Testimony

of

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Before the

United States Congress
Committee on Science and Technology

Hearings on

Electronic Waste: Investing in Research and Innovation to Reduce, Reuse, and Recycle

Presented

10:00 am, February, 11th 2009
Rayburn House Office Building, Room 2318

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Mr. Chairman, Members of Congress thank you for the opportunity to be before you today and testify on the issue of Electronic Waste: Investing in Research and Innovation to Reuse, Reduce, and Recycle. I would especially like to thank Congresswoman Biggert for her support of my work. I have submitted my full written testimony to the committee and I will only summarize my statement at this time.

Fifteen years ago I began working with discarded computer equipment to help bridge the digital divide for at risk students in high school. I was attending a board meeting of LINK Unlimited a not-for-profit organization that supplies mentors and financial aid for capable students to attend the best schools in the City of Chicago. During the meeting I was arguing that each student needed a personal computer in their home so they could prepare adequately for college. The then Chief Financial Officer of Waste Management offered four conference rooms full of equipment that they were storing because they didn't know how to throw it away. So began my adventure of computer refurbishment and electronics recycling. When I walked into the conference rooms on that cold February morning I saw opportunity not a pile of waste. For me this is e-opportunity not e-waste. With the Chairman's indulgence I will continue to use my term e-opportunity not e-waste.

We quickly discovered that the single most complicated part of computer refurbishment was installing a fresh, reliable, and legal operating system across a broad spectrum of hardware. We worked with Microsoft for seven years and in 2000 the Microsoft Authorized Refurbisher (MAR) Program was launched. My company was one of the first five organizations that Microsoft authorized to reinstall their Windows operating system on refurbished computers in the US. Since then we have refurbished over 40,000 computers for schools, not-for-profits, and in homes of children at risk. We provide a complete system (CPU, monitor, keyboard, mouse and speakers) with an instruction booklet, free US bases telephone support and a three year hardware warranty for a starting price of $150.00. Our fist year failure rates are less than new equipments first year failure rates.

We reluctantly became involved with equipment that we could not use for our refurbishing because of the demands of our donors. If we wanted the good stuff we had to take the whole lot. While this has significantly complicated our business model it has also provided us with enormous opportunities. Early in 2000 the extra equipment was relatively easy to deal with but as more and more equipment was brought out of closets and store rooms the task became more challenging. Today a significant majority of equipment is not refurbishable for general personal computer usage. Recently a stakeholder group supported by the US Environmental Protection Agency has published "Responsible Recycling (R2) Best Management Practices for the Electronics Industry." This document is attached at the end of this testimony. These practices specify the philosophy and practice that high quality organizations should employ. I whole heartily support the implementation of these practices in certification programs like. There is some controversy that these practices do not hold organizations like mine to a high enough standard. As a practitioner of the art of e-opportunity I believe that significant research and development must be carried out before we can practically implement higher standards. This legislation is well suited to accomplish those goals.
Comments on the draft legislation:

Section 3: Definitions.

1) I would suggest that the legislation include a specific definition of "recycling" that includes reuse, refurbishment, repair, remanufacturing, material recovery, and proper disposal. I have attached to my testimony a brief concept document on "Strategies for Improving the Sustainability of E-Waste Management Systems" that may be useful in defining the above terms.

2) I would suggest that the legislation include a definition of "hazardous" and "potentially hazardous" materials. I believe that it is important to assure consumers they are not overly exposed to environmental hazards while using a computer. It is however important to educate people that improper handling may be harmful to themselves and the environment.

Section 4: Electronic Waste Engineering Research, Development, and Demonstration Projects.

