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Mandated Recycling of Electronics

A Lose-Lose-Lose Proposition

by Dana Joel Gattuso

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Mandated Recycling of Computers: A Lose-Lose-Lose Proposition

BY DANA JOEL GATTUSO

EXECUTIVE SUMMARY

The widespread use of computers in the home and the rapid technological advancements that enable new, better, and more powerful models to roll out each year have created an enormous number of obsolete machines. The annual number of used, outdated personal computers increased from 18 million in 1997 to an estimated 61 million in 2004. Experts predict that from 2004 to the end of 2007, there will be a total 246 million home computers no longer in use.

To date, most used computers have not yet entered the waste stream. An estimated 75 percent are likely stored in people's homes in attics, garages, and basements. Fourteen percent are believed to be recycled or reused, and an even smaller amount—11 percent—is landfilled. The issue of what to do with the increasing amount of electronic waste (e-waste) is a growing concern,[1] particularly as consumer start disposing of their machines.

Exacerbating the challenge is the rapid spread of misinformation that is creating an unwarranted near-panic among policy makers who fear there is no adequate policy in place for handling the growing amount of waste. Most of these fears are based on the following false claims:

- E-waste is growing faster than the municipal waste stream, and will overtake the available landfill space.

- Toxics contained in computers and other electronics are leaking out of the landfills and poisoning our ground soil and groundwater.

- Our goal should be zero-waste to save our natural resources and protect the environment.

The swirl of hype and misinformation, coming largely from environmental activist organizations with a goal of generating nothing short of "zero waste,"[2] is creating enormous is creating enormous confusion and fear in the world of waste management policy, distracting policy makers from identifying the real problem and seeking a proper solution. Worse, misperceptions are generating misguided policies that only intensify the problem. For example, a number of states' recent rush to ban television sets and computers from municipal landfills is creating an even larger problem in deciding how to handle the growing amount of waste.

State and federal lawmakers, believing that the answer lies in recycling mandates, increasingly are embracing “extended producer responsibility” policies—which require manufacturers and retailers to take back and recycle or refurbish their used equipment—and “advanced recovery fee” approaches—which tax consumers to fund government-run e-waste collection and recycling operations. Some lawmakers are also considering “eco-design” mandates stipulating what materials manufacturers can and cannot use to ensure easier recyclability.

Mandated recycling and “green design” requirements would be disastrous. The costs are staggering and will ultimately be passed down to consumers. New design and recycle requirements will cripple technological innovation, and widespread recycling and substance bans will unleash a host of unintended environmental and health risks.

The problem of how to handle the nation’s electronic waste stream is a challenge, not a crisis. The growth in the amount of waste is expected to stabilize in just a few years. Most of it can be handled in today’s modern landfills, which are built to contain hazardous as well as non-hazardous waste safely. The remaining amount of e-waste can be managed through the continued recycling—and, more importantly, the reuse and donation—efforts of manufacturers, retailers, recyclers, and nonprofits. But for this to occur more extensively and successfully, government must get out of the way and end its regulatory barriers.

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The Home Computer Revolution

In the home, computers are becoming as commonplace as toasters. Rapid improvements in technology and design, as well as increased competition, have made home computers more affordable than ever. Only 14 years ago, 16 percent of U.S. households owned a home computer; today, more than half own at least one computer.[3]

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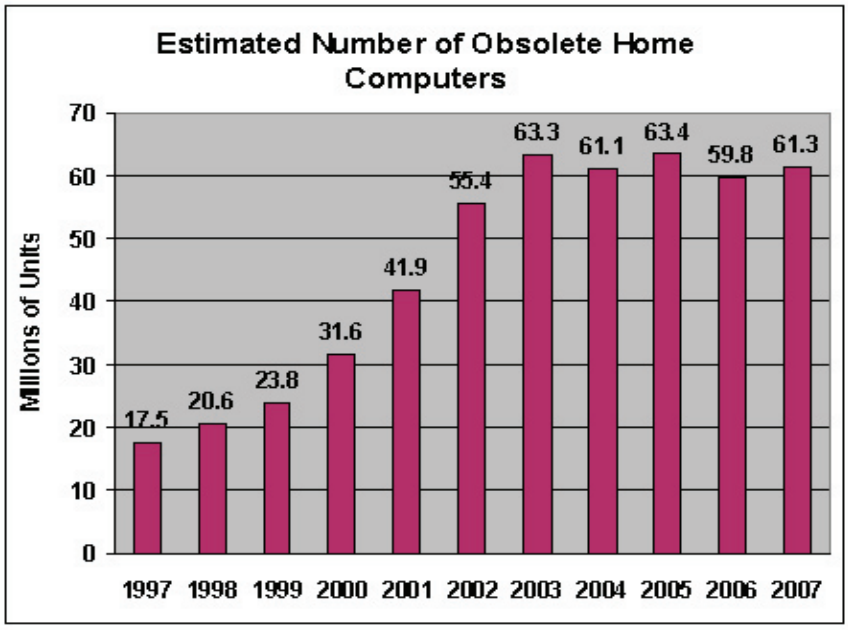
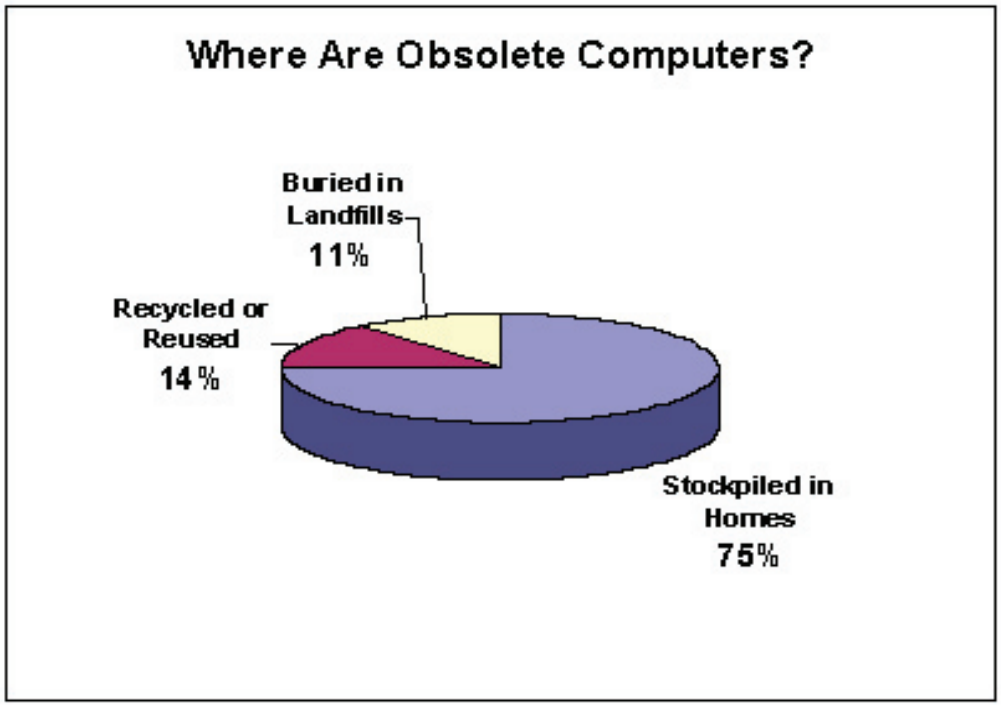
Innovation and affordability have also enabled computer manufacturers to roll out new, faster, and upgraded models at a prodigious rate. Since 1981, more than a billion personal computers have been sold worldwide—400 million of those in the United States. In 2003 alone, more than 50 million computers were sold in the U.S.[4]

A natural byproduct of the home computer revolution is the growing number of outdated computers. Between 1997 and 2003, there were an estimated 254 million obsolete computers in the U.S. Projections show another 250 million will become obsolete between 2004 and 2007, though the annual number of outdated machines is expected to level off at around 63 million by 2005, according to the National Safety Council.[5]



What is the fate of the used home computer in the U.S.? Most—an estimated 75 percent—are believed to be stockpiled in people's homes, typically in basements, attics, or garages.[6] Fourteen percent are recycled or reused.[7] And, surprisingly, only 11 percent are buried in landfills.[8]



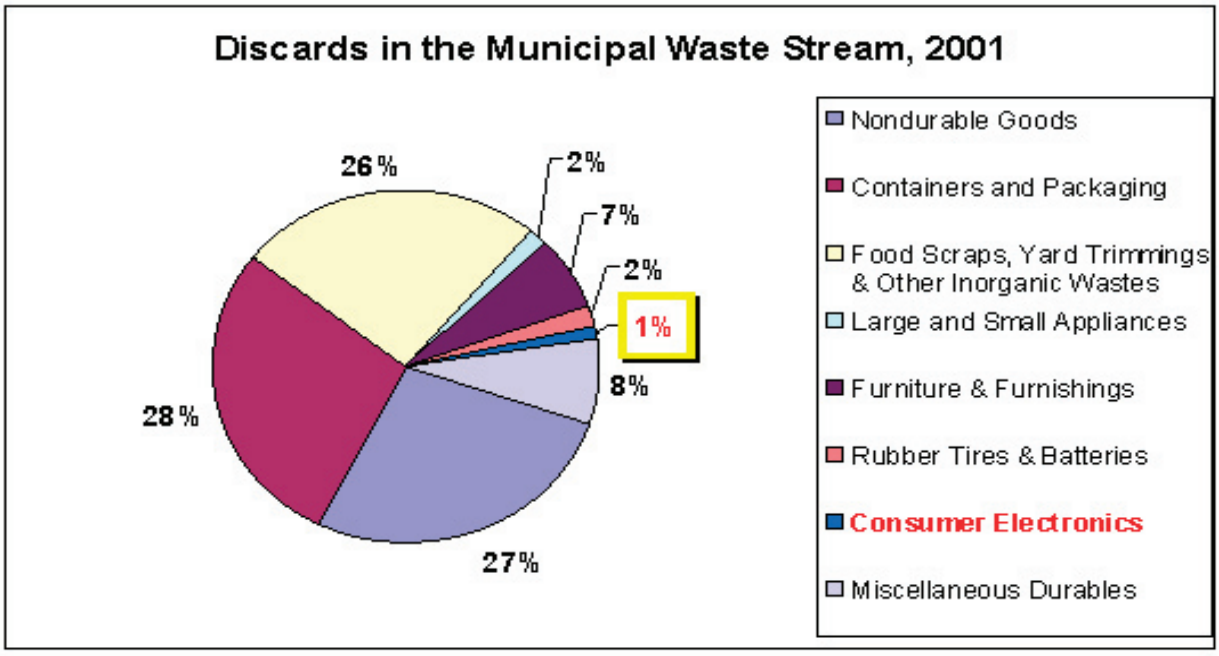
Misperceptions Fuel Fear Over E-waste

Concern over the rapid growth of used computers and what to do with them once they expire has placed the issue of how best to handle electronic waste—or "e-waste"—at the forefront of waste policy at the federal, state, and local levels. Increasingly, propaganda fueled by politically driven environmental activists[9] and a misinformed media[10] is turning concern into hysteria. Fears are largely based on the following myths:

Electronic waste is growing at a rapid and uncontrollable rate and is the fastest growing portion of the municipal waste stream. While the amount of e-waste has been increasing, it remains a tiny percent of the total municipal solid waste stream. According to the Environmental Protection Agency (EPA), e-waste—including discarded TVs, VCRs, DVD players, and audio systems, as well as personal computers, fax machines, and printers—constituted only 1 percent of the total municipal solid waste stream in 1999, the first year EPA calculated electronics discards.[11] Data for

2001 again showed electronic devices had not increased as a percent of total municipal waste but remained at 1 percent.[12]

Nor is e-waste growing at a rapid rate. National Safety Council (NSC) data show that the number of discarded computers will level off by 2005 at 63 million, and will then begin to decline.[13] While improved technology can quickly make machines obsolete, it can also extend the lifespan of the next generation of computers. More powerful microchips will soon provide machines with much greater capacity.



Source: EPA, *Municipal Solid Waste in the United States: 2001 Facts and Figures*, p. 70.

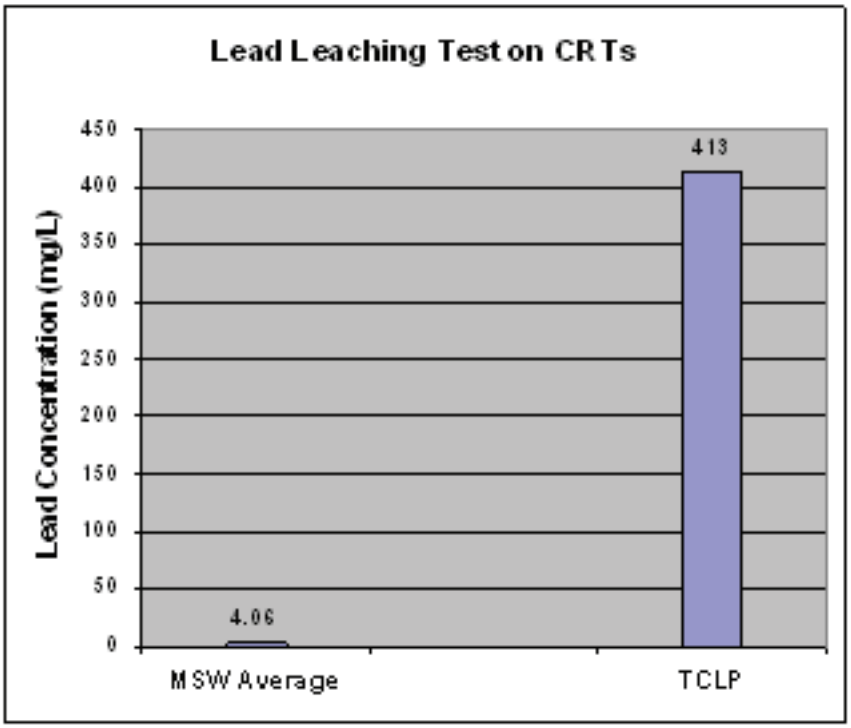
Computers buried in landfills endanger public health because they contain toxic materials such as lead, cadmium, and mercury that can leak out into the soil and groundwater. Cathode ray tubes (CRTs), the most common type of computer display monitor,[14] typically contain four pounds of lead[15] to protect users from the tubes' x-rays, the same way a lead vest protects patients who have x-rays. Because lead is a health risk at high exposure levels,[16] many lawmakers are rushing to ban display monitors and other electronics from municipal landfills, fearing that the lead and other toxic metals can leak out into the ground soil. Overwhelmingly, lawmakers and the popular press point to the work of Timothy Townsend, Associate Professor of Environmental Engineering Sciences at the University of Florida and a leading expert on solid waste, who has been studying for over six years

the potential for lead to leak out —or "leach"— from computer monitors, TVs, and other electronic components into the ground soil.

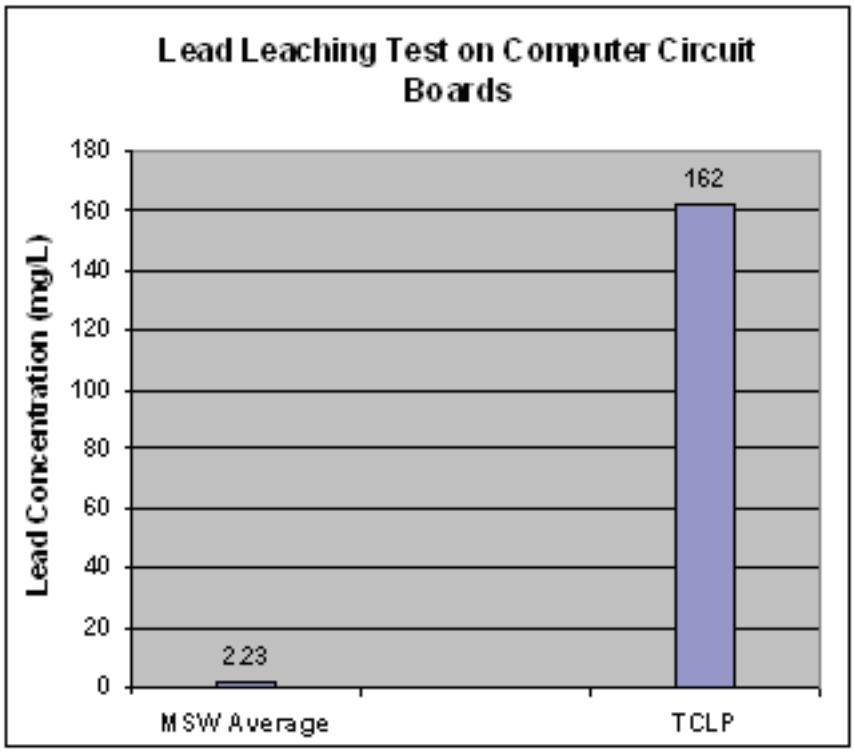
...the EPA's leaching procedure tests do not mimic what actually occurs in landfills...

But incredibly, the media has only reported on Townsend's earlier research using the questionable Toxicity Characteristic Leaching Procedure test, a method used by the EPA that attempts to simulate the conditions of a landfill under a worst-case lab test by soaking tiny samples of e-waste in an acid solution and testing their levels of toxicity. Townsend himself concluded in his 1999 report that although his tests showed that 21 of 30 color monitors failed the EPA-defined regulatory limit,[17] the EPA's leaching procedure tests do not mimic what actually occurs in landfills,[18] and "the authors do not attempt to draw conclusions beyond [the specific results of the lab test] in regard to the implications of the lead leaching from CRTs."[19] He also wrote: "The fact that the [EPA's] TCLP test may not represent the true condition of CRTs upon disposal was not an issue of discussion in this research;"[20] and "the leachate concentrations measured [by the EPA lab test method] may not accurately reflect the concentrations observed under typical landfill conditions."[21] Yet newspaper write-ups following the study's release reported only the dangers of lead from electronic monitors in landfills and triggered a panic among many policymakers and lawmakers calling for a ban of all CRTs from landfills.[22]

Recognizing the EPA test's potential inadequacy in replicating landfill conditions, Townsend and his colleague Yong-Chul Jang conducted a new test in 2003, using 11 actual landfills containing electronic waste and other municipal waste and debris. Specifically, they tested soil from landfills containing waste from color TV and computer monitors, shown in his previous EPA lab tests to leach the highest levels of lead.[23] They also tested soil containing waste from home computer circuit boards, which also contain lead. Comparing the landfills' concentrations of heavy metals in the ground-soil waste—called "leachate"— with levels from the earlier EPA lab test, Townsend found concentrations of lead from the landfilled computer monitor leachate to average only 4.1 milligrams per liter (mg/L)—that's less than 1 percent of what the laboratory studies suggested would be the case (lab tests suggested the monitors would leak 413 mg/L of lead in leachate).



Similarly, he found only 2.2 mg/L of lead in landfill leachate from computer circuit boards —a little more than one percent of the 162 mg estimated in lab tests.



Hence, it is highly likely that actual landfill releases of these heavy metals are far lower than EPA estimates. These differences are far from minimal. As Townsend concludes: "For those state and local governmental agencies wrestling with whether to ban discarded electronics from landfills, the results of this work suggest that lead leaching from [computer circuit boards] and [TV and computer monitors] will be less than might be estimated using EPA's TCLP results."[25] Even more importantly, concentrations from his landfill samples were comfortably below EPA's standards of 5.0 mg/L. Yet it is important to note that these materials would not even enter the environment, since landfill operators collect and dispose of it in a safe manner.

...the sophisticated engineering and monitoring of today's modern municipal landfills, governed by stringent state and federal regulations and performance standards, prevents lead and other heavy metals from leaching.

