

Exporting Harm

The High-Tech Trashing of Asia



February 25, 2002

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Table of Contents

Executive Summary.....	Page 1
E-Waste.....	Page 5
What is It?.....	Page 5
How Much E-Waste is There?.....	Page 5
Where Does E-Waste Come From?.....	Page 6
Where Does E-Waste Go?.....	Page 6
Hazards in E-Waste.....	Page 9
Export: The Great Escape Valve....	Page 11
Recyclers as Waste Traders.....	Page 11
Debunking Export Rationalizers.....	Page 13
How Much is Exported?.....	Page 14
China: The Story of Guiyu.....	Page 15
A Community Transformed.....	Page 15
Waste Origins.....	Page 16
The Recycled Materials.....	Page 17
Hazardous Recycling Operations.....	Page 17
India and Pakistan.....	Page 23
Karachi, Pakistan.....	Page 23
New Delhi, India.....	Page 25
Asian E-Waste Impacts (Table).....	Page 26
Legal Implications of E-Waste Export...Page 27	
Is E-Waste a Hazardous Waste?.....	Page 27
U.S. Policy and Law.....	Page 28
Chinese Law.....	Page 30
Basel Convention Implications.....	Page 32
The Dilemma of Local Governments.....Page 35	
Seattle, King County, Washington.....	Page 35
California State.....	Page 37
The Solution Lies Upstream.....	Page 40
Recommendations for Action.....	Page 40
The European Model.....	Page 42
What We Can Do.....	Page 43
Annexes	
I. Materials Found in a Computer.....	Page 44
II. Guiyu Sediment/Soil Results.....	Page 45
III. Guiyu Water Samples.....	Page 46
IV. List of Labels and Brand Names.....	Page 47
V. Example of Broker Solicitation.....	Page 48

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Executive Summary

Electronic waste or E-waste is the most rapidly growing waste problem in the world. It is a crisis not only of quantity but also a crisis born from toxic ingredients — such as the lead, beryllium, mercury, cadmium, and brominated-flame retardants that pose both an occupational and environmental health threat. But to date, industry, government and consumers have only taken small steps to deal with this looming problem.

This report reveals one of the primary reasons why action to date in the United States has been woefully inadequate. Rather than having to face the problem

squarely, the United States and other rich economies that use most of the world's electronic products and generate most of the E-Waste, have made use of a convenient, and until now, hidden escape valve — exporting the E-waste crisis to the developing countries of Asia.

Rather than having to face the E-waste problem squarely, the United States has made use of a convenient, and until now, hidden escape valve — exporting the crisis to developing countries of Asia.

Yet trade in E-waste is an export of real harm to the poor communities of Asia. The open burning, acid baths and toxic dumping pour pollution into the land, air and water and exposes the men, women and children of Asia's poorer peoples to poison. The health and economic costs of this trade are vast and, due to export, are not born by the western consumers nor the waste brokers who benefit from the trade.

The export of E-waste remains a dirty little secret of the high-tech revolution. Scrutiny has been studiously avoided by the electronics industry, by government officials, and by some involved in E-waste recycling. This often willful denial has been

aided by the cynical labeling of this trade with the ever-green word “recycling”.

The current U.S. system begins its path of failure before the electronics ever enter the marketplace. First, manufacturers refuse to eliminate hazardous materials or design for disassembly. Second, government policies fail to hold manufacturers responsible for end-of-life management of their products.

Thus, finally, consumers, are the unwitting recipients of a toxic product abandoned by those with the greatest ability to prevent problems. Left with few choices, consumers readily will turn to recycling. But it appears that too often, this apparent solution simply



results in more problems, particularly when the wastes are toxic.

The open burning, acid baths and toxic dumping pour pollution into the land, air, and water and exposes the men, women, and children of Asia's poorer peoples to poison.

While there are many E-waste recyclers who espouse and practice sincere environmental ethics and are trying to make the most of poor upstream design, there are many others whose “recycling” claims offer false solutions— recycling via export directly, or indirectly through brokers. Indeed, informed recycling industry sources estimate that between 50 to 80 percent of the E-waste collected for recycling in the western U.S. are not recycled domestically, but is very quickly placed on container ships bound for destinations like China. Even the best-intentioned recyclers have been forced, due to market realities, to participate in this failed system. They see that the real solution is producer responsibility.

Few of us realize that the obsolete computer we pay someone to take, in hopes it would be recycled, might end up in China or some other far-off Asian destination. Although it has been a

secret well-kept from most consumers, the export “solution” has been a common practice for many years. But until now, nobody, not even many recyclers, seemed to know the Asian fate of these “Made-in-USA” wastes, or what “recycling” in Asia really looks like. And it was clear that many did not want to know. Hopefully, the evidence in this report will separate recyclers who believe in an environmentally superior solution from waste brokers looking for a quick buck.

Informed recycling industry sources estimate that between 50 to 80 percent of the wastes collected for recycling are not recycled domestically at all, but very quickly placed on container ships bound for destinations like China.

It became increasingly evident that a field investigation was long overdue. The Basel Action Network (BAN), a global watch-dog network focused on toxic trade, with support from member organizations of another activist network, “Waste Not Asia”, and the Silicon Valley Toxics Coalition, a coalition advocating for a clean and safe high-tech industry, conducted an investigation that provides the basis for this report and an accompanying film. The findings documented in China, India and Pakistan should toll a loud alarm and signal a clarion call for sweeping changes in U.S. national policies and practices.

Until now, nobody, not even many of the reputable recyclers, seemed to know the fate of these “Made-In-USA” wastes in Asia and what “recycling” there really looks like. And it was clear that many did not want to know.

As detailed and illustrated in this report, the field investigation revealed extremely hazardous and dangerous E-waste “recycling” operations that pollute the air, water, and soil of

Asian countries. These operations are very likely to be seriously harming human health. Vast amounts of E-waste material, both hazardous and simply trash, is burned or dumped in the rice fields, irrigation canals and along waterways.

A free trade in hazardous wastes leaves the poorer peoples of the world with an untenable choice between poverty and poison – a choice that nobody should have to make.

E-waste exports to Asia are motivated entirely by brute global economics. Market forces, if left unregulated, dictate that toxic waste will always run “downhill” on an economic path of least resistance. If left unchecked, the toxic effluent of the affluent will flood towards the world’s poorest countries where labor is cheap, and occupational and environmental protections are inadequate. A free trade in hazardous wastes leaves the poorer peoples of the world with an untenable choice

between poverty and poison – a choice that nobody should have to make.

It was in an effort to counter the unsustainable and unjust effects of free trade in toxic wastes, that an international treaty known as the Basel Convention was created in 1989. And it was also for this reason that the Basel Convention in

1994 agreed to adopt a total ban on the export of all hazardous wastes from rich to poor countries for any reason, including for recycling.

The Basel Convention calls on all countries to reduce their exports of hazardous wastes to a minimum and, to the extent possible, deal with their waste problems within national borders. Indeed, this is an obligation of the Basel Convention regardless of the level of waste management technology in the importing country.

One would think that a country like the United States would be a country most able to fulfill and implement this call for national



self-sufficiency in waste management. But, to date, the United States is the only developed country in the world that has not ratified the Basel Convention. In fact, U.S. officials have actively worked to defeat, and then to weaken, the Basel waste export ban.

The U.S. government policies appear to be *designed* to promote sweeping the E-waste problem out the Asian back door. Not only has the U.S. refused to ratify the Basel Convention and Ban, but in fact, the United States government has intentionally exempted E-wastes, within the Resource Conservation and Recovery Act, from the minimal laws that do exist (requiring prior notification of hazardous waste shipments) to protect importing countries. When questioned, officials at the United States Environmental Protection Agency (EPA) admit that export is very much a part of the U.S. E-waste disposal strategy and the only issue of concern for the U.S. might be how to ensure minimal environmental standards abroad.

The U.S. government policies appear to actually be designed to promote sweeping the E-waste problem out the Asian back door.

But this type of thinking belies the reality of conditions in developing countries and conveniently ignores

the failures of the electronics industry to design their products so that they can be safely recycled anywhere in the world. As long as electronic products continue to contain a witch's brew of toxic chemicals and are designed without recycling in mind, they pose a threat at end-of-life. As electronic products are currently constituted, E-waste recycling operations, in any country will generate polluting residues and emissions.

Thus, even if it were somehow possible for China, India or Pakistan to possess state-of-the-art technologies, and the resources and infrastructure to ensure that such technologies work optimally, the export of all of the world's E-waste to Asia would still be an unjust, inappropriate export of pollution to a particular region of the world simply because it is poorer.

It is sadly ironic that the United States was the first country in the world to recognize and uphold the principle of environmental justice. This principle asserts that no people, based on their race or economic status should be forced to bear a disproportionate burden of environmental risks. While the United States has begun to institute some programs at home to prevent environmental injustice, U.S. policy has actually *promoted* such injustice on the global stage.

