suggests that some take-back programs have an adverse effect on reuse. Do you agree with this assessment? What effect does EPA see on reuse of commodities like cell phones due to the increase in take-back campaigns?

A2. Generally speaking, reuse occurs for products that have a reuse market. The strength of the reuse market depends on a number of factors, such as the quality and age of the product in question and demand for the product. For example, there is a strong reuse market for working CRT tubes to be used intact in new TVs or computer monitors in developing country markets, where consumers cannot afford the newer flat panel screens. EPA's Office of Solid Waste estimates CRTs that can be reused or refurbished are worth $4–$10 apiece. In addition, there is a strong demand for working CPUs in these same regions. However, as prices for shipping a container to China rise dramatically (up from $400 in 2004 to $1,850 as estimated by American Retroworks, Inc.), exports of electronics need to be valuable enough to cover this cost, meaning that products sent abroad are more likely now to be reusable or refurbishable or mined for working parts. This means that most recyclers

(with the exception of recyclers that shred exclusively) have incorporated reuse into their business model. There is a whole community of "refurbishers" whose business model is based on reuse of the electronic equipment.

Another example is cell phones, which currently has a strong reuse market. While some manufacturers of cell phones do not include reuse in their take-back programs (due to competition from used equipment and concerns about the standards used for "refurbishing" phones affecting their reputation), most cell phone retailers, carriers, and private recyclers, as well as charities, schools and other public interest organizations have a strong reuse component in their take-back programs. This is because there is still a greater economic return for resale of used phones than can be earned from recycling them. Even companies that do not resell or refurbish recovered phones, are likely to break-down the phone into its parts and recover items, such as LCD screens, speakers, and other parts that are in good working order.

It is true that some take-back programs have had the effect of discouraging or preventing reuse of some kinds of products. One example has been seen in California, not because the State's law explicitly requires recycling over reuse, but because California offers electronics recyclers a per-pound reimbursement for recycling covered electronics. This gives recyclers a choice: if they can earn more by selling discarded products for reuse, they will. Conversely, if they can earn more by recycling and claiming reimbursement from the State, they will. For a time, the recycling value paid by the state exceeded the reuse value of certain products. California recently reduced its reimbursement rate to processors who recycle, so sale for reuse may become more attractive for some products. Some voluntary manufacturer take-back programs for IT equipment do not focus on reuse, emphasizing instead parts recovery or recycling over reuse or refurbishment of the product. At least one manufacturer, Dell, however, has incorporated a strong reuse component into all of its voluntary take-back programs—both in their consumer take-back program and their partnership with GoodWill. In Dell's recycling programs, they have determined that the amount of material that goes to reuse (both whole equipment and parts) versus the amount of material that goes to recycling stays constant, indicating that reuse is still a viable part of their program.

Q3. What are the most difficult components to safely and cost-effectively recycle? Other witnesses have raised plastics, mercury lamps, and lead content as having the potential to negatively affect environmental and public health. What is the state-of-the-art for recycling or reuse of these items?

A3. There are two different questions here: whether it is possible to cost-effectively recycle electronics and whether it is possible to safely recycle electronics.

As to cost-effectiveness, it is possible to recycle many computers cost-effectively. Many used IT products (especially those of more recent vintage) can be resold as is or refurbished, at a profit (e.g., CRTs, CPUs). For those that cannot, there is often positive value in these products in the way of parts (e.g., circuit boards and disk drives) and recyclable materials. But there is a cost to collecting and transporting these products to recycling facilities. Sometimes the resale value of the products or the value of the materials in the product covers the collection and transportation costs (especially in the case of smaller, newer products such as laptops); sometimes it does not (e.g., with larger or older products, such as desktop computers). This is why some manufacturers and retailers that offer take-back programs sometimes charge a fee for some IT products.

TVs are just the opposite. It takes more labor to dismantle TVs than is earned from the materials recovered. Because TVs are a net negative cost to recycle, many collection programs (outside of those in states that mandate a point of purchase fee or manufacturer responsibility for used electronics) charge consumers a price to manage discarded TVs. Also, TVs depreciate as they age. The average PC monitor brought in for recycling is about 10–15 years newer than the average TV brought in for recycling. However, the average age of TVs brought in for recycling is starting to decline as hotels and many Americans start trading-up to flat screen models. At the same time, the average weight of these TVs is going up (reflecting the larger TVs purchased over the years) and this adds to the cost of managing them. The weight of TVs may drop again over time as thinner "flat" screens displace CRTs and large projection TVs.

Regarding safety issues in recycling electronics, many smaller products, such as cell phones, PDAs, bluetooths and cameras, contain batteries that may cause problems in recycling unless they can be readily located and removed. Some digital cameras contain mercury lamps that are time consuming to locate and remove. Failure to remove these items can contaminate the material stream if these products are crushed or shredded, creating the risk of employee or environmental exposure, as well as significantly reducing the re-sale value of the resulting materials.