Townsend is further researching leachate and waste settlement from actual landfills. His current study—due to be completed later this year—involves constructing landfills and filling them with simulated municipal solid waste containing e-waste.[26] But on the overall question of whether e-waste leaches in landfills, Townsend says "there is no compelling evidence."[27]

Other recent studies confirm that lead and other metals contained in landfills are safely contained. A year-long study by the Solid Waste Association of North America (SWANA) Applied Research Foundation, released in March 2004, concludes that heavy toxic metals, including lead, do not pose an existing or future health threat in municipal solid waste landfills. The foundation reviewed existing research and concluded that landfills' natural conditions, such as precipitation and absorption, provide chemical reactions and interactions that prevent heavy metals from dissolving into the soil. They concluded that out of 130,200 tons of heavy metals placed in municipal landfills in 2000 from electronics, batteries, thermometers, and pigments, almost all—98 percent—was lead. Cadmium and mercury made up the remaining amount. According to the authors, "The study presents extensive data that show that heavy metal concentrations in leachate and landfill gas are generally far below the limits that have been established to protect human health and the environment."[28] The report was peer reviewed by an independent panel of researchers in the field, including Timothy Townsend. Oddly, neither this report nor Townsend's recent research comparing EPA lab tests' leachate with actual landfill leachate was ever reported by the general media.

Even if the natural conditions that prevent leaching did not occur, the sophisticated engineering and monitoring of today's modern municipal landfills, governed by stringent state and federal regulations and performance standards, prevents lead and other heavy metals from leaching. MSW landfills are constructed with thick layers of clay and thick, puncture-resistant liners that keep waste from coming into contact with soil and groundwater. Also, landfills today are constructed with a leachate collection system—a system of pipes that carries any excess leachate out of the landfill and into a separate leachate collection pond where it is then tested and treated. In addition, landfills are

surrounded by groundwater monitoring stations which capture samples of groundwater and continuously test for any possible leaks.[29]

In summary, there is no scientific evidence that substances from e-waste present a discernable risk to human health or the environment when disposed of in municipal landfills.[30] Yet widespread fear that lead and other metals in landfills can leach and present a health hazard has provoked lawmakers in a handful of states—California, Maine, Massachusetts, and Minnesota—to ban desktop display monitors from landfills; another half a dozen have pending legislation.[31]

Ironically, the problem is not so much electronic waste itself, but what to do with the enormous quantities of e-waste if lawmakers choose to ban it from landfills. Furthermore, lead and other compounds are considered by some experts to be safer when contained in landfills than during the recycling process when they become exposed.[32] Finally, the cost difference is astronomical. Where a ton of e-waste can cost $500 to recycle, it costs only $40 to landfill.[33]

The U.S. computer recycling market simply isn't big enough to handle the large amount of e-waste increasingly banned from municipal landfills.

Exporting e-waste to developing countries exposes those countries to hazardous waste and toxics, forcing them to choose between "poverty and poison." In 2002, the environmental advocacy groups Basel Action Network and Silicon Valley Toxics Coalition released a scathing study on the methods and conditions of e-waste recovery in developing countries, claiming widespread abuse and mishandling of the toxic components of e-waste. According to the report, *Exporting Harm: The High-Tech Trashing of Asia*, 50 to 80 percent of e-waste collected in the United States for recycling is exported to developing countries.[34] The groups' investigators—who traveled to China, India, and Pakistan—reported that the misuse of e-waste is polluting the environment and "very likely…seriously harming human health."

The paper's sensationalistic rhetoric—for example, "free trade in hazardous waste leaves the poorer peoples of the world with an untenable choice between poverty and poison;" and "the export of e-waste remains a dirty little secret of the high tech revolution"[35]— ignited a nationwide campaign to ban further exports and to force manufacturers to take back and recycle their products. Yet no one questioned the report's findings, particularly whether the extreme conditions it described were prevalent throughout Asia.

Ironically, the thousands of tons of computers and other electronics shipped out of the United States to developing countries is the direct result of the rush to ban desktops and other electronics from landfills in this country. The U.S. computer recycling market simply isn't big enough to handle the large amount of e-waste increasingly banned from municipal landfills. That's

not the case in developing countries where markets for electronic components and recyclables thrive due to the large demand for labor. Whereas the cost to recycle a home computer in the U.S. is $20, it only costs $4 in developing countries such as India. [36] And for the workers in these poor countries, it can mean the difference between making a living or remaining unemployed.

Perceived Problem Creates Damaging Objectives and Laws

The widely exaggerated and, in some cases, bogus assumptions concerning the dangers of used computers are creating widespread panic among policy makers who view the issue of e-waste as a desperate and uncontrollable situation. Moreover, these fears are driving perverse and harmful policy objectives in a frantic attempt to solve a non-existent crisis.

Policy makers, in the mistaken belief that recycling is the answer, increasingly are considering mandatory "take back" and/or recycling laws—that is, shifting the responsibility for waste back to the producer to recycle the waste—accompanied by "green design" mandates. Policy makers assume that requiring manufacturers to take back and recycle used products will create incentives for them to make more "eco-friendly" products.

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This idea is an outgrowth of two concepts pushed by eco-activists: "product stewardship" and "extended producer responsibility." These policies hold that because natural resources are limited, measures must be taken to conserve those resources and that the best method is to hold the manufacturer responsible for the waste he produces.[37] Further, it assumes the producer should be made to "internalize" environmental "external" costs so he will be motivated to minimize pollution, and that a pricing mechanism for the product will emerge that incorporates that universal cost. "Take-back" and mandated recycling laws are the direct result of the "producer responsibility" concept.

Most laws and regulations holding manufacturers responsible are not based on any real, identifiable environmental problem.[38] Rather, they are a development of the "precautionary principle," a belief system also pushed by the environmental movement that holds if there is even a potential for an environmental risk, then measures must be taken to prevent that risk from ever occurring. One of the biggest problems with the "precautionary principle" is that it fails to consider tradeoffs—environmental, health, and economic.[39]

Lawmakers throughout Europe and parts of Asia have widely adopted "extended producer responsibility" laws, particularly in an attempt to control waste from paper and packaging, tires, automobiles, batteries, some appliances, and, most recently, electronics.[40] But studies analyzing the impact of these efforts show that these mandated recycling programs carry huge risks to both human health and the environment. Furthermore, consumers bear the burden

of paying for these costly programs that compromise product quality and reliability by impeding innovation.

The Green Dot Experience

Germany's Green Dot program, which operates under that country's Extended Producer Responsibility law—the world's longest-running mandated recycling system—illustrates how well these mandates actually perform, particularly when compared to countries that do not have regulations. Enacted in 1991, Germany's law requires manufacturers and retailers to collect merchandise packaging end-waste from consumers, and arrange and pay for it to be recycled. Germany's goal has been to reduce the economic burden of waste collection for municipal governments, increase the amount of recycling, and—to a lesser extent—minimize waste. Green Dot, named for the "green dot" logo placed on all packaging to be picked up and recycled, is the name of the system operated by a consortium of manufacturers to have package waste collected, transported, and recycled.[41]

Research shows that while Germany did eventually reach its waste reduction targets, it came at an enormously high cost. According to a 1997 OECD report's estimate, the cost to collect and recycle package waste in 1994 was $404 per ton. Given that Germany produced 4.7 million tons of package material in 1994, the program cost the country $2 billion for that year. By comparison, a 1999 study of local recycling programs in the United States by the Institute for Local Self-Reliance found that, while unit costs varied among the communities, the highest cost was $161 per ton.[42]

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In terms of performance, Germany's waste reduction rates were not as high as those in the United States, where no mandated recycling program existed. Canada, which had a voluntary package waste disposal program, achieved its goal four years earlier than scheduled and at a lower cost than Germany; and the Netherlands, which also operated under a voluntary system, achieved greater reductions in packaging materials than in Germany.[43]

The European Union's WEEE and RoHS Directives

The most far-reaching proposal to regulate e-waste is the European Union's (EU) Waste Electrical and Electronic Equipment (WEEE) directive, which went into effect in August 2004. WEEE requires all 15 member nations to implement programs requiring manufacturers or retailers of electronics and their importers to take full responsibility for the end-life of electrical and electronic equipment. Specifically, producers must implement and finance the take-back and recycling of used electronics,[44] including those manufactured in the past, by August 2005. The regulations are sweeping, applying to all large and small household appliances, information and telecommunications equipment, including PCs, TVs and audio equipment,

lighting, electronic tools, toys, and others.[45] Recovery and recycling "target" rates vary depending on the appliance, with computers targeted at 75 percent recovery rate and 65 percent recycling rate.[46]

For "historical" products—those placed on the market before August 2005—manufacturers are required to share in the costs of collection and recycling, in proportion to their share of the market.[47]

The directive also requires that substances used in electronics that are considered to be hazardous be segregated from the recycling stream and treated separately. In addition, a companion directive to WEEE, the Restriction of the Use of Certain Hazardous Substances (RoHS), mandates heavy metals to be phased out and banned altogether, and replaced with "substitutes" by July 2006. The ban would apply specifically to lead,[48] mercury, cadmium, and haxavalent chromium. Brominated flame retardants, which are routinely applied to plastic components in TVs and computer equipment to protect against fire, would also be banned.[49]

The EU's e-waste recycling directive will have a debilitating effect on hundreds of thousands of manufacturers and importers who will be forced to shift much of their human and monetary capital from product manufacturing.