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The current U.S. policy of encouraging the quick and dirty route of export, hidden under the green cloak of the word "recycling", is not only an affront to environmental justice but also to the principles of producer responsibility, clean production and pollution prevention. Such export stifles the innovation needed

to actually solve the problem at its source — upstream at the point of design and manufacture. As long as manufacturers can evade the ultimate costs of their hazardous products via export to Asia, they can delay aggressively deploying their ingenuity to make sure their products are less toxic and burdensome to the planet. This is particularly true for

electronic products because of their significant toxicity and their rapid obsolescence.

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In this regard, with little incentive, the electronics industry in the United States has, for the most part, moved at a snail's pace in preventing the problem at the source through green, toxic-free, recyclable design. Instead, thanks to the convenient pipeline of export, industry, aided by government, has taken a head-in-the-sand, business-as-usual, for-as-long-as-possible approach.



As a result, local governments and consumers are now faced with an untenable situation. We are left with very few moral, sustainable choices as to what to do with our E-waste. The mantra accepted on faith diversion from landfill to recycling, now faces a serious reality check as that push may, without responsible action, likely result in ever more massive quantities of irresponsible E-waste exports to Asia. These pressures to export E-waste are increasing now that California and Massachusetts have banned the landfilling of CRT monitors and will increase even more if and when the EPA finally issues new regulations further regulating E-wastes domestically.

While the U.S. government and industry may be acting irresponsibly, we as U.S. residents, small businesses, and consumers, can insist on another path. A way forward has been heralded by the European Union. These 15 European



countries have already implemented the Basel Convention and have banned the export of all hazardous wastes to developing countries for any reason.

They have also readied legislation which will ensure that manufacturers are responsible for the entire life cycle of computers, are required to take computers and appliances back with the costs being born by the producers, and additionally, must agree to specific phase-out dates for toxic inputs. Japan also has taken steps to solve the problem by mandating upstream design criteria and mandatory take-back programs. Just as the U.S. is the largest impediment to the Basel treaty, the U.S. is also increasingly falling behind in the global efforts to bring about producer responsibility for life cycle impacts of products.

Now that we have seen the ugly face of the E-waste problem we must give the European model a second look.

Summary Findings

- Millions of pounds of electronic waste (E-Waste) from obsolete computers and TVs are being generated in the U.S. each year and huge amounts -- an estimated 50% to 80% collected for recycling -- is being exported.
- This export is due to cheaper labor, lack of environmental standards in Asia, and because such export is still legal in the United States.
- The E-waste recycling and disposal operations found in China, India, and Pakistan are extremely polluting and likely to be very damaging to human health. Examples include open burning of plastic waste, exposure to toxic solders, river dumping of acids, and widespread general dumping.
- Contrary to all principles of environmental justice, the United States, rather than banning exports of toxic E-waste to developing countries, is actually facilitating their export.
- China has banned the import of E-Waste and yet the United States refuses to honor that ban by preventing exports to them.
- Due to a severe lack of responsibility on the part of the federal government and the electronics industry, consumers, recyclers and local governments are left with few viable, sustainable options for E-waste.

Now that we have seen the ugly face of the E-waste problem we must give the European model a second look. We can no longer pretend that we don't know what is happening with a large portion of our discarded electronic waste. We can no longer allow its dumping on foreign shores. The real answer surely lies not in exporting our problems to those least able to deal with them, but in preventing the problems at their source.

E-Waste

Just beneath the glamorous surface of the benefits and the wealth created by the information technology revolution looms a darker reality. Vast resource consumption and waste generation are increasing at alarming rates. The electronics industry is the world's largest and fastest growing manufacturing industry, and as a consequence of this growth, combined with rapid product obsolescence, discarded electronics or E-waste, is now the fastest growing waste stream in the industrialized world. The growing quantity of E-waste is beginning to reach disastrous proportions and industrialized countries all over the world are just now beginning to grapple with the problem. After initially turning a blind eye to the problem, governments of all sizes have been forced to respond as E-waste begins to seriously inundate solid waste disposal facilities and programs.

What is it?

E-waste encompasses a broad and growing range of electronic devices ranging from large household appliances such as refrigerators, air conditioners, hand-held cellular phones, personal stereos, and consumer electronics to computers.

E-waste has become a problem of crisis proportions because of two primary characteristics:

- **E-waste is hazardous** — E-waste contains over 1,000 different substances, many of which are toxic, and creates serious pollution upon disposal. Just some of the materials found in computers can be found in Annex I. A full discussion of the hazardous characteristics of E-waste is at the Hazards in E-Waste section of this report.
- **E-waste is generated at alarming rates due to obsolescence** — Due to the extreme rates of obsolescence, E-waste produces much higher volumes of waste in comparison to other consumer goods. Where once consumers purchased a stereo console or television set with the expectation that it would last for a decade or more, the increasingly rapid evolution of technology combined with rapid product obsolescence has effectively rendered everything disposable. Consumers now rarely take broken electronics to a repair shop as replacement is now often easier and cheaper than repair. The average lifespan of a computer has shrunk from four or five years to two years.¹ Part of this rapid obsolescence is the result of a rapidly evolving technology. But it is also clear that such obsolescence and the throw away ethic results in a massive increase in corporate profits,

particularly when the electronics industry does not have to bear the financial burden of downstream costs.

- Americans are buying more computers than people in any other nation. Currently over 50% of U.S. households own computers.²
- Data from single-day recycling collection events has revealed that more than 50% of turned-in computers are in good working order, but they are discarded nonetheless to make way for the latest technology.³
- By the year 2005, one computer will become obsolete for every new one put on the market.⁴
- In California alone, over \$1.2 billion will be spent on E-waste disposal over the next five years.⁵

How Much E-Waste is There?

In 1998, it was estimated that 20 million computers became obsolete in the United States, and the overall E-waste volume was estimated at 5 to 7 million tons.⁶

The figures are projected to be higher today and rapidly growing. European studies estimate that the volume of E-waste is increasing by 3% - 5% per year, which is almost three times faster than the municipal waste stream is growing generally.⁷ Today, electronic waste likely comprises more than 5% of all municipal solid waste; that's more than disposable diapers or beverage containers, and about the same amount as all plastic packaging.

To make matters worse, solid waste agencies and recyclers are anticipating a major increase in the volume of computer and TV monitors discarded in the next 5 years. As cathode-ray tube (CRT) monitors currently in use will be replaced by smaller, and more desirable liquid crystal display (LCD) screens, this could mean massive dumping of CRT monitors at an even higher rate. Add to this the fact that new federal rules for high-definition televisions (HDTV) will become effective in 2004. This leap in technology is also expected to lead to a significant increase in television disposal.

A 1999 study conducted by Stanford Resources, Inc. for the National Safety Council projected that in 2001, more than 41 million personal computers would become obsolete in the U.S. Analysts estimate that in California alone more than 6,000 computers become obsolete every day.⁸ In Oregon and Washington, it is estimated that 1,600 computers become obsolete each day.⁹ Between the years 1997 and 2007, experts estimate that we will have more than 500 million

obsolete computers in the United States.¹⁰ As this wave of electronics surges into the waste stream, the environmental and economic challenges will leave no community untouched.

How much waste is in 500 million computers?

Plastics	6.32 Billion Pounds
Lead	1.58 Billion Pounds
Cadmium	3 Million Pounds
Chromium	1.9 Million Pounds
Mercury	632,000 Pounds

Where Does E-Waste Come From?

Electronic waste is generated by three major sectors in the United States:

- individuals and small businesses
- large businesses, institutions, and governments
- original equipment manufacturers (OEMs).

Individuals and Small Businesses -- Electronic equipment, and computers in particular, are often discarded by households and small businesses, not because they are broken but simply because new technology has left them obsolete or undesirable. With today's computer industry delivering new technologies and 'upgrades' to the market about every 18 months, the useful life-span of a personal computer has shrunk from four or five years down to two years. Often new software is incompatible or insufficient with older hardware so that customers are forced to buy new ones.

Due to legal exemptions in the definitions of solid and hazardous wastes, household and small business users are legally allowed to simply dump their computers into their trashcans for disposal in the local landfill or incinerator. The only exceptions to that so far are in California and Massachusetts where landfill bans have been passed. Thus, the present legal loophole makes landfill disposal preferable. In fact, if a consumer goes to a recycler, they most likely will be charged a front-end fee (for monitors). By avoiding recyclers altogether, and simply throwing it in a dumpster, disposal of E-waste is no more costly than throwing away an orange peel.

Large corporations, institutions, and government -- Large users upgrade employee computers regularly. For example, Microsoft, with over 50,000 employees worldwide (some of whom have more than one computer) replaces each computer

about every three years.¹¹ By law it is illegal for these large users to dispose of computers via landfill and thus, this E-waste goes to the re-use/recycling/export market.

