Testimony of Ted Smith
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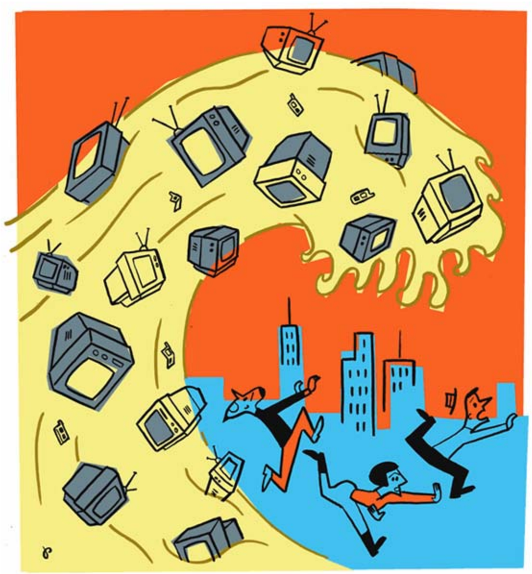
Before the House Committee on Science and Technology
Subcommittee on Research & Science Education
Subcommittee on Technology & Innovation

April 30, 2008



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, and 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 life-spans, 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%, 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 collection 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 takeback 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 takeback 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 takeback programs only take back about 10-15% of what they sold seven years ago. This is why we need legislation that actually drives them to do takeback 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 takeback legislation, these laws can't legally restrict exports. Sadly, it's perfectly legal to export toxic waste from the US 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 lifecycle 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

US 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 1800 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 US 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 approach to a lengthy list of chemicals. For more information, see http://www.cleanproduction.org/Green.Greenscreen.php.

US 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 US 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 US, 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

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

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 re-use and recyclability, including maximizing componentization and part interchangeability
4) Be designed to minimize material use per functional unit (dematerialization)
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

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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, sociopolitical 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, biodiversity, 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 appropriate. 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.

REFERENCES

Anastas, P.; Warner, J. *Green Chemistry: Theory and Practice*; Oxford University Press: London, 1998.

Anastas, P.; Zimmerman, J. "Design through the Twelve Principles of Green Engineering," *Environmental Science and Technology*, 37, 94A – 101A, 2003.

McDonough, W.; Braungart, M.; Anastas, P.T.; Zimmerman, J.B. "Applying the Principles of Green Engineering to Cradle-to-Cradle Design." *Environmental Scienceand Technology*, 37 (23): 434A-441A, 2003.

Mihelcic, J.; Ramaswami, A.; Zimmerman, J. "Integrating Developed and Developing World Knowledge into Global Discussions and Strategies for Sustainability," submitted to *Environmental Science and Technology*, 2005.

United Nations Department of Economic and Social Affairs (UNDESA), Population Division, *World Population Pojrections to 2050*, 2004.

Zimmerman, J.B.; Clarens, A. F., Skerlos, S. J.; Hayes, K. F. "Design of Emulsifier Systems for Petroleum- and Bio-based Semi-Synthetic Metalworking Fluid Stability Under Hardwater Conditions." *Environmental Science and Technology*, 37 (23): 5278-5288, 2003.

Zimmerman, J.B.; Anastas, P.T. "The 12 Principles of Green Engineering as a Foundation for Sustainability" in *Sustainability Science and Engineering: Principles*. Ed. Martin Abraham, Elsevier Science. available 2005.

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