Part 1) I believe that Radio Frequency Identification (RFID) should be the major way that efficiency of recycling (in all of its' forms) be studied. For over a year my organization has cataloged over 7,000 items at the Computer Collections facility that we operate for the City of Chicago on Goose Island. We keep detailed data on each item over one pound that is delivered to this permanent collection facility. There are roughly 3,000 different model numbers from over 425 different Brands. The average age of the equipment is 10.2 years old. People travel on average 6 miles to drop off their equipment. TVs average 15.5 years old while Apple Computers are two to three years older than other brands of computers. CPUs average 25 pounds and monitors average 35 pounds while TVs average 45 pounds. Automated triage with the support of RFID must be developed that fully utilize both the carbon investment of the products and increase the recovered value. (Note: over 80% of the energy used in the life cycle of a computer is used in the making of the product)

Part 2) Casual reading of the Discussion Draft in this section might lead one to believe that research should only be done on "e-opportunity" only after it has been destroyed and separated into different commodities. While I concur that much work still needs to be done on that issue there is a broader area of research that should be identified. A significant majority of the equipment being turned in by consumers and organizations is still functioning. Newer models may have come on to the markets that perform the desired tasks faster and better: *triggering the false impression that the older equipment is waste*. For instance most of the working CPUs that we receive could be cost effectively remanufactured into home energy monitoring and control devices, thus allowing consumers simple and efficient ways to take advantage of Smart Grid technology in their homes. I believe that the refurbishing and remanufacturing of e-opportunity will bring the electronics manufacturing industry back home.

Part 3) The university setting is well suited for this kind of basic materials research. I applaud the committee for it's inclusion in this legislation.

Part 4) I believe that it will be at least 15 years before all of the potentially hazardous materials will be removed from our electronic devices. In the mean time we need to develop safe methods of removing those materials both in developed and underdeveloped countries. Many well intentioned environmentalists have suggested that unwanted electronic devices that come from the US and go to developing countries should be shipped back to us for end of life processing. I would rather see safe portable processes that are applicable in many different environments.

Part 5) Product design is one of the most important issues in transforming e-opportunity into value. To that end I currently teach a graduate/undergraduate "e-opportunity" course at the University of Illinois at Urbana/Champaign. The course is housed in its' industrial design department, the oldest such program in the country. This semester we are conducting a contest, open to all students on campus, for the most creative and the most "geeky" use of e-opportunity. I would like to invite each and every Member of this committee to be a judge for this contest on April 21st of this year.

Part 6) We need scientifically sound tools that aid us in assessing the environmental impact of e-opportunity and manufacturing in order to make informed decisions about the quality of our processing and balance it against the needs to be cost effective. I am not suggesting that we diminish our goal of 100% environmental safety but rather that we use these new tools to expedite reaching those goals. Again I applaud the committee on the inclusion of this section of the legislation.

Part 7) We have not come close to exhausting our electronic devices. All too often our perception of obsolescence prematurely retires our electronics. Product design that can incorporate repairs, upgrades, etc. need to be encouraged and real business cases need to be found to support them.

Part 8) I believe that the single biggest issue confronting consumers and business in recycling their equipment is the concern about data security. People are not educated nor can they readily identify a device that has its data erased. Given that the systems turned in at our facility in Chicago are on average 10.2 years old and preliminary research has shown that people use their computers for about 6 years they must be storing them for 4 plus years. RFID can allow a complete and reliable chain of custody that can generate better consumer acceptance and therefore quicker equipment turn around. This would be a better utilization of the carbon investment made in our devices.

I also applaud the inclusion of sections 5, 6, and 7.

Please let me reiterate the following point . . . this legislation will significantly contribute to brining home the electronics manufacturing industry.

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Strategies for Improving the Sustainability of E-Waste Management Systems

Concept Document

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February, 2009

Executive Summary

Strategies for Improving the Sustainability of E-Waste Management Systems

Americans currently own nearly 3 billion electronic products and as new products are purchased, obsolete products are stored or discarded at alarming rates. About two-thirds of the electronic devices removed from service were still in working order. However, only about 15% of this material is recycled while the vast majority is disposed in landfills. The existing system for managing E-waste is generally not sustainable because mechanisms for collecting, sorting, reuse, refurbishing, repairing, and remanufacturing are not well developed and/or implemented. Problems associated with market issues, obsolescence issues, feedstock collection, feedstock management, and product-design need to be addressed. Given the complexity, uncertainty and diversity of the E-waste problem, a rigorous multidisciplinary academic approach is necessary to develop and implement systems that effectively utilize and recycle these products.

A need exists for a Center dedicated to the development and implementation of a more sustainable system for designing, producing and handling electronic devices. Specific elements of such a Center would include programs for research, education, data management and technical assistance. The Center would be formally referred to as the International Center for the Advancement of Reuse of Electronics (iCARE) and housed at the Sustainable Technology Center (ISTC) located at the University of Illinois at Urbana-Champaign (UIUC). The UIUC has a rich history of industrial leadership and the State's first in the nation "extended producer responsibility" legislation that rewards reuse of electronic products.