Some large companies lease their computers from leasing companies, who take back working and non-working computers at the end of contracts. Leasing companies take out hundreds or thousands of computers at a time and in turn resell them to brokers in the reuse/export markets.

The volume of leased computers is huge in comparison to sales of new computers to corporations.¹² Even the federal government is now getting into leasing rather than buying computers which by law they cannot send to landfills.¹³

Original equipment manufacturers (OEMs) -- OEMs generate E-waste when units coming off the production line don't meet quality standards, and must be disposed of. Some of the computer manufacturers contract with recycling companies to handle their electronic waste, which often is exported. Other OEM's are major handlers of their own waste, e.g. Hewlett Packard who has two recycling facilities, in California and Tennessee. IBM has started its own recycling program in New York.

Where Does E-Waste Go?

The volume of obsolete computers thrown out or temporarily stored for later disposal is already a serious problem that is escalating at a rapid rate. Currently, and unfortunately, the vast majority of E-waste ends up in our landfills or incinerators. While there are efforts to divert E-waste from landfills, via "recycling", electronics "recycling" is a misleading characterization of many disparate practices -- including de-manufacturing, dismantling, shredding, burning, exporting, etc. -- that is mostly unregulated and often creates additional hazards itself. "Recycling" of hazardous wastes, even under the best of circumstances, has little environmental benefit -- it simply moves the hazards into secondary products that eventually have to be disposed of. Unless the goal is to redesign the product to use non-hazardous materials, such recycling is a false solution. Current market conditions and manufacturing methods and inputs discourage environmentally sound electronic recycling practices, so most E-waste that is currently being "recycled" is actually being exported, dismantled in prisons, or shredded in processes where there is some material recovery followed by the discard of the remaining materials.

Storage -- U.S. government researchers estimate that three-quarters of all computers ever sold in the United States

remain stockpiled, awaiting disposal.¹⁴ Other studies estimate that the number of these unused, stored, computers in the U.S. will soon be as high as 315–680 million units.¹⁵ Consumers have, on average, a surprising 2–3 obsolete computers in their garages, closets or storage spaces.¹⁶ They often hang on to them in hopes that they will be worth something to someone someday. The value of computers decreases rapidly over time and will ultimately be worth only the value of the raw materials, less the cost to properly recycle them domestically. The residual value of old electronic equipment soon after production is 1–5% of the original cost of the equipment.¹⁷ Many consumers are unwilling to accept the fact that the latest system they paid top dollar for, just two or three years ago, is now largely worthless.

Landfill and Incineration -- According to the EPA, in 1997 more than 3.2 million tons of E-waste ended up in U.S. landfills. It is thought that most households and small businesses that dispose rather than store their obsolete electronic components send their material to landfills or incinerators rather than take them to recyclers.

All waste landfills leak. Even the best ‘state of the art’ landfills are not completely secure and a certain amount of chemical and metal leaching will occur. The situation is far worse for the older or less stringently maintained dump sites. When disposed of in a landfill, E-waste becomes a conglomeration of plastic and steel casings, circuit boards, glass tubes, wires, resistors, capacitors, and other assorted parts and materials. About 70% of heavy metals (including mercury and cadmium) found in landfills come from electronic discards. These heavy metals and other hazardous substances found in electronics can contaminate groundwater.¹⁸ In 2001, CRTs were banned from municipal landfills in California and Massachusetts because of their recognized hazardous nature.

Municipal incinerators are some of the largest point sources for dioxins in the U.S. and Canadian environments and of heavy metal contamination of the atmosphere. Copper, common in E-waste, is a catalyst for dioxin formation. This is of particular concern as the incineration of brominated flame retardants and PVC leads to the generation of extremely toxic dioxins and furans and copper makes their formation more likely. Some producers send their E-waste to cement kilns for use as an alternative to fuel. But cement kilns present much the same problems posed by incinerators.

Re-use -- Re-use constitutes direct second-hand use, or use after slight modifications are made to the original functioning equipment—memory upgrades, etc. Re-use makes up a

small percentage (about 3% in 1998) of the computers that have been discarded by their users. These computers are later sold in very small numbers at some recycling stores or are given to schools, or non-profit organizations. School districts that used to accept older computers though, now demand more recent generation computers for training students.

Foreign markets, on the other hand, have such cheap labor forces that they can buy working and non-working old computers, repair them at very little cost, and resell them for a profit. While there are no figures available, the amount of computers being exported for reuse is increasingly significant. While extending the usable life of a computer is a good thing, these older units obviously have a limited life span and will end up as waste sooner or later. Thus, these used computers will also end up as E-waste on foreign shores, often in countries that are least able to deal with them appropriately.

Domestic Recycling -- All of the current information regarding E-waste recycling glaringly fails to point out that most of what is called E-waste recycling today involves recycling in a developing country. All of the studies that have been done fail to make a distinction between domestic recycling and recycling in developing countries with the gross assumption that all recycling is the same and all is equal from an environmental standpoint. The assumption too, is that recycling is always better than landfilling. This is not the case when the recycling results in toxic worker exposures, and the open dumping or burning of toxic residues and wastes that we have witnessed in Asia. While the recycling of hazardous materials anywhere creates a serious pollution challenge, it can be a disastrous one in an area of the world where the knowledge of, and infrastructure to deal with hazards and waste is almost non-existent.

With the cautionary note above, it is nevertheless estimated that in 1998, 11% of computers were being recycled (including those sent for export).¹⁹ And the amount is thought to be growing at about 18% per year.²⁰ Thus, it is expected that 12.75 million computers (including monitors, and keyboards) will be recycled in 2002.²¹

Large corporations and manufacturers of new equipment tend to have a much higher rate of electronic waste recycling than individuals and small businesses because EPA regulations apply to much of this sector (unlike households and small business who are basically exempt from regulation). About 75 percent of end-of-life electronic products received by electronics recyclers come from new equipment managers and large-scale users (those with more than 500 employees).²² The corporate need to protect/destroy proprietary or confidential information on discarded computers provides another incentive for these large users to recycle;

some recyclers offer specialty services that certify hard drives have been wiped clean.

It is very important to bear in mind that this very small percentage of E-waste now thought to be destined for recycling could increase dramatically with future state or federal legislation that might make it more and more difficult for small and household users to dispose of their waste in landfills. If legal restraints were placed on small users and households, the numbers of computers and E-waste diverted to recycling (and thus export) would grow dramatically (See the section on State of California for more about this).

After possibilities for re-use have been exhausted and a computer is slated for disposal, its worth in the marketplace will likely have been reduced from over 1,000 dollars to, very likely a negative value. Indeed most recyclers, due to the costs of dealing with the disposal of non-recyclable parts and the expense of dealing carefully with the toxic waste components of old computers, will not take your computer unless you are willing to pay them to take it.

While more recent model computers are valuable on the re-use market, the net worth of older computers at the point of disposal, not counting the costs of “recycling”, is very small. For example, in an old computer: 5 pounds of steel could be worth \$0.25; the central processing unit (cpu) with its gold tips and wiring (if the chip itself isn’t worth anything on the re-use market) could be worth \$1.00; the motherboard with its metal (gold, silver and copper) connectors - \$2.00; cable (that are 30% copper in PVC sheaths) could be worth \$0.09; the hard drive which is about 15% aluminum worth \$0.10; and the monitor yoke which can be 60% copper is worth \$0.80.²³

In total, if it weren’t for the fact that there are precious metals in computer electronic chips and boards, including silver, gold, platinum, and palladium, obsolete computers would be worth very little in today’s recycling marketplace. For those with the technology to recover it, palladium is the most profitable. But many types of circuit boards (e.g. those found in monitors) have such low levels of precious metals that there is no domestic interest for them.

So, recycling the computers is often impossible without the consumer subsidizing the recycler. For large commercial customers, computer system leasers may negotiate lower prices for the collection of obsolete computer systems. Individual customers looking to recycle computers are left with far fewer options and will likely have to pay a recycler from \$10-\$30 per unit before they will be willing to accept it. Households and small users are not required by law to

manage their E-waste as a controlled solid waste, and many consumers would prefer to throw their old computers away rather than pay \$10-\$30 for recycling.