Looking forward, several factors will affect how safely and cost-effectively electronics will be recycled. These factors include: 1) amount of electronics available for recycling; 2) innovations in recycling technology; 3) the degree to which products are designed to be more readily recyclable; and 4) the development of markets for materials that cannot be readily used in the making of new electronics. Due to State take-back requirements and the expanding use of voluntary industry take-back options, the volume of electronic material for recycling has increased. As the volume increases, economies of scale in collection, transportation and processing will reduce costs. New technologies are being developed that will make it easier and more lucrative to process older electronics moving through the system. New methods to quickly and safely dismantle CRTs are now being demonstrated; technologies for improving the recognition and segregation of the multiple plastics used in electronics are starting to improve. While more research is needed to perfect these new technologies, these improvements will increase the speed with which products can be processed and improve the end-markets for the materials recovered.

Also, newer electronics are increasingly designed for recycling as a result of EPEAT, green design innovations by manufacturers, and EU mandates. For example, manufacturers are looking at ways to identify where toxic components are located inside products and make it easier to remove them. They are also looking for ways to mark various materials (e.g., plastics) so that they can be quickly identified and separated in the recycling process, leading to more consistent and valuable material streams. EPA recently approved a grant for the Green Electronics Council to work with recyclers to recommend design changes to an array of electronics that will facilitate faster and safer recycling.

New markets for certain materials recovered in the recycling process may be necessary to help electronics recycling succeed economically. One example is CRT glass. While CRT glass can be used in lead smelting as a fluxing agent (and there is worldwide capacity for this use), there are also markets for CRT glass in Asia to make new CRTs. As CRTs are gradually replaced by other screen technologies, these glass-to-glass markets will decline and so other leaded glass markets would be good to identify. The same will be true for LCDs and plasma screens that may be supplanted by other technologies.

It also is likely that many newer electronic products will contain less of the high value metals (precious and otherwise) that typified the earlier generations of these products. This will mean that the value to be recovered from these products will decline, unless the value of materials in electronics increases. This is particularly true of computers and TVs. Older computers, like those in the early '90s, were larger and with more copper wiring and steel casing (steel casing in the support banding of the CRT in TVs and CPUs). Now CPU casing is made primarily from plastics. Computers and TV housings are now smaller, with less metal content and snore plastics. Additionally, in some cases, copper wiring is being replaced by fiber optic.

How these two conflicting trends (lower cost of recycling vs. lower inherent value in electronics for recovery), will affect the overall cost-effectiveness of electronics recycling is hard to predict. However, as long as the costs of recycling continue to decline and the value of materials and the ability to find markets for materials that are recovered improves (as a result of better technologies for separation (e.g., plastics) and new market applications for materials that need them (e.g., CRT glass), the economic outlook for recycling of electronics should improve.

With respect to the state-of-the-art recycling methods for plastics, mercury lamps, and lead, the following describes those methodologies that are currently used:

- Recycling of mercury-containing devices, such as mercury lamps, occurs in a number of U.S. facilities. The process they follow includes recycling the glass and aluminum end caps, and recovering the mercury through retorting. The mercury is then used in the manufacture of new products.
- Lead has two primary uses in consumer electronics: (1) it is used in CRTs to prevent consumer exposure to harmful x-rays, and (2) its use in solder used in electronic circuitry.
    - State-of-the-art reuse and recycling of CRTs is (1) reuse of the CRT for its original function—that is as a video display device, (2) recycling of scrap CRT glass for the purpose of producing new CRTs in a CRT manufacturing furnace (glass to glass furnace), and (3) placement of CRTs and CRT glass in a lead smelter. In a lead smelter, not only is the lead recovered for reuse, but the glass serves as a flux that is useful to the smelting process.
    - State-of-the-art for the recycling of circuit boards is placement in a smelter to recover copper and precious metals. Depending upon the particular

smelter, the lead may also be recovered or it will remain in the smelter slag, which is land-filled.

- Plastics from electronics are also recovered and recycled, often involving hand separation of plastic types, removal of contaminants, pelletization and then use in manufacturing new plastic products. Although a great deal of research has been conducted on methods for mechanical sorting of mixed plastics, it is not clear that such methods have been perfected to the point of being viable on a commercial scale.

Q4. There have been claims in the testimony that most electronics recycling in the U.S. is collected for export to countries with less stringent environmental safety laws. Is there truth to this claim and if not where does the e-waste in other countries come from?