Specific research and education elements of iCARE would include: 1) a complete, acccurate and useful data collection and management system 2) use of "greener" raw materials and recovery of valuable constituents, 3) methods for making products that are more easily disassembled, repaired, remanufactured and reused, 4) methods for managing the complexity of recycled feedstock, 5) techniques for collection, labeling, tracking, transportation, storage, data security, 6) assessing quality of recovered feedstocks, and 7) alternative mechanisms for delivering performance (e.g. leases, service contracts, etc). Design and engineering courses would be developed regarding these topics to advance the science of E-waste management. Additionally, student projects would be developed where students design and construct useful products from E-waste.

Technical assistance activities undertaken by iCARE would include managing and maintaining a database to facilitate the tracking of dozens of parameters associated with products, components, quantities, quality, availability, value, age, materials, etc. Additionally, technical support would be provided regarding methods for E-waste collection, storage, feedstock management and data management. Seminars and training regarding best practices associated with E-waste management would help promote behavior change. All activities and products would be communicated nationwide through existing networks on pollution prevention and waste minimization.

Introduction

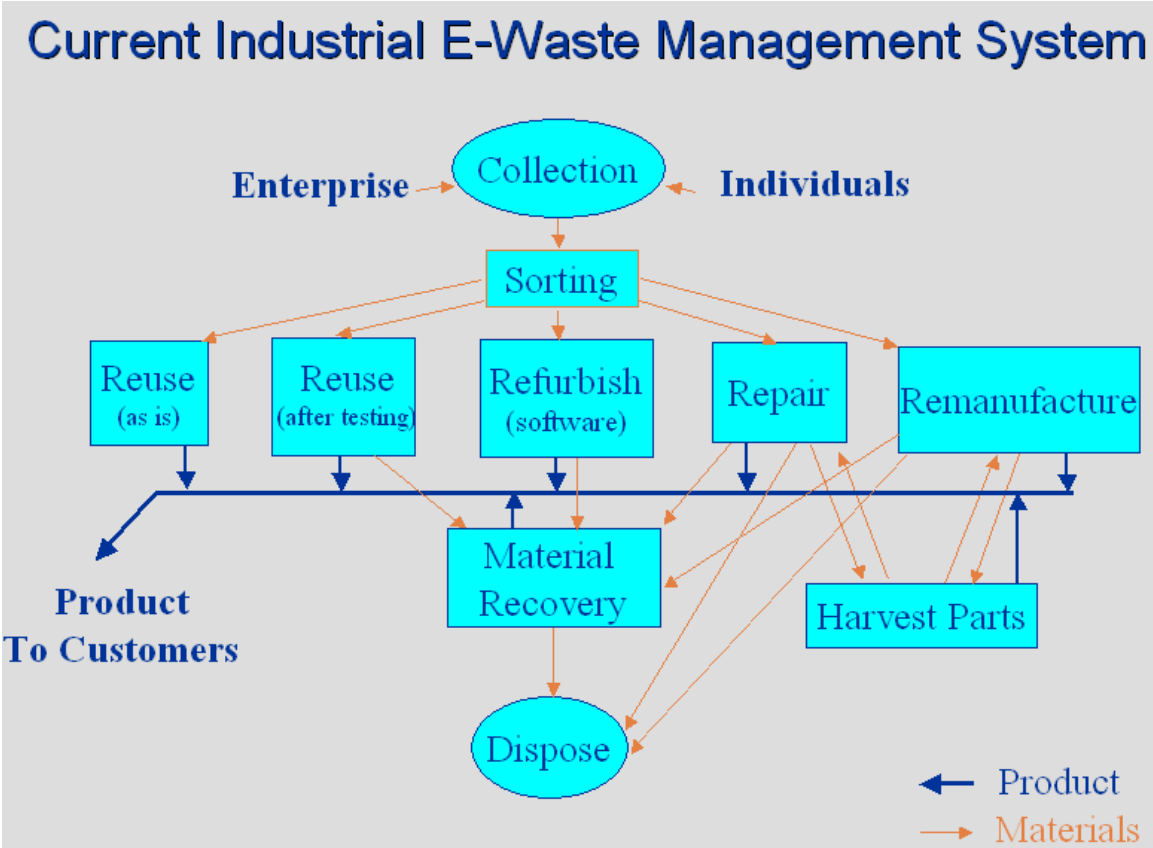
Americans currently own nearly 3 billion electronic products and as new products are purchased, obsolete products are stored or discarded at alarming rates. For instance, in 2005, the USEPA estimates that 26-37 million computers became obsolete. In addition to computers, large numbers of TVs, VCRs, cell phones, and monitors also became obsolete such that an estimated 304 million electronic devices weighing between 1.9 and 2.2 million tons were removed from U.S. households. According to Consumer Electronics Association estimates, about two-thirds of the electronic devices removed from service were still in working order. However, only about 15% of this material was recycled while the vast majority was disposed in landfills.