Monetary costs. It is difficult to know exactly how much the EU's recycling directive will cost. The EU puts the total annual cost for all 15 member states at €500 ($610) million to €900 ($1,100) million.[50] But this is low by other estimates. Orgalime, a European federation of national industry associations representing electrical and electronic manufacturing engineers, estimates the total cost per year at €62.5 ($76) billion. This includes €40 ($49) billion a year to handle historical waste, another €7.5 ($9) billion to handle new equipment waste, and €15 ($18) billion in technological changes to meet the requirements of banned materials.[51] In Great Britain alone, the UK Department of Trade and Industry estimates the directives will cost British manufacturers £600 million ($1.1 billion) a year.[52]

The EU's e-waste recycling directive will have a debilitating effect on hundreds of thousands of manufacturers and importers who will be forced to shift much of their human and monetary capital from product manufacturing to recycling and "demanufacturing." While the burden on all manufacturers will be substantial, a heavy and disproportionate share will fall on small businesses throughout Europe, including manufacturers, importers, and retailers. These small operations simply don't have the financial resources or the infrastructure needed to establish take-back programs of the magnitude required under the directive. The number of small businesses estimated to go out of business by the regulations is not yet known, but is expected to be substantial.[53]

Almost all experts agree that the consumer ultimately will shoulder most of the cost. Gartner Inc., a British technology analysis company, estimates that, by 2005, the selling price of a PC in Europe will likely increase by $50

due to the EU's recycling directive and another $10 due to the designated substances ban.[54]

Environmental costs. In addition to high monetary costs, the EU directives also impose costs on the environment—without yielding any clear environmental benefits. In fact, the EU fails to make a strong case for why the directives are needed; that is, what the specific problem is with current practice, and what actual environmental benefits will result from the costly regulations. As the British Department of Trade notes in its Consultation Paper on the directive, the regulations' objectives do not make any reference to assumed environmental benefits as an outcome.[55]

...the final directive ...never provides any conclusive evidence that current waste disposal practices are an environmental or human health threat.

While the final directive does identify environmental protection as its objective—"to preserve, protect and improve the quality of the environment, protect human health and utilize natural resources prudently and rationally" and "to reduce the quantity of waste for disposal and saving natural resources"—it never provides any conclusive evidence that current waste disposal practices are an environmental or human health threat.[56] Rather, it implies it is justified based on the need to adopt the "precautionary principle" and "sustainable development."

Nor are the directives' costs and tradeoffs ever considered.[57] The following are just some of their likely risks and costs to the environment and to human health:

- **The recovery and recycling of electronics emit air, water, and solid waste pollution.** According to a study conducted by the UK's Department of Trade and Industry, the recycling directive will worsen environmental impacts for some products, particularly TV and computer monitors. For example, the required increase in recycling and recovery for displays is estimated to increase greenhouse gas emissions by 29 percent and air acidification by 18 percent due to the greater amounts of energy required for recycling.[58] As the department concluded, "For certain items, [the directive] may not be the best practicable environmental option."[59] These estimates do not include other contributors to greenhouse gas emissions, including the hundreds of miles every electric and electronic item will travel to be dismantled, plus possible further travel for recycling.

  These findings are consistent with other studies that find that government-forced recycling generally does not produce a net environmental benefit and, in most cases, consumes more resources than landfilling.[60]

- **The directives prevent the adoption of new, cleaner technologies.** Technological advancements generally tend to promote cleaner, more environmentally friendly methods of production and

disposal. The directives' strict regulations on product design will keep manufacturers from being able to utilize new, cleaner technologies— a problem that will increase over time as the directives fail to keep up with innovations in product design.

- **WEEE presents environmental risks from stockpiling, similar to the UK's "fridge fiasco."** A large concern throughout Europe, particularly in the UK, is the issue of how to handle the millions of discarded products that must be collected, transported, and treated for recycling. Without a proper market to handle the castoffs, stockpiling of end-life electrical and electronic products could present a serious environmental and health threat if not contained in some manner.

The UK witnessed this crisis in the aftermath of a 1998 EU directive requiring the removal of chlorofluorocarbons (CFCs) from used refrigerators and freezers. When the regulations went into effect in January 2002, no facility existed to handle the waste. Within weeks, fridges started to pile up throughout the UK, prompting Prime Minister Tony Blair to order the local authorities to set up emergency centers to handle what was referred to as the "multi-million-pound fiasco." An estimated 6,500 abandoned fridges piled up daily—2.4 million annually—costing taxpayers up to £75 million ($138 million) to handle.[61] There was no system in place to handle the appliances, and it was not uncommon to see fridges dumped along the highway.

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Some government officials fear that if the UK was unable to deal with the mere treatment of fridges' insulation foam, European nations will not be able to handle the enormous number of discarded products under the EU's electrical and electronics regulations requiring complete dismantling and recycling. According to one official of Great Britain's Environment Agency, "Fridges are just one tiny party of the WEEE directive—if we think we have problems now then we ain't seen nothing yet."[62]

- **Substitute metals and flame retardants carry serious environmental and human safety risks.** Like the recycling directive, the EU's directive to ban "certain hazardous" substances lacks justification on the basis of either sound science or risk analysis.[63] There is no proven health or environmental risk to the current handling of Europe's electronics' substances. Nor are there known safe and effective substitutes. In most cases, the alternative compounds work less effectively and carry their own environmental or health risks.

The lead-free requirement is one example. Despite media hype on the dangers of lead leaching from landfills, there is no conclusive evidence that the lead used in electronics presents environmental or health risks. Lead is a crucial substance used in numerous electronics. In computers, it is

used not only in display monitors to protect users from x-rays, but also in solders, metal alloys that attach other metal components to printed circuit boards. No other substitutes to lead-based solders are as effective or as efficient, largely because of lead's characteristics that enable it to melt at relatively low temperatures during the soldering process. Substitute metals typically require temperatures 20 to 35 degrees Celsius higher than lead to melt properly, which requires greater energy consumption.[64] The UK's Department of Trade and Industry estimates that substituting lead-free alloys with a combination tin-silver-copper alloy, the leading lead-free alternative, will increase energy usage anywhere from 6 to 18 percent.[65]

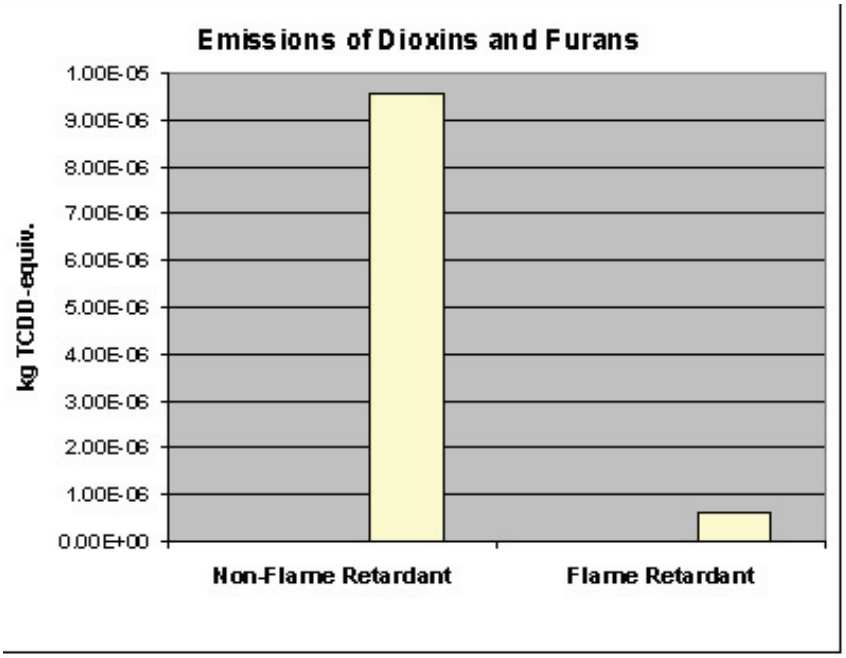
A number of recent studies show that there is no known substitute to lead-based solders that is preferable in terms of both environmental impact and human safety. One study conducted at the University of Stuttgart compares the environmental impact of lead substitutes with lead-based solders during the manufacturing process. Its findings show that environmental impacts—including carbon dioxide emissions, acidification, human toxicity, and ozone depletion—are all significantly higher for substitutes currently being considered when compared to lead-based alloys. Environmental impact was particularly high for the favored lead-free alternative, the tin-silver-copper combination.[66]

Ironically, five years ago, the EU's own science advisory committee on toxicity and the environment rejected a Danish government proposal to ban the use of lead from all products manufactured in the country. Among the science panel's findings: "no attention is given to any adverse impact which could occur in humans or to the environment from the introduction of substitutes for lead."[67]

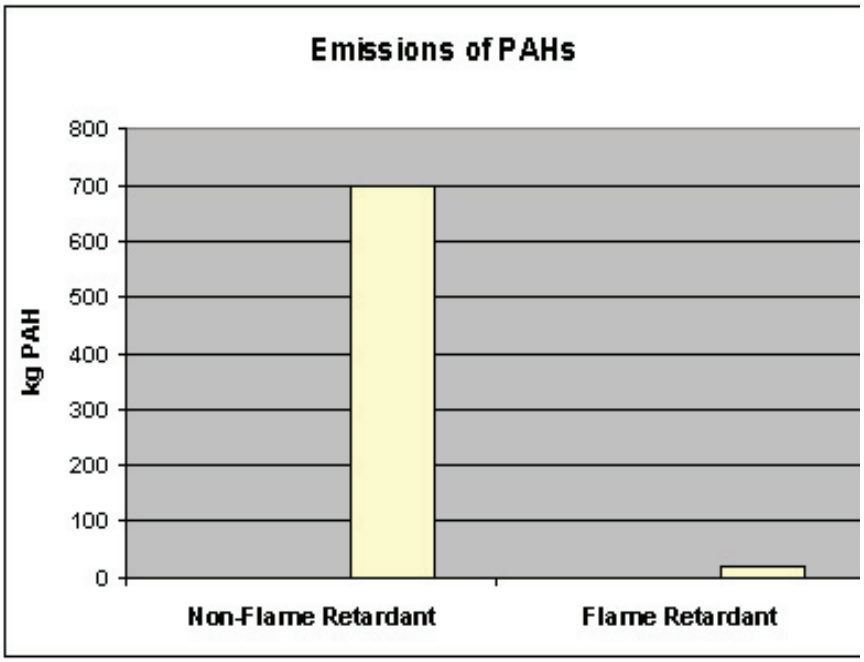
Brominated flame retardants, crucial chemicals applied to plastics used in electronics to ensure against fire provide another example. In particular, decabromodiphenylehter (deca-bde), used in plastic casings on TV sets and computer monitors, faces a potential ban due to allegations by environmental groups that during the recycling process, the flame retardants release dioxins and furans into the air.[68] Yet the European Union's own 10-year risk assessment released in the spring of 2004 shows there is "no identifiable" risk from the chemical and no justification for applying the "precautionary principle" to ban its use.[69] The findings are consistent with previous studies on deca-bde by the National Academy of Sciences,[70] the World Health Organization,[71] and the U.S. Consumer Product Safety Commission[72] that also conclude the compound presents no significant risk.