A4. As discussed above, most used and scrap electronics are exported for reuse or recycling abroad, either intact, or as parts or as pre-processed materials that can be used directly in the manufacture of new products. The U.S., like other developed countries, operates in a global market where much of our electronic material is recycled in other countries based on economic drivers. Thus, Western Europe, Japan, South Korea, Australia and Canada all have exports of used and scrap electronics for reuse and recycling. These exports often go to the same locations as exports from the U.S.

Used electronics are exported to many countries for the purpose of recycling, not just developing countries with less stringent environmental laws. Currently, the primary destinations for these materials are Canada, Belgium, Sweden, Japan, Mexico and various Asian countries, including China, India and Malaysia. Electronic circuitry is exported to smelters in Canada, Belgium, Sweden and Japan for copper and precious metals recovery. Materials for copper recovery are also exported to China. Plastics are largely sent to Asian recycling facilities, particularly China. Glass from cathode ray tubes is exported to Canada for lead smelting, Mexico for processing prior to shipment to Asian glass furnaces, and CRT glass furnaces in India and Malaysia. Whole used electronics are also exported for dismantling or refurbishment or remanufacturing in Canada, Mexico, and a number of Asian countries. EPA is aware that not all of these exports result in environmentally sound management. Since global markets are essential to sustainable and sound management of e-waste, the key is to continue to work towards assuring that management of e-waste is protective of human health and the environment wherever it takes place. We are committed to continuing our ongoing efforts in this regard.

Q5. Does the EPA collect statistics on recycling by individual manufacturers? Do you know what the average recycle rate of manufacturers is in the U.S. for the following products: CRT monitors, televisions, computers, car batteries, and cell phones?

A5. No, we do not have information to determine an average manufacturer recycling rate, but we do have information on the national recycling rate of select electronic products. In the U.S., computer products and TVs are recycled at a rate of approximately 18 percent. For cell phones, we have published a recycling rate of less than 20 percent, but based on recent analyses believe it closer to 10 percent.[10]

Through the Plug-In To eCycling Program, which includes electronic manufacturers and retailers, partners inform EPA of their recycling activities. Often times the recycling data that partners provide is a total summation of their voluntary recycling efforts and it is not broken down by product.

With respect to car batteries, they typically are managed in programs separate from those designed for collection of consumer electronics. In 2006, lead-acid car batteries were recycled at a rate of 99 percent.[11]

Q6. How many products require refurbishment before they can be reused? Where does refurbishment typically take place and are refurbished goods subject to, different trade standards?

A6. We are not able to say how many products require refurbishment before they can be reused. However, products which typically undergo some degree of refurbishment are those for which there is a reuse or resale market. This includes late model computers, laptops, and CRTs (either computer or TV CRTs) which can be used in

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[11] U.S. EPA. *Municipal Solid Waste Generation, Recycling and Disposal in the United States: Facts and Figures for 2006.* EPA–530–F–07–030.

new computers and TVs (typically for sale in developing countries where the market for newer monitor technologies is limited), and cell phones.

Refurbishment typically takes place at the recycler, with refurbishment of all electronic equipment being done both domestically and abroad. Refurbished or remanufactured electronic goods are not subject to trade standards (i.e., refurbishing process standards).

They are, however, subject to general FTC standards which require them to be labeled and marketed as refurbished/remanufactured to prevent deceptive practices. Consequently, electronic recyclers have developed their own individual policies for (1) what used equipment can be refurbished or remanufactured; and (2) to what level they will be refurbished (sometimes in conjunction with manufacturers and carriers).

There is a broad spectrum of recycling programs established across the United States. Recycling programs may incorporate reuse and or refurbishment to different levels. Specifically, recyclers may:

- Set no criteria, other than reuse or refurbish all collected material that has a viable resale market.
- Set minimum criteria. Criteria may be set with regard to functionality, cosmetics or age of the equipment. Companies have also set criteria based on the ability, or ease of clearing personal data. Any or all of these criteria could be part of a recyclers refurbishing policy.
- Set very strict criteria. Some manufacturers and network carriers in both the PC and cellular industry have set strict standards (called factory refurbishment standards) for what is required for use in warranty exchange. These standards address both the cosmetic and the functional condition. Industry sources state that a large percentage of cell phones that are retired when consumers upgrade to new devices are fully functional and require no repair. However, these phones would require cosmetic renewal to meet the strict warranty exchange requirements.
- Engage in no refurbishment or reuse at all. Under this model, all material goes directly to material recovery, often shredding. Some of the original electronic manufacturers have programs in this category as they express concerns with competition from used equipment and the "standards" used for refurbishing phones affecting their reputation.