Electronic wastes contain toxic substances such as lead, mercury, cadmium, and lithium. These toxic materials can be released upon disposal, posing a threat to human health and the environment. Inconsistencies in worker safety and environmental protection mean potential liability concerns for those sending electronics to recycling facilities – especially if these facilities are located in developing countries. However, electronic wastes also contain precious metals such as gold, silver, which offer opportunities for economic extraction. For example, precious metals contribute well over 70% of all metals related value in cell phones, calculators and printed circuit board scraps. In other items such as TV boards, and DVD players they still contribute about 40% of the value.

Many states such as California, Maine, Washington, Minnesota, and Illinois have or are considering legislation that will require manufacturers to pay for the cost of the 'end of life' treatment of electronic products. Industry experts estimate that the cost in Illinois alone will be over $10 million each year. Nationwide, the costs could exceed $200 million. It is estimated that Dell alone could face a $1.5 million expense in 2010 for its share of the e-waste stream. Most of the products received at electronic collection sites are functional but not necessarily the latest or the greatest. The collection and management of the electronics stream is an industry that is in its infancy. Given the complexity, uncertainty and diversity of this stream, a rigorous multidisciplinary academic approach is necessary to develop and implement systems that effectively utilize and recycle these products.

The figure provided below describes the current processes available for managing E-waste. It was developed with input from an E-waste focus group convened at the University of Illinois in September of 2008. This focus group was comprised of experts from industry, government and academia. As shown, the existing process, when functioning properly, provides mechanisms for collection, sorting, reuse, refurbishing, repairing, and remanufacturing. Given that two-thirds of electronics are still in working order when they are discarded, these steps are critical for an effective E-waste management system.

Unfortunately, in most instances these mechanisms are not available for the vast majority for discarded electronics thus leading to the relatively low 15% recycle rate that currently exists.



Problems with Existing System

The University of Illinois Focus Group identified a number of deficiencies associated with existing E-waste management systems that have prevented more widespread recycling and reuse. A summary of these issues is provided below:

- Market Issues – A severe lack of "market intelligence" exists with respect to how the market values individual components. The materials are extremely complex and information regarding the availability and quality of recyclable materials is very limited.
- Obsolescence Issues – Some electronic devices have relatively short life-spans with limited opportunities for maintenance and recycling. However, many electronic products are perceived to be obsolete well before their useful life has expired due to reduced performance associated with lack of software maintenance and upgrades.

- Feedstock Collection Issues – No standardized methods currently exist for executing successful E-waste collection events. Existing methods have resulted in events that are inconvenient for potential users and the public is mostly uneducated regarding E-waste issues and the importance of recycling. Additionally, procedures for preserving the quality of harvested components have been inadequate and the economics of holding collection events have not been strong.
- Feedstock Management Issues – Labeling information on discarded electronics is limited making it difficult to accurately identify parts. The available work force tends to lack experience in part identification and training is not available regarding best practices.
- Design Issues – Many electronic devices are not designed for disassembly and maintenance. Additionally, many items are not designed for remanufacturing.

Opportunities for Developing a More Sustainable System

In addition to the problems identified above, the University of Illinois focus group also identified some potential solutions that could address the majority of these issues. Addressing these opportunities will require a combination of diverse disciplines ranging from various engineering disciplines and material science to the social sciences. A summary of these opportunities is provided below.