In fact, according to a growing body of research, the risks to human health and the environment are far greater in the absence of brominated flame retardants due to the increased chance of fire. A study by the Swedish National Testing and Research Institute compared the outbreak of fires in TV sets in Europe, where restrictions in the use of deca-bde has already greatly limited its use on TVs produced and sold in Europe, to those manufactured in the United States, where there were no limits to its use at the time of the study.[73] Using conservative estimates, the study found that 16 people die each year from TV fires in Europe, while in the U.S. there is no record of fatalities from TV fires.[74]

The study also found that in Europe, which already enforces severe restrictions on the flame retardant's usage on TVs, there are 165 TV fires per million TVs each year; in the U.S., where the flame retardant is used to comply with a higher fire resistant standard, there were five fires per million TVs. The researchers also compared the energy use and emissions generated through the typical product life cycle of non-flame-retardant TVs with flame-retardant. The results showed the emissions of dioxins and furans, and polycyclic aromatic hydrocarbons to be dramatically higher for TVs that were not flame-retardant. This effect resulted from the significantly higher probability of fire outbreak.[75]



Note: The emission of the TCDD-equivalents, a weighted sum of dioxins and furans, for 106 TV set over their 10-year life cycle.



Note: The emission of Polycyclic Aromatic Hydrocarbons to the air for 106 TV sets over their 10-year life cycle.

Inferior products. The sweeping regulations will impede improvements in product design and hamper current design methods that optimize product performance. Also, as stated before regarding the substance ban directive, there are no known substitute compounds that work as effectively as those targeted for elimination. For example, the high temperatures needed to properly melt lead-free alternatives for soldering can cause defects in other parts that aren't able to withstand extreme heat. In most cases, problems are not easily detected during production.[76] Another serious problem with tin is the development of "whiskers"—tiny strands of tin that form as a result of too much moisture—which can spread along a circuit board, causing short-out failures. Other known substitutes, including zinc, copper, and bismuth, fail to provide a strong enough solder joint, essential to a circuit board's operation. These metals consistently fail stress tests, and are generally "identified as a potential reliability concern."[77] Ironically, product failure triggered by these eco-design restrictions can shorten the life of the product and increase the number entering the waste stream.

In summary, there is no scientific justification for the sweeping EU directives to mandate recycling, require eco-design standards, and ban key components of electrical and electronic equipment. The regulations are not derived from sound science or risk analysis, but are based on fears of unproven risk, dictated by the "precautionary principle." The requirements will be costly and, most experts agree, will be passed down to the consumer. Furthermore, the directives will create their own set of health

and environmental risks and will compromise the reliability of electronic products. Yet the benefits are unknown and uncertain.

E-Waste Legislation Advances in the United States

In 2000, Massachusetts became the first state to ban CRTs from municipal landfills. To address the handling of the new waste stream, state officials believed that providing municipalities with grants for e-waste collection and handling would provide the local governments with enough incentives and rewards to handle the growing waste.[78] But it didn't happen that way. Localities simply have not been able to tackle the growing stream of waste in a cost-effective manner. States have gradually switched approaches from the carrot to the stick—going from giving localities grants to do the service to directly taxing consumers and requiring municipalities, manufacturers, and retailers to work together to collect and recycle or refurbish used electronics.

During the 2003-2004 legislative session, more than half the states proposed legislation to introduce, in some manner, the recycling of e-waste.[79] Eleven states introduced legislation to impose a statewide "advanced recovery fee" on consumers' purchase of CRTs to fund local or state government collection and recycling programs. Six states introduced legislation requiring retailers or manufacturers to set up collection points for discarded electronics, and four states introduced legislation mandating both take-back and recycling of e-waste.[80]

E-Waste Legislation Introduced in 2003-2004 Sessions*

Establish Committee to Study E-Waste	CRT Ban from Landfills	Advanced Recovery Fee Imposed	Take-back and/or Recycling Mandate	Phase-out of Certain Substances
Hawaii	California	California	Illinois	California
Idaho	Maine	Connecticut	Maine	Maine
Maryland	Maryland	Florida	Maryland	New York
Michigan	Massachusetts	Illinois	Massachusetts	
Minnesota	Michigan	Maine	Minnesota	
New Hampshire	Minnesota	Maryland	New York	
New Mexico	Nebraska	Nebraska	Pennsylvania	
New Jersey	New York	New York	Rhode Island	
Oregon	Oregon	North Carolina	Vermont	
Rhode Island	Pennsylvania	Oregon	Washington	
Washington	Vermont	South Carolina		
	Virginia			
	Washington			

* States that enacted legislation are highlighted in yellow.

State legislation on e-waste primarily has been a response to the following:

1) Misplaced fears that landfills will fail to contain the waste's toxics and/or fears that landfills are not large enough or plentiful enough to contain the growing number of discarded computers and electronics;

2) Laws in a growing number of states that ban computer monitors and TVs from landfills, creating the overwhelming problem of what to do with the large amount of waste;

3) Shortage of funds available to finance local governments' collection and recycling or recovery services, leading to the concept of "shared responsibility."

California: The advanced recovery fee. In 2003, California enacted the nation's first statewide e-waste recycling legislation. The law requires consumers purchasing a new computer or TV to pay an advanced recovery fee of $6 to $10 to finance municipal collections and recycling of used computers and TVs, and outlaws the sale of computers that don't meet European manufacturing specifications. The new law came about largely as a response to local governments' struggle to handle the growing mounds of computers and TVs that have been banned from California's municipal landfills since 2001.

The law also bans by 2007 the use of most heavy metals, and requires manufacturers before that time to report on all efforts to phase out those substances and design-for-recycling efforts. Manufacturers must also follow new product specifications and labeling requirements aimed at making recycling easier.

Consumers will bear most of the burden—a double tax consisting of the cost of the manufacturers' mandates that ultimately will be passed down to the consumer and the cost of the advanced recovery fee. And, while the $10 fee may not seem excessive, it is not likely to stay at the current level for long. The fee falls considerably short of the current cost of recycling a TV or desktop display—$20 to $25 per unit—though government officials believe that cost will go down once the program is in full swing.[81]

But some advocates for mandated take-back and recycling laws already are claiming the California law does not go far enough,[82] and that the fee should be raised from $10 to $60 per product to fully cover recycling costs.[83] In practice, there is actually no limit to how high the fee could be raised. Starting in 2005, the California Integrated Waste Management Board, the agency charged with administering the program, is required to evaluate the fee once every two years and to raise it if revenues are insufficient to fund

the statewide collection and recycling program. Further, given the state's severe budget shortfall, it's not unlikely that funds earmarked for the recycling fund could be tapped for other budget needs.

The requirements to phase out lead, mercury, cadmium, haxavalent chromium, and PBDEs by 2007 impose the same environmental and human safety risks as Europe's substance ban directive, and finding safe, effective, and permissible substitutes will pose a significant challenge. Regarding the lead ban, for example, there are no realistic alternatives since potential substitutes like the silver and/or tin compound combinations are also heavily regulated under California's non-hazardous environmental laws.[84]

Overall, the California law will be a costly initiative for the state's taxpayers and computer users, will undermine the computer industry, and will greatly diminish the functionality and performance of the home computer. The benefits are unclear. Even assuming collection and recycling is a worthwhile goal, it is hard to understand how the law creates incentives for consumers to turn in their used products.

The requirements to phase out lead, mercury, cadmium, haxavalent chromium, and PBDEs by 2007 impose the same environmental and human safety risks as Europe's substance ban directive.

Maine: Mandated take-back and recycling. Maine's law, the most draconian in the United States, is the first in the nation to require manufacturers to take back and recycle their e-waste. Starting January 1, 2006, manufacturers must arrange to have their used computers picked up from residences and safely recycled at an acceptable recycling plant. Before 2006, municipalities are responsible for pick-up and recycling costs.[85]

Maine lawmakers say these requirements will put the right kind of pressure on manufacturers to make computers that are easier to recycle since they are now responsible for taking them apart. But manufacturers respond that they have no control since most of the units that will be returned in the next few years were built over a decade ago.[86]

Maine also requires the phase-out and eventual ban of lead, mercury, cadmium, haxavalent chromium, and brominated flame retardants from electronics—specifically, the flame retardants known as penta- and octa-PBDE starting in 2006, and deca-PBDE beginning 2008.[87] Again, the lack of any scientific justification, or any effective substitute to the flame resistant, makes this an extremely dangerous precedent.

Virginia: "Encouraging" take-back and recycling. Rather than force manufacturers to collect and recycle products or impose a mandatory fee at the point of purchase, Virginia uses a softer approach. The state Waste Management Board is required by a law enacted in 2003, to "promulgate regulations to encourage" electronics recycling. The law also allows jurisdictions in the state to refuse to discard TVs or monitors in privately run landfills, as long as

that jurisdiction operates a recycling program capable of handling all TVs and monitors.[88]

While Virginia's carrot approach to give consumers the option of disposing their computer for a fee is far less authoritarian than California and Maine's approach, it is still less ideal than simply getting government out of the way and allowing manufacturers to voluntarily handle the waste, as many producers already are doing (see next section). The waste fees, though discretionary for consumers, are still arbitrarily determined and therefore not likely to cover the full costs of recycling. Because it's a state-run program, overrun costs will ultimately be passed down to the taxpayer.

The federal level. To date, most of the legislative activity regulating e-waste has been at the state level. There have been a few bills introduced in Congress but, fortunately, none have advanced.