Prison -- As an alternative to export to developing countries, there is another high growth area for E-waste emerging in the U.S. New “electronics recycling facilities” are opening in California and other states—in prisons. These recycling operations are touted as low-cost solutions to the E-waste problem. A brand new federal maximum security prison facility based in Atwater, California will occupy more than 50,000 square feet and will create 350 “jobs” dismantling computer monitors, televisions and other E-waste. It is being billed as the solution to California’s crisis that has developed since the state Department of Toxic Substance Control banned cathode ray tubes from landfills last year. However, because of the low labor costs, domestic recyclers are concerned that they will not be able to compete. Others are concerned about the health and safety of prisoners working on the hazardous dismantling of monitors, since the federally prescribed occupational safety and health regulations of OSHA will not be applicable.²⁴

Export to Developing Countries -- The subject of this report is primarily about the most often overlooked and ignored E-waste management option — export to developing countries under the name of “recycling”. There are three primary reasons why E-waste is increasingly flooding Asian countries:

- The labor costs are very low (China \$1.50 per day);
- Environmental and occupational regulations are lax or not well enforced; and
- It is legal in the U.S., despite international law to the contrary, to allow export of hazardous E-wastes with no controls whatsoever.

The issue of export of E-waste is the primary subject of this report and will be further explored in the following sections.



Hazards In E-Waste

Although it is hardly well known, E-waste contains a witches' brew of toxic substances such as lead and cadmium in circuit boards; lead oxide and cadmium in monitor cathode ray tubes (CRTs); mercury in switches and flat screen monitors; cadmium in computer batteries; polychlorinated biphenyls (PCBs) in older capacitors and transformers; and brominated flame retardants on printed circuit boards, plastic casings, cables and polyvinyl chloride (PVC) cable insulation that release highly toxic dioxins and furans when burned to retrieve copper from the wires.

Due to the hazards involved, disposing and recycling E-waste has serious legal and environmental implications. When computer waste is landfilled or incinerated, it poses significant contamination problems. Landfills leach toxins into groundwater and incinerators emit toxic air pollutants including dioxins. Likewise, the recycling of computers has serious occupational and environmental implications, particularly when the recycling industry is often marginally profitable at best and often cannot afford to take the necessary precautions to protect the environment and worker health.

Lead -- The negative effects of lead are well established and recognized. It was first banned from gasoline in the 1970s. Lead causes damage to the central and peripheral nervous systems, blood systems, kidney and reproductive system in humans.²⁵ Effects on the endocrine system have been observed and its serious negative effects on children's brain development are well documented. Lead accumulates in the environment and has high acute and chronic effects on plants, animals and micro-organisms.²⁶ The main applications of lead in computers are: glass panels and gasket (frit) in computer monitors (3-8 pounds per monitor), and solder in printed circuit boards and other components.

Cadmium -- Cadmium compounds are toxic with a possible risk of irreversible effects on human health, and accumulate in the human body, particularly the kidneys.²⁷ Cadmium occurs in certain components such as SMD chip resistors, infra-red detectors, and semiconductor chips. Cadmium is also a plastics stabilizer and some older cathode ray tubes contain cadmium.

Mercury -- Mercury can cause damage to various organs including the brain and kidneys, as well as the fetus. Most importantly, the developing fetus is highly susceptible through maternal exposure to mercury. When inorganic mercury spreads out in the water, it is transformed to methylated mercury in the bottom sediments. Methylated

mercury easily accumulates in living organisms and concentrates through the food chain, particularly via fish. It is estimated that 22 % of the yearly world consumption of mercury is used in electrical and electronic equipment. It is used in thermostats, sensors, relays, switches (e.g. on printed circuit boards and in measuring equipment), medical equipment, lamps, mobile phones and in batteries. Mercury, used in flat panel displays, will likely increase as their use replaces cathode ray tubes.²⁸

Hexavalent Chromium/Chromium VI -- Chromium VI is still used as corrosion protection of untreated and galvanized steel plates and as a decorative or hardener for steel housings. It easily passes through cell membranes and is then absorbed—producing various toxic effects in contaminated cells. Chromium VI can cause damage to DNA and is extremely toxic in the environment.²⁹

Plastics including PVC -- Plastics make up 13.8 pounds of an average computer. The largest volume of plastics (26%) used in electronics has been poly-vinyl-chloride (PVC). PVC is mainly found in cabling and computer housings, although many computer moldings are now made with the somewhat more benign ABS plastics. PVC is used for its fire-retardant properties. As with many other chlorine-containing compounds, dioxin can be formed when PVC is burned within a certain temperature range.

Brominated flame retardants (BFRs) -- BFRs are used in the plastic housings of electronic equipment and in circuit boards to prevent flammability. More than 50% of BFR usage in the electronics industry consists of tetra-bromo-bis-phenol – (TBBPA), 10% is polybrominated diphenyl ethers (PBDEs) and less than 1% is polybrominated biphenyls (PBB).³⁰ Some BFRs have been targeted for phase out by the European Parliament between the years of 2003 and 2006.

Barium -- Barium is a soft silvery-white metal that is used in computers in the front panel of a CRT, to protect users from radiation. Studies have shown that short-term exposure to barium has caused brain swelling, muscle weakness, damage to the heart, liver, and spleen.³¹ There is still a lack of data on the effects of chronic barium exposures to humans. Animal studies, however, reveal increased blood pressure and changes in the heart from ingesting barium over a long period of time.

Beryllium -- Beryllium is a steel-grey metal that is extremely lightweight, hard, a good conductor of electricity and heat, and is non-magnetic. These properties make beryllium suitable for many industrial uses, including, electronic applications such as computers. In computers, beryllium is commonly found on

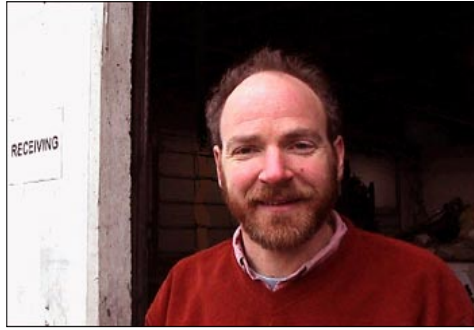
mother-boards and “finger clips” as a copper beryllium alloy used to strengthen the tensile strength of connectors and tinyplugs while maintaining electrical conductivity.

Beryllium has recently been classified as a human carcinogen as exposure to it can cause lung cancer.³² The primary health concern is inhalation of beryllium dust, fume or mist. Workers who are constantly exposed to beryllium, even in small amounts, and who become sensitized to it can develop what is known as Chronic Beryllium Disease (berylliosis), a disease which primarily affects the lungs.³³ Exposure to beryllium also causes a form of skin disease that is characterized by poor wound healing and wart-like bumps.³⁴ Studies have shown that people can still develop beryllium disease even many years following the last exposure.

Toners -- One of the ubiquitous computer peripheral scraps and post consumer E-waste is the plastic printer cartridge containing black and color toners. The main ingredient of the black toner is a pigment commonly called, carbon black³⁵ - the general term used to describe the commercial powder form of carbon. Inhalation is the primary exposure pathway, and acute exposure may lead to respiratory tract irritation.³⁶ The International Agency for Research on Cancer has classified carbon black as a class 2B carcinogen, possibly carcinogenic to humans.³⁷ Little information exists on the hazards of colored toners. Some reports indicate that such toners (cyan, yellow and magenta) contain heavy metals.

Phosphor and additives -- Phosphor is an inorganic chemical compound that is applied as a coat on the interior of the CRT faceplate. Phosphor affects the display resolution and luminance of the images that is seen in the monitor. The hazards of phosphor in CRTs are not well known or reported, but the U.S. Navy has not minced words about the hazards involved in some of their guidelines: “NEVER touch a CRT’s phosphor coating: it is extremely toxic. If you break a CRT, clean up the glass fragments very carefully. If you touch the phosphor seek medical attention *immediately*.”³⁸ The phosphor coating contains heavy metals, such as cadmium, and other rare earth metals, e.g. zinc, vanadium, etc. as additives. These metals and their compounds are very toxic. This is a serious hazard posed for those who dismantle CRTs by hand.

A Recycler’s Challenge



Some recyclers in the United States are not happy with the idea that so much of the E-waste generated is

currently exported off-shore to Asia. Many got into the recycling business to help find solutions to problems created by our consumption habits.

Mr. Craig Lorch of Seattle’s Total Reclaim, is one who got into the business as both an environmentalist and a businessman. Total Reclaim entered into a cooperative agreement with King County in Washington State to provide a mechanism to try and prevent the leaded CRTs in computer monitors from entering landfills. Total Reclaim breaks down monitors and crushes the leaded glass. Thereafter, the glass is sent to Envirocycle in Pennsylvania to be cleaned and used as feedstock in the manufacture of new CRTs. While Lorch has developed a strategy to manage the leaded CRT glass domestically, he has little alternative but to sell the circuit boards, plastics, wires and cables to scrap brokers who are very likely to export them depending on the global market.

“I don’t want to see this stuff exported to developing countries and I think there are a lot of recyclers out there like me. But with no domestic markets for material and no regulations against export, I’m afraid its going to happen...and ultimately it does not really solve the serious issues -- it merely sweeps these issues under the carpet. We can do better than that.”

Lorch provides true domestic recycling for CRTs and is the only such outlet in the Washington State area. He is frustrated that not all local area recyclers care to utilize available domestic solutions even when they are available, but simply export the monitors.