Research Opportunities

- Data Management - Current methods for tracking the origin, use and management of E-waste are extremely limited. EPA currently estimates the amount of electronic products sold, stored, recycled, disposed of, and exported in the U.S. using a series of assumptions and estimates based on market research data for sales and data from electronics collection programs along with some government statistics for sales. These data are usually not complete or current and are developed only for purposes of deriving national estimates. Additionally, the information is woefully inadequate for making strategic decisions regarding feedstock, market and system management. Current EPA E-waste management efforts focus on:

  1. number and weight of products that become obsolete
  2. amount of electronic products that are recycled or disposed of
  3. amount of electronic equipment that is stock-piled
  4. collection rates of current electronics recycling programs, and
  5. export of electronic material

  The development of a more sustainable E-waste management system is contingent on the quality of data available for decision making purposes. Consequently, development of a more complete, accurate and useful data collection and management system is paramount to establishing a more

sustainable E-waste management system. Examples of additional data needed to support an effective system include the following.

1. Where the waste originated/how far it traveled
2. User information (personal, commercial, industrial, etc)
3. Manufacturer name
4. Model numbers
5. Serial numbers
6. Product type (TV, monitor, CPU, etc)
7. Product age
8. Product service life
9. Reason for discarding (e.g. obsolete, damaged, software issues, etc)

This information could be combined with other pertinent databases associated with product information (e.g. model numbers could be cross-referenced with specific parts lists) and demographic information (e.g. census, Thomas Registry, etc) to create a comprehensive database that would be extremely valuable for users interested both in the quality of the products they produce, availability of reusable components, and methods for remanufacturing, reusing and recycling them.

- Materials - E-waste is well known for containing a wide range of materials that are potentially hazardous to both the environment and the people who work with E-waste. Consequently, a need exists to fully understand the potential environmental and safety impacts of E-waste components. Additionally, methods to efficiently recover valuable materials (e.g. gold and silver) from E-waste need to be developed. Also, new products need to be developed using "greener" raw materials and processes.
- Design – Development of methods for making products that are more easily disassembled, repaired, remanufactured and reused are essential to a more sustainable system.
- Feedstock Management - Methods for managing the complexity of recycled feedstock are extremely important. Techniques for collection, labeling, tracking, transportation, storage, data security, and assessing quality of feedstocks are key components of an effective system.
- Behavior Change – The public does not currently take full advantage of existing E-waste recycling opportunities. Studying the factors that influence behavior and developing methods to improve behavior are extremely important. Additionally, Most users of electronics do not need to own them – they only need the performance they provide. Development of alternative mechanisms for delivering performance (e.g. leases, service contracts, etc) could dramatically reduce waste.

Education Opportunities

- Courses – Specific design and engineering courses could be developed to advance the science of E-waste management, some ideas for course topics include:

  -Life Cycle Assessment for Electronics Manufacture, Use and Recycling
  -Environmentally Conscious Design of Electronics
  -Designing Electronics for Disassembly
  -Designing Electronics for Remanufacture

- Student Projects – Ideas for student projects with respect to E-waste are unlimited. Some project ideas that have been undertaken recently at the University of Illinois include:

  - Student competition to design and construct useful products from E-waste
  -Student competition to make a parallel computing system constructed from recycled processors
  -Student sponsored E-waste collection events

Outreach Opportunities

- Database Management – Managing and maintaining a database with relevant information regarding parameters that would be useful to electronics producers, recyclers, and users would be a key component of an E-waste outreach program. It is anticipated that dozens of parameters associated with products, components, quantities, quality, availability, value, age, materials, etc. would be tracked and maintained in the database. This information would be extremely valuable to database users and these customers would be willing to pay fees that would make the long-term viability of this activity self-sustaining.
- Technical Assistance – Technical support regarding methods for E-waste collection, storage, feedstock management and data management would be extremely important to ensure behavior change and widespread diffusion of sustainable E-waste management . Additionally, seminars and training on best practices associated with E-waste management would promote behavior change. Help associated with implementation of pilot E-waste management programs would be another key component.