In 2003, Rep. Mike Thompson (D-Calif.) introduced the National Computer Recycling Act (H.R. 1165), which would place an advanced recovery fee of up to $10 on consumer purchases of desktops, notebook computers, and monitors to finance "a national infrastructure for the recycling of used computers" and an EPA grant program for local governments and private organizations that promote collection, reuse, or recycling of electronic waste. Interestingly, the Act would require EPA to submit, immediately following the bill's passage, a study to Congress identifying "waste materials in used computers that may be hazardous to human health or the environment"—but nowhere does it request any information or study on risks associated with these materials in landfills.[89] The legislation was reintroduced January 2005.

While Virginia's carrot approach... is far less authoritarian than California and Maine's approach, it is still less ideal than simply getting government out of the way[.]

More recently, U.S. Reps. Randy Cunningham (R-Calif.) and Eric Cantor (R-Va.) introduced legislation to provide tax credits to manufacturers who recycle electronic equipment "in an environmentally sound and responsible manner."[90]

In the executive branch, officials generally support a federal mandated recycling program, believing that a national approach is preferable to 50 different approaches at the state level. Most recently, the Department of Commerce's Technology Administration has been holding roundtable discussions with industry and government representatives to discuss possible options. Among the policy options discussed are an advanced recycling fee like California's or collection and recycling mandates on manufacturers like Maine's.[91]

There is no scientific justification for recycling mandates or for government-administered fees to fund recycling programs for electronics, whether at the state or federal level. These regulations would impose enormous costs on consumers, negate industry's voluntary recycling and

recovery efforts already well underway, and unleash harmful unintended risks similar to those Europe now faces due to the EU directive.

Voluntary Initiatives Versus Government Mandates

Manufacturers Operate their own Take-back and Recycling Programs

Long before EPA launched its e-waste recycling campaign and before some states began mandating recycling, a number of electronics manufacturers were already running their own recycling programs. These early efforts were geared toward collecting and recovering systems from business customers. More recently, manufacturers have begun to set up programs to address e-waste in the home. Today, almost all manufacturers have in place some sort of a system to collect and recycle their used products.

At a time when state and local governments are struggling to fund electronic waste recycling efforts—and financing these efforts on the backs of taxpayers and/or consumers—manufacturers are voluntarily running their own collection and recycling programs, providing a service to their customers, and competing with other players in the market.

Today, almost all manufacturers have in place some sort of a system to collect and recycle their used products.

Round Rock, Texas-based Dell, the world's second largest computer manufacturer, has been operating its own computer take-back and recycling program since 1991. The program, called Asset Recovery Services, provides Dell's business customers with the option of reselling used computer systems and recovering the value of the equipment or recycling the systems if they no longer have value. Dell also provides businesses with the option of leasing computer equipment, which ensures the computer systems will be returned to the manufacturer at the end of their use.[92]

In 2002, Dell expanded its recycling services to include used computers from residences. For $15 a unit, Dell will pick up a used computer of any brand. The company will arrange to have it either recycled or donated through the National Cristina Foundation, a nonprofit charity organization that provides used computers to disadvantaged children and adults. Dell will also give customers rebates for trading in a used computer for a new one.[93]

Through these promotions, as well as a national recycling tour that enabled 9,000 residents in 17 cities to bring their used computers to a designated location, Dell collected a record 35 million pounds of computer waste during its fiscal year 2004. Dell has set a goal to increase the amount collected in weight by 50 percent next year.[94]

Palo Alto, California-based Hewlett-Packard (HP), the world's biggest computer manufacturer, recycles and refurbishes its used machines in-house, running one of the largest recycling plants in the world. According to HP,

the company has recycled more than 500 million pounds of electronic waste since its recycling program started in 1987.[95] Each year, HP reports, it collects about 80 million pounds of used products a year. During its fiscal year 2004, HP recycled 42 million pounds—an annual increase of 3 million pounds—and pledges to reach 1 billion pounds of recovered or recycled waste by 2007.[96] Like Dell, HP will take back computers from any manufacturer, not just HP. The company charges anywhere from $13 to $34 per unit, depending on the type of equipment.[97]

Gateway, based in San Diego, pays its customers for their old computers. Purchasers of new systems receive a $50 rebate for trading in the old one. According to Gateway's executives, "It's a win-win. It drives sales for us, and it takes PCs out of the basements and storerooms."[98]

Manufacturers Have Flexibility, Creativity That Government Efforts Lack

The nation's leading computer and electronics manufacturers, by running their own recycling programs ... now know how best and most effectively to take them apart.

The nation's leading computer and electronics manufacturers, by running their own recycling programs for some time now, have developed skills beyond designing and constructing new computers: They now know how best and most effectively to take them apart. No two take-back and recycling programs are the same. Companies are testing and devising methods that best work for them, their contractors, and their customers.

Furthermore, because companies are in the driver's seat, they are continuously looking for ways to improve their recycling and reuse programs, making it easier for customers to return used products, and finding ways to collect and break down the used equipment more cost-effectively. As Dell Sustainable Business Director Pat Nathan told *The Dallas Morning News*, Dell is looking to "analyze data from suppliers and customers to develop more efficient recycling methods, eventually recycling computers at a lower cost than its competitors can and offering customers a lower price."[99] Over time, these companies are learning how to cut costs. As a result, the collection fees that manufacturers charge consumers have remained constant or even declined[100]—with some companies like Dell, Gateway, and HP providing customers with rebates for trading in used computers.

By contrast, local governments attempting to operate electronic collection and recycle services for residents are struggling, prompting states to enact fee programs to come to their rescue. But even the fees, which have risen on average by 40 to 100 percent since 2001, are failing to cover the costs.[101]

Some argue that these recycling and reuse efforts by the private sector do not even come close to addressing the millions of obsolete electronics that are entering the waste stream each year. Yet this argument fails to acknowledge the enormous achievements the industry has made in

a relatively short time. Last year, Dell, HP, and IBM collectively recycled 160 million pounds of computers and computer equipment. This figure doesn't include the number of units remanufactured for donations and reuse.

If the growing trend is for government to impose its own set of rules on how manufacturers should build and take apart electronics, producers and recyclers will be forced to abandon what works for them and follow a new set of rules. A burgeoning private marketplace of creative ideas and innovations, where producers compete to provide the best collection service at the lowest possible cost to the customer, will be replaced by a government bureaucracy that has no particular incentive—or ability—to keep costs down.

If the growing trend is for government to impose its own set of rules on how manufacturers should build and take apart electronics, producers and recyclers will be forced to abandon what works for them[.]

The Right Solution

What's the Problem?

Before we consider a possible solution, we first have to identify the problem. Despite panic over the e-waste "crisis," the real problem with obsolete computers and electronics seems to depend on who you ask. As Resources for the Future resident scholar Margaret Walls writes, "In discussions about policies directed at electronic waste, one often finds that participants have different views on policy objectives—i.e. different views on exactly which environmental problems…should be the focus of policy."[102]

For example, some policy makers' concerns center around the rapid increase in the amount of discarded electronics—fears that waste is growing at an uncontrollable rate and that we are running out of landfill space. A related concern is how local and state governments are going to handle the increasing number of discards. Others worry about the lead used in CRTs and fear that it and other heavy metals are not safely contained in landfills. Most media reports play off public fears of lead and other toxics seeping into the ground soil and drinking water.

EPA officials, however, assert that our municipal landfills safely contain the lead, mercury, and other metals. Their concern is over the issue of sustainability, troubled that we are not addressing the environmental impacts of these products and the natural resources they consume throughout their life cycle.[103] Similarly, environmental pressure groups argue that the growing amount of electronic waste reflects the ills of a "throw-away" society, and that the recycling of all electronics is our moral obligation in helping to achieve "zero waste tolerance."

This is consistent with the observation—noted in the section in this report on the European Union's new laws—that the directives never specifically articulate an environmental problem but state that the objective is to save natural resources. As Jacques Fonteyne of the European Recovery and Recycling Organization in Brussels, notes, "The debate has been

inappropriately centered on the idea that the aim of EU waste policy should be 'to maximize recycling.' We argue that the aim should be 'to minimize the environmental impact.'"[104] These are two very different policy goals that require very different policy actions.

The confusion and inability to reach a consensus on identifying the problem is not surprising given the amount of baseless facts and misinformation flying around about e-waste. Lawmakers are responding to a lot of conflicting information without knowing if used electronics truly pose a problem and if so, what the actual problem is.

Policy makers have a responsibility to look hard at the evidence on computer and electronic waste and determine if there is a real problem. If a problem is identified, it is crucial to know if the solution can be achieved without unleashing problems of its own. The types of policy decisions now being debated—and in some cases, enacted—have been shortsighted. These new laws carry extremely high costs, and their consequences carry their own health and environmental risks, as has been discussed throughout this report.

Increasing amount of waste? It is true that the number of obsolete electronics is growing and will continue to grow as new and improved systems replace the old and systems now gathering dust in attics and basements enter the waste stream. But the growing quantity of waste is not an insurmountable problem. The same data on increasing quantities of e-waste cited by environmental activists also show that the annual number of obsolete computers will peak *this year*—at 63.4 million units.[105]

Lawmakers are responding to a lot of conflicting information without knowing if used electronics truly pose a problem and if so, what the actual problem is.

Contrary to popular belief, landfill capacity in the United States is plentiful. A single 120-foot-deep, 44-square-mile landfill could accommodate the United States' garbage for the next 1,000 years—that's less than one-tenth of 1 percent of the land in the U.S.[106] Furthermore, landfill capacity is not diminishing but remains fairly constant, according to the EPA.[107] While many landfills have been closing due to stringent federal regulations, these represent only 8 percent of all capacity. New landfills are on average 25 times larger than the older landfills they are replacing.[108]

Landfill limitations are primarily due to political constraints, not physical ones. As archaeologist and anthropologist William Rathje, the author of *Rubbish! The Archaeology of Garbage*, wrote in *Smithsonian* magazine, "The United States has plenty of space for solid waste disposal for centuries to come; the political decision of which particular spaces to use is the problem."[109] Finally, a ton of waste costs only $40 to landfill, another indication of the abundance of landfill space, compared to a staggering $500 to recycle.[110]

Safety of landfills? Without question, computer and TV monitors containing lead, cadmium, mercury, and other hazardous materials should

be handled with care. But, given the modern design, required piping systems to carry out leachate, and extensive monitoring system of today's landfills, there is no reason to believe that landfills are ill-equipped to handle hazardous materials in e-waste. In fact, some experts believe recycling computers and TVs carry far greater health and environmental risks due to emissions from lead smelters in the recycling process, "compared to the small likelihood that a [computer monitor] would ever leach lead in a…lined landfill."[111]

Another important consideration for policy makers is the fact that cathode ray tube monitors are gradually being replaced throughout the world by liquid crystal display (LCD) panels, which are far more energy efficient and contain fewer toxic components. Dell estimates that the company has saved 100 million pounds of lead by transitioning from CRTs to flat-panel displays,[112] (though some flat-panels contain small amounts of mercury in the fluorescent backlighting that help make them more energy efficient).