“Right now, the economics of electronics recycling clearly prefers export over managing the material in the U.S. Every day we must make the choice between spending money to disassemble and manage the material here or simply load it into a shipping container and sell it offshore. Why would a good business person allow spending 3 to 4 dollars to disassemble and handle material domestically when the same material can be sold offshore for 3 bucks. It’s a 6 dollar swing -- that’s a make or break difference for a recycler.”

Export: The Great Escape Valve

One of the primary reasons why the United States lags behind the rest of the world in grappling with the growing E-waste crisis is due to the fact that they, and some other rich industrialized countries, have made use of a convenient, and until now, hidden, escape valve – the export of the E-waste crisis to the developing countries of Asia.

Rich industrialized countries have made use of a convenient, and until now, hidden escape valve – the export of the E-waste crisis to the developing countries of Asia.

The overwhelming majority of the world's hazardous waste is generated by industrialized market economies. Exporting this waste to less developed countries has historically been one way in which the industrialized world has avoided having to deal with the problem of expensive disposal and close public scrutiny at home. Indeed, the world faced a rash of blatant waste trade scandals in the late 1980's and early 1990's. These were largely quelled by public pressure and the passage of international law, such as the Basel Convention.

Now, however, we are seeing a new wave of the waste trade which is often justified by calling it recycling. This waste trade often involves post-consumer wastes such as old ships laden with asbestos and other toxins sent for breaking in South Asian countries, or now, as we have discovered, hazardous electronic wastes sent for dirty "recycling" operations in Asia.

Like most waste trade, E-waste exports to developing countries are motivated entirely by brute global economics. Market forces, if left unregulated, dictate that toxic waste will always run "downhill" on an economic path of least resistance. If left unchecked, the toxic effluent of the affluent will flood towards the world's poorest countries where labor is cheap, and occupational and environmental protections are inadequate. A free trade in hazardous wastes leaves the poorer peoples of the world with an untenable choice between poverty and poison – a choice that nobody should have to make.

Now we are seeing a new wave of waste trade often justified by calling it recycling. This waste trade often involves post-consumer wastes such as hazardous E-wastes sent for dirty "recycling" operations in Asia.

It was in an effort to counter the unsustainable and unjust effects of free trade in toxic wastes, that an international treaty

known as the Basel Convention was created in 1989. And it was also for this reason that the Basel Convention in 1994 agreed to adopt a total ban on the export of all hazardous wastes from rich to poor countries for any reason, including recycling (see section on Basel Convention).

There are two fundamental reasons for banning the economically motivated trade in hazardous wastes:

- **Downstream Impacts:** Hazardous waste trade is fundamentally unjust and environmentally damaging since it victimizes the poor, burdening them with toxic exposure and environmental degradation. This is especially egregious when the victims get little benefit from the industrialization that created the waste in the first place.
- **Upstream Impacts:** Hazardous waste trade allows waste generators to externalize their costs, creating a major disincentive to finding true solutions upstream for the problems they create. As long as one can cheaply dump their waste problems on poorer economies, there will never be incentives to minimize hazardous waste at the source. This forestalls the necessary innovation to solve environmental problems through design.

The latter reason is extremely important and comes into play even if the recipient country possesses a so-called state-of-the-art hazardous waste recycling facility. No hazardous waste recycling facility is without its toxic impacts, residues, emissions and worker exposure. It is a risky and polluting enterprise even in optimal conditions. The ultimate answer is to minimize the generation of hazardous wastes, not recycle them. Yet via economically motivated export, the preferable goal of zero hazardous waste generation will be forestalled.

The U.S. failure to join the consensus of the international community in condemning waste trade has enabled the U.S. electronics industry to continue a head-in-the-sand, business-as-usual, for-as-long-as-possible approach, with little incentive to aggressively pursue greener product design and producer responsibility.

Recyclers as Waste Traders

Consumers may be very surprised to know that most companies that call themselves recyclers of computers and E-waste often do more waste trading than actual waste recycling, either directly or indirectly. Informed industry insiders have indicated that around 80% of what comes through their doors will be

exported to Asia, and 90% of that has been destined for China. And as recycling rates are expected to increase 18% per year, we can also expect the amount going for export will increase at that rate as well.

...Industry insiders have indicated that around 80% of what comes through their doors will be exported offshore to Asia and 90% of that will go to China.

Typically a computer recycler will “high-grade” incoming material – that is skim the most valuable components off of the pile and possibly sell them in a store or to specialty brokers. The rest of the material may be broken down and sorted according to the type of waste (e.g. circuit boards, wires and cables, plastics, CRTs, and non-recyclables) and thrown into large cardboard boxes (or gaylords). These gaylords are then sold to brokers who arrange the shipping via container to Asia. In China, the containers arrive at the port of Nanhai, near Hong Kong in Guangdong Province where it is reported there are 4 large warehouses. The warehouses subsequently “high-grade” again and sell accordingly in the Chinese market.



Alternatively, an E-waste broker may simply take the material in bulk and ship it off to Asia as-is with no separation whatsoever. E-waste brokering is an aggressive and very competitive business, and it is not difficult to find buyers for all kinds of E-waste for the Asian market (see a typical solicitation in Annex V). The largest market of non-working equipment is for the circuit boards that are rich in precious metals, i.e. silver, gold, palladium and platinum.

As Craig Lorch of Total Reclaim, a recycler in Seattle who tries to avoid export, described the waste brokerage business: *“I think it’s about the money. When you move material offshore, you get paid twice for doing very little work. You get paid on the front side for taking somebody’s material and you get paid on the backside for getting rid of it to Asia, and*

*you don’t do a whole lot of work for it, so its all about the money.”*³⁹

A pilot program conducted by the U.S. EPA that collected electronic scrap in San Jose, CA estimated that it was 10 times cheaper to ship CRT monitors to China than it was to recycle them in the U.S.⁴⁰

“I think it’s about the money. When you move material offshore, you get paid twice for doing very little work. You get paid on the front side for taking somebody’s material and you get paid on the backside for getting rid of it to Asia”

Domestic “electronics recycling” is currently more a wish than a reality. Computers are not really designed for ease of recycling, and thus, their dismantling is extremely labor

intensive. Further, the existence of toxic components in the waste poses a significant risk to recyclers and, increasingly, the disposal of these components and residues from recycling are more and more costly to manage. Further, obtaining access

to the valuable materials that are contained in E-waste – especially metals like copper or gold – is difficult because it is bound up in plastics and mixed with other contaminants that makes it expensive to separate. Environmentally appropriate recycling facilities that handle leaded glass, mixed plastics, lead solder in circuit boards, etc. are now very limited in the United States.

In short, computers and electronic equipment are designed with little regard for downstream impacts and ease of recycling. Thus to date, very little economical recycling is taking place in a rich, developed country like the United States. Without the end-of-life costs being incorporated into the upfront price of new products, the only economically viable recycling that can take place is in an economy far different from the economy in which it most likely was consumed, utilized and enjoyed. Most E-waste will only

have positive value in a poor developing country where labor costs might be \$1.50 per day and environmental and health standards are lax or not enforced. But this grim reality, in a free market, means that the poor of the world will be forced to bear a disproportionate share of the E-waste burden. This current reality is the dirty little secret of the electronics industry.

Finally, it must be remembered that as long as the U.S. recyclers are competing with the low costs of Asian recycling, it is unlikely that there will be sufficient incentives to invest in the necessary infrastructure for efficiently and safely recycling E-wastes in this country, such as through the purchase of computer shredders and material separators which might be a practicable, though expensive way to handle the complex mix of materials that make up electronic equipment.

Debunking Export Rationalizers

Global “Standards” -- Discussions with United States officials reveal the U.S. position on E-waste export. Their hopes rest in the misguided notion that all that is necessary to justify export to developing countries is to improve their standards and operating procedures. But this idea conveniently fails to comprehend realities in developing countries. Does a typical developing country really possess the resources and infrastructure to monitor and maintain the technology? Does the regulatory infrastructure allow for the protection of workers and community rights? Are there sufficient rights of citizens to sue for damages caused to their health, environment and property? There is so much more involved in environmental and health protection than mere turn-key technology.

The U.S. failure to join the consensus of the international community in condemning waste trade has enabled the electronics industry to continue a head-in-the-sand, business-as-usual approach.

“Take Back” to Asia? -- We have also heard argumentation that insists that because electronics are increasingly manufactured in Asia, then export of these waste materials back to Asia makes some kind of sense from either a moral or environmental standpoint. We have even heard justifications of waste export to Asia as a twist on the “take-back” argument. This argumentation is seemingly compelling to those wishing to justify waste exports, but the professed logic falls apart very quickly on closer examination.