Attachment A
Funding for the Design for the Environment Program

Year-by-year funding for Design for the Environment (DfE) and estimated funding for DfE electronics projects:

Enacted Budget by Fiscal Year	DfE Total Funding	Estimated Portion of DfE Funding for Electronics Rounded to the nearest $5,000
FY 1992	$2,000,000	$665,000
FY 1993	$2,000,000	$665,000
FY 1994	$2,000,000	$665,000
FY 1995	$2,000,000	$665,000
FY 1996	$2,000,000	$665,000
FY 1997	$2,182,000	$730,000
FY 1998	$2,300,000	$770,000
FY 1999	$2,625,000	$875,000
FY 2000	$2,824,000	$940,000
FY 2001	$2,898,000	$965,000
FY 2002	$2,729,000	$910,000
FY 2003	$2,565,000	$855,000
FY 2004	$2,770,000	$925,000
FY 2005	$2,537,000	$845,000
FY 2006	$2,443,000	$815,000
FY 2007	$3,383,000	$1,125,000
FY 2008	$2,416,000	$805,000

The President's budget request for fiscal years 2008 and 2009:

President's Budget by Fiscal Year	DfE Funding
FY 2008	$3,462,000
FY 2009	$3,204,000

Attachment B

List of stakeholders from the U.S. Environmental Protection Agency Design for the Environment (DfE) Partnerships

Industry

- Acer in cooperation with ITRI (Industrial Technology Research Institute)
- Agilent
- Albemarle
- Alcatel Telecom
- AlphaGary
- Alpha Metals
- Apple Computer, Inc.
- Chemtura
- Cable Components Group
- Celestica, Inc.
- Chemson
- Ciba Specialty Chemicals
- Clariant
- CommScope
- Cookson Electronics
- Corning Asahi
- Daikin America
- Dell Computer
- Delphi Delco
- Display Device Consultants
- Display Search
- The Dow Chemical Company
- DuPont
- Dynamic Details, Inc.
- Eastman Kodak Company
- Electronic Industries Alliance
- Ecolibrium
- Electrochemicals, Inc.
- Enthone-Polyclad Technologies
- Ferro Corporation
- Florida CirTech
- Fujitsu Siemens Computers
- GE Power Systems
- Georgia Gulf
- HDP User Group International, Inc. (High Density Packaging)
- HFFREC (The Halogen-Free Flame Retardants Electronics Consortium)
- Hitachi Chemical Company America, Ltd.
- HP (Hewlett-Packard Company)
- IBM
- ICL Industrial Products
- Intel
- Isola
- ITEQ Corporation
- ITI (Information Technology Industry Council)
- Judd Wire
- Lenovo
- Manitoba Corporation
- MacDermid, Inc.

- Matsushita Electronic Corporation of America
- McGean-Rohco, Inc.
- METSS Corp.
- Motorola, Inc.
- Nabaltec AG
- Nan Ya Plastics
- Nokia
- Ormet Corporation
- Panasonic
- PE International
- Phibro-Tech Inc.
- Philips Consumer Electronics
- Pitney Bowes
- Polaroid Corporation
- Princeton University Center for Energy & Environmental Studies
- PWB Interconnect Solutions, Inc.
- Raytheon Systems Co.
- Rockwell Collins
- Rockwell International Corp.
- Sematech
- Sharp Electronics Corporation
- Sony Electronics Inc.
- Southwest Technology Consultants
- Southwire Company
- Substrate Technologies Inc.
- Sud-Chemie
- Superior Essex
- Supresta
- Technic, Inc.
- Teknor Apex
- Teradyne Inc.
- Thomson Multimedia
- Tyco Printed Circuit Group, LP
- United Copper Industries
- Universal Circuits Inc.

Associations and Consortiums

- BSEF (The Bromine Science and Environmental Forum)
- Electronic Industries Alliance, IPC—Association Connecting Electronics Industries (printed circuit board trade association)
- iNEMI (International Electronics Manufacturing Initiative)
- National Electrical Manufacturers Associations (NEMA)
- Society of the Plastics Industry
- U.S. Display Consortium
- Vinyl Institute of the American Plastics Council

Environmental Groups

- Clean Production Action
- Communities for a Better Environment
- GreenBlue
- Greenpeace
- Silicon Valley Toxics Coalition

Universities and Other Organizations

- City of San Jose Environmental Services
- Contamination Studies Laboratory
- Georgia Institute of Technology Materials Science & Engineering
- Minnesota Office of Environmental Assistance
- NJ Institute of Technology
- Purdue University
- The Swedish Institute for Fibre and Polymer Research (IFP Research) in co-operation with KemI
- The SemiCycle Foundation
- Underwriter's Laboratories
- University of Massachusetts Toxics Use Reduction Institute
- University of Tennessee—Center for Clean Products and Clean Technologies
- University of Michigan School of Natural Resources & the Environment
- U.S. Navy

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