Are we truly using up our natural resources and ruining our environment? To be sure, our natural resources are not infinite. But we are in no danger of even coming close to depleting them and probably never will. Glass, for example, one of the key materials used to build a computer monitor, is largely made from sand, a finite material, and yet we are not likely to run out of it. Moreover, what is infinite is our ability to uncover new resources through innovation and advanced technologies. One only needs to look at the falling prices of desktop computers and other electronics to see that we are in no danger of running out of the raw materials that go into producing these products.

...a ton of waste costs only $40 to landfill, another indication of the abundance of landfill space, compared to a staggering $500 to recycle.

Modernization and a strong economy also enable us to conserve resources and reduce our impact on the environment. An increasing standard of living enables us to innovate and improve the use of our natural resources. Again, liquid crystal display technology's ongoing displacement of CRTs is one example. LCDs overall leave less of an imprint on the environment than cathode ray tubes because they use fewer materials, conserve more energy, and have a longer lifespan. They are an outcome of private sector ingenuity, not government mandates. Another example is the rapid development of new, more powerful computer chips that will expand computers' memory capacity and potentially extend the life of the home computer. These sorts of developments are much less likely to happen if manufacturers are burdened with take-back and recycle mandates.

Even if we believe that we are using up natural resources and destroying the environment through consumption, we still need to ask if mandated recycling and bans on heavy metals are the way to go. The answer is still no. Evidence shows these regulations are not likely to produce a net environmental benefit. As discussed earlier, recycling carries its own environmental costs. Consider, for example, the transport of e-waste. For every mile traveled, a

truck emits diesel particles, carbon monoxide, organic compounds, oxides of nitrogen, and rubber particles. As Chris Hendrickson, chairman of civil and environmental engineering and co-director of the Green Design Initiative at Carnegie Mellon University observes, one of the problems with "green design" is that there is no clear consensus of the goals to be pursued. A danger is that we "direct all attention to a particular environmental problem…and ignore other environmental effects."[113]

Even if we believe that we are using up natural resources and destroying the environment through consumption, we still need to ask if mandated recycling and bans on heavy metals are the way to go. The answer is still no.

Furthermore, the narrow focus on recycling undermines more worthy and efficient methods of disposal, such as reuse efforts. Nonprofit and community groups throughout the country—and the world, for that matter—are running operations to refurbish and distribute used computers to disadvantaged businesses, public schools, and low-income families that otherwise would not have access to computers. In addition to aiding underprivileged segments of the population, reuse is also more efficient than recycling. CompuMentor, a San Francisco- based nonprofit organization that provides technological education and assistance to community organizations, reports that adding several years to the life of a computer by donating it is five to 20 times more energy efficient than recycling. CompuMentor estimates reuse options could easily meet current demand for 28 million computers.[114] Demand beyond the United States, including developing nations, would bring those numbers much higher. But the growing emphasis on recycling, no matter the costs, will reduce the implementation of other options, including reuse.

Recommendations

1. State and federal policy makers should abandon efforts to mandate take-back and/or recycling of electronics. There is no e-waste predicament that warrants this costly and problematic approach. Landfill capacity is plentiful, and there is no evidence that landfills fail to keep e-waste leachate safely contained. Natural resources are far from limited, and our ability to maintain a clean environment depends on our ability as a nation to innovate and improve technology, not impede it.

Recycling unleashes its own set of human and environmental trade-offs, and there is no evidence that it produces a net benefit to the environment over landfilling. As Germany's Green Dot experience shows, recycling costs were extremely high while waste reduction rates were lower than in countries that did not mandate recycling.

Even if recycling were a worthwhile goal, it would be next to impossible to implement. The number of disassembling and recycling

plants in the United States that have the necessary capacity and know-how to handle all future e-waste does not exist.[115]

2. State and federal policy makers should abandon efforts to impose an advanced recovery fee. Some policy makers believe that, rather than imposing mandates on manufacturers, the best policy option is for local governments to collect the discards and arrange to have them reused or recycled. This approach relies on financing through an advanced recovery fee administered by the state—or federal[116]—government on new purchases of electronics.

If extended throughout the United States, an advanced recovery fee on televisions and computer monitors is estimated to cost taxpayers anywhere from $7.5 billion to $45 billion, according to the Silicon Valley Toxics Coalition.[117]And there is no way to prevent the likelihood that a fund allocated for recycling expenditures would be raided for other government expenditures, a concern noted even by supporters of the fee.[118]

The number of disassembling and recycling plants in the United States that have the necessary capacity and know-how to handle all future e-waste does not exist.

Furthermore, this costly option would negate the successful efforts of manufacturers who have successfully—and more economically than have government efforts—operated their own collection and recycling programs. The growing track record of the nation's leading manufacturers and retailers, who have developed their own proven methods for how best to collect, finance, and reuse or recycle electronic discards, illustrates the private sector's capability, creativity, and knowledge in this area, particularly compared to that of the public sector.

3. State and federal policy makers should abandon efforts to ban the use of heavy metals, fire retardants, and other substances. There is no scientific justification for banning lead, mercury, cadmium, or brominated flame retardants. Furthermore, because the bans are not based on any proper risk assessment study, they fail to account for the unintended health and environmental risks of using substitutes. The most serious health risk to banning brominated flame retardants, for example, is the potential for fire ignition, since there are no known substitutes that are as effective in fire prevention.

In fact, some of the substitutes currently being tested, such as the preferred tin-silver-copper substitute, are problematic since these metals—in this case, silver—are also heavily regulated in this country under Superfund and RCRA. Therefore, they may not provide any more regulatory relief than those currently targeted for elimination under the European Union's directive and California's new law.[119] The same is true for finding permissible substitutes to brominated flame retardants. The United States' flammability standards are much harsher than Europe's, and there are currently no known substitutes to BFRs that would meet U.S. fire

safety requirements. Would the United States then adopt less stringent fire safety standards?[120]

Like the other mandates, fees, or restrictions discussed in this report, the bans would end up costing consumers billions of dollars for no known benefits. The transition to lead-free solders, for example, would end up costing computer users tens of billions of dollars for the cost of substitute materials throughout the supply chain, according to the National Center for Manufacturing Sciences.[121]

Finally, the lack of effective known substitutes will diminish the performance capability, reliability, and in some cases, the capacity of the new "green" machine. This could well decrease the average lifespan of the product and result in the generation of more, not less, waste.

Like the other mandates, fees, or restrictions discussed in this report, the bans would end up costing consumers billions of dollars for no known benefits.

Conclusion

Government—at the state and federal levels—should get out of the recycling business altogether. Government fees, mandates, and regulations only create barriers to private efforts to find successful ways to recycle and reuse electronics. Much of the waste can and is being handled by manufacturers, retailers, recyclers, and nonprofits, but these efforts will only succeed and grow if government gets out of the way. The remaining amount of waste can and should be placed in landfills designed, built, and regulated to handle hazardous waste far more toxic than that which is found in e-waste.

Notes

[1] Electronic waste generally refers to PCs, TVs, VCRs, DVDs, camcorders and other cameras, cell phones, office equipment, and other information and telecommunications equipment. Most of this study specifically addresses home computers, given the particularly strong policy concerns, issues, and controversies centered around the end-life of PCs.
[2] See the Silicon Valley Toxics Coalition, http://www.svtc.org/cleancc/erit.htm.
[3] U.S. Census Bureau, *Statistical Abstract of the United States*, edition 1995, No. 1233, "Appliances Used by Households: 1990," p. 739; and edition 2003, No. 1159, "Households with Computers and Internet Access: 1998 and 2001," p. 736.
[4]Jim Lynch, CompuMentor, *Islands in the Wastestream* (San Francisco, CA), Fall 2004, p. 7.
[5] National Safety Council, *Electronic Product Recovery and Recycling Baseline Report: Recycling of Selected Electronic Products in the United States* (Washington, D.C.), May 1999, p. 29.
[6] Phone interview with Clare Lindsay, Project Director, Extended Product Responsibility, Office of Solid Waste, EPA, March 22, 2004.
[7] National Safety Council, *op. cit.*, p. 28.
[8] Clare Lindsay, *op. cit.*
[9] Consider statements like this made on the web site of the California-based Silicon Valley Toxics Coalition: "high-tech development…harms people's health as well as the environment that sustains all life." See http://www.svtc.org/hightech_prod/index.html.
[10] For example, articles abound with titles like "Killer Computers: The Growing Problem of E-waste." (Morgan O'Rourke, *Risk Management Magazine*, October 1, 2004.)
[11] EPA, Office of Solid Waste and Emergency Response, *Municipal Solid Waste in the United States: 1999 Facts and Figures*, EPA 530-R-01-014, July 2001, p. 11, http://www.epa.gov/epaoswer/non-hw/muncpl/mswfinal.pdf.
[12] EPA, *Municipal Solid Waste in the United States: 2001 Facts and Figures*, EPA530-R-03-011, October 2003, pp. 70**,** 163-4.
[13] National Safety Council, *op. cit.*, p. 29.
[14] Though liquid crystal display (LCD) technology—flat panel displays—are coming down in price and are gradually replacing CRTs in the marketplace. LCDs do not contain lead, though they do contain a fairly small portion of mercury.
[15] EPA, *Electronics: A New Opportunity for Waste Prevention, Reuse, and Recycling*, EPA 530-F-01-006, June 2001, at http://www.epa.gov/epaoswer/osw/elec_fs.pdf.
[16] For a good discussion on public health issues concerning lead exposure, see J.M. Schoenung, O.A. Ogunseitan, J-D Saphores, and A.A. Shapiro, *Industrial Ecology of Lead in Electronics: Perspectives on Legislation, Materials Engineering and Environmental Management,* (manuscript under review at MIT, *Journal of Industrial Ecology,* submitted July 2003). Also, Angela Logomasini, "Regulation of Lead Releases," *Mid-term Report Card: Bush Administration's Environmental Policy*, Eds. Bruce Yandle and Jane S. Shaw, PERC, January 2003, p. 90.
[17] In this research, 36 CRTs were tested for toxicity using the TCLP. Under this "over-conservative" approach (see Yong-Chul Jand and Timothy G. Townsend, "Leaching of Lead from Computer Printed Wire Boards and Cathode Ray Tubes by Municipal Solid Waste Landfill Leachates," *Environmental Science & Technology*, Vol. 37, No. 20, 2003, p. 4784) where tiny samples of leachate—or e-waste—are soaked in an acid solution intended to simulate the biological decomposition of a landfill and then tested for toxicity, 21 of the 30 color monitors failed the EPA-defined lead limit. None of the 6 non-color CRTs failed. Timothy Townsend, Stephen Musson, Yong-Chul Jang, and Il-Hyun Chung, *Characterization of Lead Leachability from Cathode Ray Tubes Using the Toxicity Characteristic Leaching Procedure*, State