It is very sad that the most toxic and polluting segments of the life cycle of electronics -- the manufacturing and then the disposal -- have migrated to developing countries. This is not by accident -- these dirty segments follow the path of least

economic resistance. The mere fact that cheap labor is exploited *first* by a transnational electronics manufacturer in the *production* of a product can absolutely not be a justification to *further* exploit that very same low-wage labor population again at the end-of-life *disposal* of that product, particularly if that exploitation involves hazardous substances. Already the high-tech industry has become notorious for creating toxic jobs and toxic pollution in Asian manufacturing operations. It is the height of cynicism to claim that therefore they might see more of the same -- particularly when the benefits of most of the high-tech products are enjoyed *after* dirty manufacturing and *before* dirty disposal in rich developed countries. This is the despicable underbelly of globalization that constitutes a violation of both environmental and human rights.

Take-back must occur in the country of consumption and where the product becomes a waste in order to minimize cross-border economic dumping and unnecessary transport.

The concept of producer responsibility is aimed at placing responsibility fully with those that create the polluting product. “Take-back” programs to accomplish this, do not necessarily mean physically transporting wastes back to the actual persons that may have impacted design. Rather they are a means to return the wastes to the ownership of those responsible for producing them. But, in no way can “take-back” programs be new-found justifications for the transboundary movements of wastes. This is contrary to what the global community has already instructed in the Basel Convention which calls for a minimization of the transboundary movement of hazardous wastes, particularly to developing countries. Rather, “take-back”, in this light, means that within each country where sales occur, manufacturers must create a means of dealing with the end-of-life of their products *where they become wastes*. “Take-back” must occur in the country of consumption and where the product becomes a waste, in order to minimize cross-border economic dumping and unnecessary transport.

Export for Re-use? -- Finally, we have heard arguments that suggest that exporting obsolete computers for refurbishing and re-use in Asia or elsewhere is laudable as it adds extra life to the product and provides those more needy with a way to cross the digital-divide. While we can sympathize with such justification for export, few have comprehended that even when working computers are exported to Asia, they will in fact end their life cycle in Asia. If this becomes commonplace, the day when obsolete electronics from U.S. consumers become E-waste on Asian soil is simply forestalled by some months or a years. The environmental and justice impacts from the export will be the same -- the United States will still have moved a large share of its toxic E-waste problem to Asia.

How much E-Waste is Exported?

The short answer is that nobody really knows. Yet anecdotal evidence on E-waste exported by the U.S. to Asia is abundant. While it is a secret well-kept from the American public, it is



Just some of the many institutional labels from the United States found on computers in Guiyu, China in, December 2001. © BAN

well known in the E-scrap business that very substantial percentages of what comes in their doors moves quickly off-shore. What cannot be recycled readily or economically in the United States is often very quickly sold to one of the many very competitive brokers that look for the best price on the global market. Very often that best price will be found in Asia where labor costs are cheap and environmental and health protections minimal. Very knowledgeable and informed industry sources, however, have estimated that around 80% of what is diverted to recycling is actually exported to Asia.⁴¹

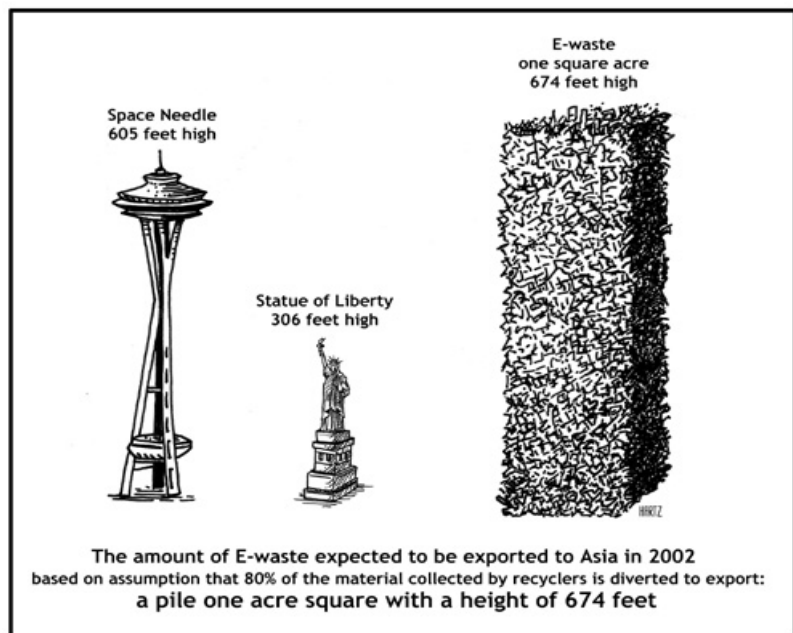
The U.S. government has no idea how much E-waste is exported from their territory or where it goes. When asked directly about the existence of such data, the U.S.

Department of Commerce representative replied, "There aren't any."⁴²

The U.S. government utilizes the global Harmonized Tariff System (HTS) to monitor the millions of import and export transactions occurring within its borders. Under the HTS, transactions are classified under approximately 8,000 product categories. But none of these categories corresponds to computer or electronic waste. Rather, whenever a shipment of E-waste occurs, it is included under the HTS category for new computers and electronics.⁴³ Thus, the trade data for the export of new computers includes the data for obsolete computers. Until this serious problem with the HTS is corrected, the U.S. will have inadequate data regarding waste exports. For some, this institutionalized ignorance is a blissful one.

There are, however, some serious studies which provide estimates of the amount of U.S. computers that go or will go to recyclers each year. One such study compiled by the Graduate School of Industrial Administration of Carnegie Mellon University, concludes that in the year 2002, 12.75 million computer units will go to recyclers in the U.S.⁴⁴

Based on this estimate, and with a rate of 80% moving offshore to Asia, the total amount would equate to 10.2 million units. This is the equivalent of a tightly stacked pile of computer waste one acre square and 674 feet high -- a height easily covering the Seattle Space Needle or more than twice the height of the Statue of Liberty from ground to torch. If we were to calculate a conservative figure of 50% diversion to Asia, we could expect a solid stack of computer waste one acre square and lifting to a height of 421 feet. It must be remembered that this is for only one year and one source country.



China: The Story of Guiyu

In December of 2001, the Basel Action Network (BAN), with the logistical support of Greenpeace China in Hong Kong, conducted an investigation to observe first hand, the recycling conditions of imported E-waste in China. In the course of three intensive days, the investigatory team conducted interviews, shot video and still photographs, and took spot sediment, soil and water samples near and within the town and vicinity of Guiyu, located about an hour's drive west of Shantou City in the Chaozhou region of the greater Guangdong Province.



Very typical on-street E-waste dismantling operation in Guiyu. Using hammers and chisels and their bare hands, workers separate the waste into aluminum, steel, copper, plastic and circuit boards. © BAN

The investigation does not purport to be a comprehensive one, and we do not claim that what we witnessed was representative of all E-waste recycling in China. Rather, it must be seen as one view – and perhaps a view of the “tip-of-an-iceberg.” We do not know if Guiyu is the only E-waste processing center in China, nor do we know if other centers, should they exist, are similar in scale and type of operation to what we witnessed. We were told that in Nanhai, and perhaps in Guangzhou, other operations also exist, perhaps of larger scale and employing hundreds of workers each. We were also told that in Guangzhou there are operations that include the resale of used parts and the renewal of computer parts to manufacture as “new” computers.



Drinking water is routinely transported to Guiyu from Nanjing due to severe groundwater pollution. © BAN

A Community Transformed

“For money, people have made a mess of this good farming village. After they have dismantled the computers, they burn the useless parts. Every day villagers inhale this dirty air; their bodies have become weak. Many people have developed respiratory and skin problems. Some people wash vegetables and dishes with the polluted water, and they get stomach sickness.”

-- Mr. Li who has lived in Huamei village for 60 years.⁴⁵

The entire Guiyu area is actually made up of four small villages which lie along the Lianjiang River: Huamei Village, Longgang Village, Xianpeng Village, and Beilin Village (which we will refer to collectively as “Guiyu”).

Since 1995, Guiyu has been transformed from a poor, rural, rice-growing community to a booming E-waste processing center. While rice is still grown in the fields, virtually all of the available building space has given way to providing many hundreds of small and often specialized E-waste recycling shelters and yards. The types of waste and processing are often segregated, with one neighborhood, for example, involved in dismantling printers while another might process recovered plastics.

Along with the new E-waste recycling business has come serious environmental and occupational impacts, some of

which are accepted by the population and work force while other chronic toxic impacts are unnoticed as the public is unaware of the hidden threat. The likely health and environmental implications from this new industry are discussed elsewhere in this report.

One impact that has not gone unnoticed has been the deterioration of the local drinking water supply. The E-waste industry in Guiyu has been going for six years; for the last 5 years, due to groundwater pollution, water has had to be trucked in from the town of Ninjing, 30 kilometers away. The local residents claim that the water has become foul tasting. It is unknown whether the government has warned the public not to drink it. But in any case, a new business has developed with a constant parade of tractors carrying large plastic tanks of fresh water into Guiyu every day.