International Center for the Advancement of Reuse of Electronics (iCARE)
Based on the problems and opportunities described above, a need exists for a Center to develop and implement a comprehensive strategy for sustainable E-waste management. Specific elements of such a Center would include programs for research, education, data management and technical assistance. The Center would be formally referred to as the International Center for the Advancement of Reuse of Electronics (iCARE) and housed at the Sustainable Technology Center

(ISTC) located at the University of Illinois at Urbana-Champaign (UIUC). A brief explanation of iCARE's vision, programs and functions is provided below.

Vision: A Center dedicated to the development and implementation of a more sustainable system for designing, producing and handling electronic devices.

iCARE Programs

Research	Education	Data Management	Technical Assistance
•Design	•Design	•Quality	•Awareness
•Processing	•Processing	•Performance	•Demonstrations
•Remanufacturing	•Remanufacturing	•Demographics	•Pilot Programs
•Sustainability	•Sustainability	•Marketing	•Logistics
•Life Cycle	•Life Cycle	•Compliance	•Policy
•Waste Management	•Materials	•Inventory	•Recycler Certification
•Logistics			

UIUC Qualifications

The UIUC has a rich history of industrial leadership and the State's first in the nation "extended producer responsibility" legislation that encourages reuse could be significant assets in creating the world's premier research center devoted to the reuse of electronics. The Illinois Sustainable Technology Center (ISTC) is a change agency that performs research, spreads awareness, and facilitates implementation regarding practices, technology and systems that improve sustainability. The Illinois Sustainable Technology Center (formerly the Waste Management and Research Center) has been providing these services to businesses and the public since 1985. Examples of services offered include: research to develop innovative techniques to solve waste problems, sophisticated analytical laboratory support, a library and clearinghouse on environmental and pollution prevention topics, technical assistance associated with implementation of more sustainable practices. ISTC has a long history of developing processes and solutions to minimize pollution in closely related industries such as electroplating and printed circuit board manufacturing that could be brought to bear in extracting metals from e-wastes.

ISTC has coordinated the Great Lakes Regional Pollution Prevention Roundtable (GLRPPR) since 1995. This is a professional organization dedicated to promoting information exchange and networking to pollution prevention (P2) professionals in the Great Lakes regions of the United States and Canada. GLRPPR's membership consists of assistance providers, business, industry, governmental agencies, non-profits, consultants, vendors, and universities in WI, MN, IL, IN, OH, MI, PA, NY and Ontario. GLRPPR is one of eight centers that make up the national Pollution Prevention Resource Exchange (P2Rx).

GLRPPR gives ISTC the regional and national reach to disseminate information about e-waste problems and opportunities and to exchange assistance and advice with professionals across the nation. This networking with peer organizations reduces duplication of efforts and leverages monetary and personnel resources. GLRPPR and P2Rx support technical resources through

the GLRPPR web site (www. glrppr.org), listservs, factsheets, calendars and funding information, news, information hubs devoted to specific topics, help desk for P^2 inquires, and a P^2 Library. GLRPPR's efforts also have included shepherding a portion of the national P^2 measurement database since its inception. ISTC maintains an active account on the P^2 measurement database.

The College of Engineering at UIUC is among the world's most prestigious and largest engineering institutions, with undergraduate and graduate programs rated among the top five nationally. Approximately 5,600 undergraduates and more than 2,500 graduate students are divided within 12 specialized departments. The breadth and scope of research activities are enormous--over $167 million funding more than 1,900 projects by some 650 researchers and thousands of graduate and undergraduate students. In addition to long-standing leadership in traditional engineering specialties, they are pioneering new areas such as nanotechnology, bioengineering, trusted computer systems, novel materials, and much more.

The Industrial Design program at UIUC is one of the oldest programs in the nation with an impressive list of distinguished alumni who have risen to leadership positions in the profession. The Product Innovation Research Laboratory conducts sponsored interdisciplinary research involving applied design projects linking business, technology and design resources throughout the university. There are also interdisciplinary campus-wide education and research initiatives such as the solar decathlon, solar vehicle, engineering capstone projects, and race car design. Most recently, a Sustainable E-waste design competition has been established where teams of 3-5 students work together to create innovative uses for e-Waste. These students from across campus collaborate to create new uses for e-Waste will demonstrate positive ways of dealing with the growing e-Waste problem.