University System of Florida, Florida Center for Solid and Hazardous Waste Management, Report #99-5, December 1999.

[18] This information is not new. In fact, EPA's own Science Advisory Board concluded in 1999 that there were problems with the TCLP test in simulating conditions of a landfill and that "the TCLP may be inappropriate" in its broad application by regulators and industry. See EPA, Science Advisory Board, *Waste Leachability: The Need for Review of Current Agency Procedures*, EPA-SAB-EEC-COM-99-002, February 26, 1999.

[19] Timothy Townsend, Stephen Musson, Yong-Chul Jang, and Il-Hyun Chung, *Characterization of Lead Leachability from Cathode Ray Tubes Using the Toxicity Characteristic Leaching Procedure*, State University System of Florida, Florida Center for Solid and Hazardous Waste Management, Report #99-5, December 1999, p. 16

[20] *Ibid.*

[21] Yong-Chul Jang and Timothy G. Townsend, "Leaching of Lead from Computer Printed Wire Boards and Cathode Ray Tubes by Municipal Solid Waste Landfill Leachates," *Environmental Science & Technology*, Vol. 37, No. 20, 2003, p. 4778.

[22] Articles such as this one on Townsend's research are typical: "Inside the computer monitor staring back from your desk, and behind the blue glare of your living room television, lurks an environmental hazard. It's the cathode ray tubes. They contain lead, a toxin mixed into (the computer)." See Neil Santaniello, "PC Monitors, TVs May Hold Peril of Lead: Recycling Tops Possible Answers to Tubes' Disposal," South Florida *Sun-Sentinel*, December 19, 1999.

[23] Jang and Townsend, *op. cit.*, pp. 4778-84.

[24] *Ibid*, p. 4780.

[25] *Ibid*, p. 4784.

[26] See Timothy G. Townsend web site, "Simulated Landfill Lysimeters for Evaluating Leachate Quality," at http://www.ees.ufl.edu/homepp/townsend/Research/Lysimeters/default.asp.

[27] Chaz Miller, "Poison PCs" *Waste Age*, September 1, 2003, at http://www.wasteage.com/mag/waste_poison_pcs.

[28] Solid Waste Association of North America, Press Release, "MSW Landfills Effectively Control the Release of Heavy Metals," March 9, 2004, at http://www.swana.org/sections/press/pr_viewdetail.aspx?pressId=96.

[29] See Craig C. Freudenrich, "How Landfills Work," How Stuff Works, http://people.howstuffworks.com/landfill.htm/printable. Also, see Clark Akatiff, *Is this Ban Really Necessary?: A Critical Investigation of the CRT Ban*, City of Palo Alto, May 2002, http://www.westp2net.org/archive/Is%20this%20ban%20necessary%20CRT%20.doc.

[30] EPA officials back the claim that landfills do not pose a threat. Their concerns are not over landfills' ability to contain waste but on sustainability issues and electronics' lifecycle footprint on the environment. Phone interview with Clare Lindsay, Project Director, Extended Product Responsibility, Office of Solid Waste, EPA, March 22, 2004; and EPA, Office of Inspector General, *Evaluation Report: Multiple Actions Taken To Address Electronic Waste, But EPA Needs To Provide Clear National Direction*, Report. No. 2004-P-00028, September 1, 2004, p. 30.

[31] National Caucus of Environmental Legislators, "Introduced and Enacted PBDE Legislation, 2003-2004,"As of June 28, 2004 (Bethesda, MD). At www.ncel.net.

[32] Northeast Recycling Council (NERC), *Setting Up & Operating Electronics Recycling/Reuse Programs: A Manual for Municipalities & Counties* (Brattleboro, Vermont), March 2002, p. 3.

[33] Valerie Hubbard, "Off the Desk and Into the Bin," *Richmond Times Dispatch*, September 13, 2004.

[34] The Basel Action Network and Silicon Valley Toxics Coalition, *Exporting Harm: The High-Tech Trashing of Asia*, February 25, 2002.

[35] *Ibid.*

[36] "NGO Sounds E-waste Alert," *The Times of India Online*, March 13, 2004.

[37] The international Organization for Economic Co-operation and Development (OECD), at its Waste Minimization Workshop held in Washington, D.C. in 1995, laid out the principles of EPR to be the following: "Producers of products should bear a significant degree of responsibility (physical and/or financial) not only for the environmental impacts of their products downstream from the treatment and/or disposal of the product, but also for their upstream activities inherent in the selection of materials and in the design of products." OECD *Extended Producer*

Responsibility: A Guidance Manual for Governments, Paris, France, 2001, pp. 21-22, at http://www1.oecd.org/publications/e-book/9701041e.pdf.

[38] "There is no widespread consensus or agreement on the particular goals to be pursued by green design." Chris Hendrickson, Noellette Conway-Schempf, Lester Lave, and Francis McMichael, "Introduction to Green Design," Green Design Initiative, Carnegie Mellon University (Pittsburgh, Pennsylvania), 1999, p. 2.

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[41] Karen Palmer and Margaret Walls, *The Product Stewardship Movement: Understanding Costs, Effectiveness, and The Role for Policy*, Resources for the Future, November 2002, p. 14.

[42] OECD and the Institute for Local Self-Reliance in Karen Palmer *op. cit.*, pp. 14-15.

[43] Schwartz and Gattuso, *op. cit.*, pp. 32-3, 42-4.

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[45] European Union, WEEE summary, at http://europa.eu.int/scadplus/printversion/en/lvb/l21210.htm.

[46] WEEE Directive, *op. cit.*, p. L37/29.

[47] Inform Inc., *EU Electrical and Electronic Products Directive*, June 2003, p. 3, at http://www.informinc.org/fact_WEEEoverview.pdf.

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[49] WEEE Summary, *op. cit.*

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[51] Orgalime, *Detailed Position of Orgalime's Electrical & Electronic Liaison Committee in Cooperation with European Sector Committees*, Brussels, Belgium, September 5, 2000, p. 1.

[52] "Electronic Waste Is Growing Concern," *ViewsWire*, published in *The Economist*, Economist Intelligence Unit, ebusinessforum.com, August 25, 2004.

[53]British Retail Consortium, *WEEE: BRC Response*, p. 10. Also, see Federation of Small Businesses (FSB), *Response of the FSB to the Implementation of WEEE and ROHS*, May 8, 2003, at http://www.fsb.co.uk/policy/archivePubs/assets/weee_rohs_2003.pdf.

[54] Meike Escherich, *EU's New Recycling Rules Could Drive Up European PC Prices*, Gartner Inc., January 6, 2004, in Fiona Harvey, "The Greening of Your PC," *National Post*, February 5, 2004.

[55] UK Department of Trade and Industry (DTI), *Consultation Paper: Proposed EC Directive on Waste Electrical and Electronic Equipment and Proposed EC Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment*, August 11, 2000, p. 48.

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[61] Nicholas Watt, "Taskforce To Tackle £75m 'Fridge Mountain,'" *The Guardian*, January 21, 2002.

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[67] European Commission, Directorate-General Health and Consumer Protection, Scientific Committee on Toxicity, Ecotoxicity and the Environment (CSTEE), "Lead—Danish Notification 98/595/DK," Brussels, Belgium, May 5, 2000, p. 3.

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[69] Kara Sissell, "EU Finds Deca-BDE Poses No Health Risk," *Chemical Week*, June 9, 2004.

[70] Bromine Science and Environmental Forum (BSEF), "Study Finds Very Low Detection of DecaBDE," Press Release, June 10, 2004.

[71] World Health Organization, International Programme on Chemical Safety, "Environmental Health Criteria 172: Tetrabromobisphenol A and Derivatives" (Geneva, Switzerland), 1995.

[72] BSEF, *op. cit.*

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[74] Margaret Simonson and Hakan Stripple, *LCA Study of Flame Retardants in TV Enclosures*, Sweden, February 2, 2000, p. 11.

[75] *Ibid*, pp. 3-4, 8.

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[78] Northeast Recycling Council, Inc. (NERC), *op. cit.,* p. 5.

[79] "Electronic Waste Is Growing Concern, *ViewsWire*, The Economist, *op. cit.* Also, see National Caucus of Environmental Legislators, "Introduced Electronic Waste Legislation 2003-2004," April 23, 2004, at http://www.ncel.net/news_uploads/101/2003-2004bills-ewaste.update.doc. The number of bills introduced this session is actually less than the number introduced the previous year. Mark Hachman, "California To Step Up CRT, Cell-

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