The relatively small scale of the many individual operations belies the magnitude of the operations multiplied in their totality. After three days of driving about Guiyu and its many back-streets and neighborhoods, we did not even come close to seeing all of the operations. Chinese press accounts placed the total employed in the E-waste sector in Guiyu at 100,000; but it would be a very difficult number to estimate, due to a fluctuating migrant workforce.

Most of the labor force working in the recycling operations comes from outlying agrarian regions. The former farmers migrate to Guiyu from provinces such as Hunan or Anhui to take the menial jobs of dismantling and processing the imported E-waste for an average wage equivalent to \$1.50 per day. Many of the workers are women and children. It is also virtually impossible to estimate how much E-waste is processed there annually. However, the anecdotal observation is one of very high turn-over with hundreds of trucks moving in and out daily, and a steady rumble and buzz of activity. These observations led us to conclude that Guiyu is a very significant destination for the world's E-waste.



Typical truckload of E-waste purchased from Nanhai for scrapping in Guiyu. © BAN

Waste Origins

Due to the institutional labels, markings, maintenance stickers and phone numbers on the computers and peripheral units, it was very easy to determine the source of the E-wastes. Most of the material was clearly of North American origin, with Japanese, South Korean, and European waste witnessed to a lesser degree.

Each business in Guiyu operates at a fairly small scale. Operators are able to purchase just single truckloads at a time. These trucks ferry the E-waste from what is reported to be four large warehouses in the port of Nanhai (see map) where the imported waste arrives in sea-going containers. The trucks used for the five-hour transport to Guiyu are smaller than sea-



Map depicting the location of Guiyu in the Chaozhou region of Guangdong Province. Most of the E-waste arrives by sea-going containers via ships at the port of Nanhai. © BAN

going containers. However, the waste clearly comes unsorted from the same containers, as the institutional labels, phone numbers and other geographic markers remain consistent with each truckload.

The Recycled Materials

Most of the activity in Guiyu involves physical dismantling by hammer, chisel, screw driver and bare hand. The most high-tech piece of dismantling equipment witnessed was an electric drill. The immediate objective of most of the operations involve dismantling -- the rapid separation of primary materials. The following materials were observed being separated for further recycling:

- **Material containing copper:** Including printer and other motors, wires and cables, CRT yokes.
- **Steel:** Including internal computer frames, power supply housings, printer parts, etc.
- **Plastic:** Including housings of computers, printers, faxes, phones, monitors, keyboards, etc.
- **Aluminum:** Printer parts, etc.
- **Printer Toner:** From spent toner cartridges
- **Circuit Boards:** These come from many applications including computers, phones, disc drives, printers, monitors, etc. *These boards were subject to further separation in other facilities as follows:*
 - **Valuable reusable processors and chips:** for resale
 - **Other chips and connectors containing gold:** for acid processing
 - **Solder:** (lead/tin base) for resale

Hazardous Recycling Operations

Toner Sweeping

Certain areas of Guiyu are dedicated to printer dismantling. In those areas the operations strictly deal with toner cartridges -- both black as well as the cyan, magenta and yellow toners of color copiers and printers. We observed that the only recycling taking place involved the small amounts of residual toner, with the black cartridge plastic largely discarded. Workers without any protective respiratory equipment or special clothing of any kind opened cartridges with screw drivers and then used paint brushes and their bare hands to wipe the toner into a bucket. The final end-use of the recovered toner is uncertain. The process created constant clouds of toner that billowed around the workers and was routinely inhaled. In the course of the workday, the worker's skin and clothing was blackened. Material Safety Data Sheets (MSDS) provided by Xerox and

Canon indicate that although carbon black and other black toner ingredients are not toxic *per se*, they will cause lung and respiratory irritation. Other documentation claims that carbon black is a possible human carcinogen. No reference indicating what chemicals are present in color toners has been found. The MSDS sheets are careful to note that under *normal* use the black toners will cause no health problems. Clearly what takes place in Guiyu is not normal use.



Worker without respiratory protection brushing carbon black toner from printer cartridge into bucket. © BAN

Open Burning

In the process of dismantling computers, a considerable amount of material is collected and dumped outside of town along the river where much of the dirtier operations of Guiyu take place. There, a small village has stood (for two years now) where the residents make their living entirely by burning these wires to recover copper. The village exists in a landscape of black ash residue which covers the ground and the houses of the village. The burning always takes place in the middle of the night, indicating that local authorities have likely frowned upon the black smoke plumes.



Child of wire-burning village eating an apple in his "back-yard" playground -- a landscape of ash and toxic residues. © BAN



Living on ash: Wire-burning village where the residents sort wires by day and burn wires by night. © BAN

It is extremely likely that due to the presence of PVC or brominated flame retardants in wire insulation, the emissions and ashes from such burning will contain high levels of both brominated and chlorinated dioxins and furans – two of the most deadly persistent organic pollutants (POPs). It is also highly likely that cancer-causing polycyclic aromatic hydrocarbons (PAHs) are also present in the emissions and ash.

Yet about 100 people live in the village, including pregnant women. Scores of small children play among the ash heaps. Drinking, cooking and washing is done with local ash-contaminated surface waters. Additionally, the village lies adjacent to two fish ponds which provide the villagers with their food and protein supply. It is extremely likely that

this food source is contaminated from the pollution.

CRT Cracking and Dumping

Prior to leaving for China we had heard reports that cathode-ray tubes (CRTs) from computer monitors and televisions were sold to China for refurbishing into “new” television sets or computers. Unfortunately, this is not what was witnessed in Guiyu. Rather, invariably we saw the copper-laden yokes from the end of the tube broken off with the CRT itself being cracked and discarded in the process. We were informed that the yokes were sold to copper recovery operations.



Open burning of wires and other parts are common to recover metals such as steel and copper. Dioxins and furans can be expected due to the use of PVC and brominated flame retardants. © BAN



Close-up of computer wires prior to burning. © BAN



Broken CRTs awaiting land disposal after the copper yoke has been removed in Guiyu, China. © BAN



Dismantler cracking a monitor to remove the copper yoke. The rest of the CRT is dumped. © BAN

In any case, the lead-laden monitor glass, which qualifies as a hazardous waste in the Basel Convention and fails U.S. EPA's leachate tests (TCLP), was regularly dumped on open land or pushed into rivers. In Guiyu itself, a former rice-growing village, the ancient granite-lined irrigation canals were routinely filled with the broken monitor glass and other un-recycled plastic E-waste. Once these were filled, bulldozers were brought in to push the material out into trucks to be hauled away elsewhere. It is likely that this routine dumping of monitor glass is at least partially responsible for the severe well-water pollution.

Circuit Board Recycling

It is likely that the most environmentally destructive recycling overall involves the recovery of the various components and materials found on electronic circuit boards.

While there are differing approaches practiced around Guiyu, the general approach to recycling a circuit board involves first a de-soldering process. Many hundreds of workers, usually women and girls, are active each day

in this endeavor. They place the circuit boards on shallow wok-like grills that are heated underneath by a can filled with ignited coal. In the wok-grill is a pool of molten lead-tin solder. The circuit boards are placed in the pooled solder and heated until the chips are removable. These are then plucked out with pliers and placed quickly in buckets.



Piles of de-soldered circuit boards, ubiquitous in Guiyu, await hauling to a dump or riverside to be burned. © BAN



Laborer de-soldering circuit boards over a coal-fired grill. Rock in the box is where boards are hit to remove solder. Pliers are used to pluck off chips which go into various buckets. The boards are then tossed into a pile for open burning. © BAN

Solder is also collected by slapping the boards hard against something such as a rock where the solder collects and is later melted off and sold. While fans are sometimes used to blow the toxic lead-tin solder fumes away, the exposure on a daily basis is likely to be very damaging.



Laborer heating aqua regia acid mixture along riverside chemical stripping operation to extract gold from imported computer chips. All waste acids and sludges are dumped into the river. The only protective equipment used are rubber boots and gloves. © BAN

The loosened chips are then sorted between those valuable for re-sale and those to be sent to the acid chemical strippers for gold recovery. Often the pins on chips will be straightened and later dipped in fresh solder to make them look new for use in the computer refabrication business, said to be prominent in Guangzhou.

After the de-soldering process, the stripped circuit boards go to another less skilled laborer who then removes



Laborer swirling aqua regia acid over computer chips to extract gold. © BAN

small capacitors and other less valuable components for separation with wire clippers. After most of the board is picked over, it then goes to large scale burning or acid recovery operations outside of town along the river where the last remaining metals are recovered. Whole riverbanks were seen full of charred circuit boards reduced to blackened fiber-glass.

This final burning process is bound to emit substantial quantities of harmful heavy metals, dioxins, beryllium, and PAH's. Some of very contaminated areas we sampled are adjacent to where circuit boards were burned (see Annexes II, III).

Acid Stripping of Chips

Much of the work to remove chips from circuit boards is done for the ultimate purpose of removing precious metals. This is most often done by a very primitive process using acid baths. Although we could not test the actual chemicals, after consulting with metallurgical experts, we are confident that the baths were in fact *aqua regia* (a mixture of 25% pure

nitric acid and 75% pure hydrochloric acid). This mixture and process was invariably applied directly on the banks of rivers and waterways. The *aqua regia* was first heated over



Another gold extraction operation utilizing aqua regia on the banks of another river near Guiyu. © BAN

small fires and then poured into plastic tubs full of computer chips. These in turn were routinely swirled and agitated to dissolve the tiny amounts of gold found inside. After many hours of this, a chemical is then added which precipitates the gold, making it settle to the bottom of the tub. This is

recovered as a mud, dried, and then finally melted to a tiny bead of pure, shiny gold.

The process resulted in huge clouds of steamy acid gases being emitted, which looked like smoke from even far away. Worse, the process resulted in the routine dumping of *aqua regia* process sludges that blackened the river banks with the resinous material making up computer chips. A quick test using pH paper on the saturated ground surrounding the tubs measured at a pH level of 0 -- the strongest level of acidity.

The men worked at this process day and night protected only by rubber boots and gloves. They had nothing to protect them from inhaling and enduring the acrid and often toxic fumes. The *aqua regia* process is known to emit toxic chlorine and sulphur dioxide gases.



Plastic computer housings separated and stacked to go to where it all is melted down for low quality further-use plastics. © BAN



Plastic chipper (foreground) and melter unit (behind) being operated without respiratory equipment. The operation melts down computer plastics possibly impregnated with brominated flame retardants -- likely creating dioxins. © BAN

whether it would be possible to filter out the dangerous hydrocarbons, including the dioxins and furans, that are likely to be produced when melting brominated flame retardant-impregnated plastic or PVC plastic.

Despite the attempt to recycle much of the plastic from the E-waste stream, it was clear that a large percentage was deemed unrecyclable due to impurities or the difficulty in separating it, or matching the colors. The result of this was that many, many tons of plastic E-waste was seen in countless piles dumped throughout the landscape and most often near waterways.

Materials Dumped

A tremendous amount of imported E-waste material and process residues are not recycled but simply dumped in open fields, along riverbanks, ponds, wetlands, in rivers,

Plastic Chipping and Melting

The plastic parts of E-waste, and in particular the housings of computers, monitors, and plastic keyboard parts, etc. were all sent to one of the Guiyu villages that was preoccupied with processing plastics.

Much time is spent there, chipping plastics into small particles, and then separating the various colors of plastics so that a clean colored remelt would be possible. Often children are employed for this tedious job. Then the chips are bagged and sent to melting and extruding operations. The melting of the computer plastics is done in rooms with little ventilation and with no respiratory protection. It is not even known if such protection were to be used,



Children sorting out tiny specks of wrong colored plastic chips. Many hundreds of bags await their eyes and fingers. © BAN

and in irrigation ditches. These materials include leaded CRT glass, burned or acid-reduced circuit boards, mixed, dirty plastics including mylar and videotape, toner cartridges, and considerable material apparently too difficult to separate. Also dumped are residues from recycling operations including ashes from numerous open burning operations, and spent acid baths and sludges. It is this indiscriminate dumping which has no doubt led to the severe contamination of the drinking water supply of Guiyu. Although we are not aware of whether the government has conducted tests of the groundwater or local sediments, BAN did take some samples along two rivers which we analysed.

Sediment and Water Sample Results

The investigative team took one water sample, one sediment sample, and three soil samples in one area along the Lianjiang River where charred circuit boards had been treated with acid and fire and dumped along the banks. A year previously, in 2000, a Hong Kong reporter from Eastweek magazine, a Chinese language journal, had visited the very same site when operations there were active. After the publication, the government halted the operations in that locale.

All of the test results taken by BAN and the reporter were analyzed by the Hong Kong Standards and Testing Centre Ltd. Later, BAN took one more sample in another location along the Lianjiang River downstream from where wires were routinely burned.

The test results revealed alarming levels of heavy metals that correspond very directly with those metals most commonly found in computers (see Annexes II and III).

The single water sample taken by the reporter in 2000 adjacent to a location where circuit boards had been processed and burned in the past, revealed lead levels that were *2,400 times* higher than World Health Organization (WHO) Drinking Water Guidelines. In December of 2001, when BAN visited the site, the levels were found to still be *190 times* the threshold WHO level.



Irrigation canal now used for CRT glass dump.
© BAN

This likely demonstrates that the sediment and soil remain saturated with pollution.

Sediment samples were also astonishingly contaminated. A sediment sample taken near the above river location, showed lead *212 times* higher than what would be treated as hazardous waste had it been dredged from the Rhine River bottom in the Netherlands. Likewise other heavy metals found in circuit boards and in CRTs were found in very high quantities. Barium was found at levels almost 10 times higher than an EPA threshold for environmental risk in soil. Tin was found at levels 152 times the EPA threshold. Chromium in one sample was at

levels 1,338 times the EPA threshold level. And copper in another sample (which in fact appeared to be a dumped residue from some recycling process found on the banks of a river) was an astounding 13.6% of the total.

Of course these spot samples cannot provide a comprehensive view of the contamination levels of Guiyu and environs. It is imperative therefore that serious data be gathered on both human



Dump of acid treated circuit boards and processing residues along the Lianjiang River. © BAN

and environmental health in the region. Rather, these samples reveal that in some locations, Guiyu is very seriously polluted, and signal an urgency to find out how widespread the problem really is, and how far it has impacted the health of the community and its residents.

India and Pakistan

Very preliminary investigations in both Pakistan and India reveal that these countries are receiving and processing western originated E-waste in similar processes to what was observed in China. It is clear from these first glimpses of operations in these two South Asian countries that the migration of E-waste to Asia is not limited to China. Indeed, it may well be that as China begins to enforce its laws, more and more may be flowing to countries with even less infrastructure and government ability to protect its citizens from the environmental and occupational impacts than China possesses. If anything, the first look at India and Pakistan reveals the

conditions to be even worse than those found in China. For example, in Pakistan, circuit boards are de-soldered with blowtorches with no ventilation fans and acid operations take place indoors with less ventilation. In India, open burning of circuit boards in the middle of New Delhi neighborhoods is routine as is the use of child labor to accomplish these tasks.

E-Waste Recycling in Karachi, Pakistan

Sher Shah in Karachi is one of the principle markets for second hand and scrap materials in Pakistan where all sorts of electronic, electrical, spare parts, computers and smuggled goods arrive by sea and land for sale or further distribution to other cities in Pakistan. Sher Shah serves as an open informal market, without state controls of any kind. Some of the primary warehouses for scrap computers in Sher Shah include H-Akbar, Quality, and Al-Faisal.

Countries from which the computer waste/scrap comes include: Australia, Japan, England, the United States, Kuwait, Saudi Arabia, Singapore, and the United Arab Emirates (UAE).

Dubai, the capital city of UAE appears to be one of the primary predistribution centers between Europe and South Asia. Another of these is Singapore. Pakistani businessmen purchase the E-waste from Dubai and forward it to Karachi in sea-going containers. Typical costs of a scrap purchase in Dubai is around 35-40 Pakistani Rupees (PKR) (65 US

cents) per kilogram, including all expenses, whereas costs from Singapore were reported as being around PKR 200 or (US \$3.27) per kilogram.

After reaching the port, custom officials scatter the waste out and impose duty on various items according to their value and use. Thereafter the material is brought to large warehouses. Other than the duty officers, there is no authority to question the import or subsequent

recycling and disposal in Pakistan. The warehouses work as open markets from where buyers procure items either for re-use applications or for scrap processing. It is stated that only 2% out of this whole bulk can be re-used with slight repair, while the rest is used for extraction of metals and plastics.

Products extracted from the computers include: copper, gold, platinum, plastics, lead, and glass. No special equipment or protective clothing of any kind is used. All the work is done by the bare hand. The main parts of the computers are separated,

which include monitors, key boards, mother boards, casing, processors, floppy drives, CD drives and circuit boards.

Monitors

The copper yoke coils found around the picture tube end are the main item dealers look for and which are later smelted for copper alone. The glass and plastic housing are simply dumped and thereafter scavengers pick their share. The plastic casing of the monitor is either burned openly or is sold at a price of PKR 10 per kilo.



Imported computers piled high at one of the warehouse yards in Sher Shah. © SCOPE



Scavengers picking through E-waste dump near Sher Shah, in Karachi. © SCOPE

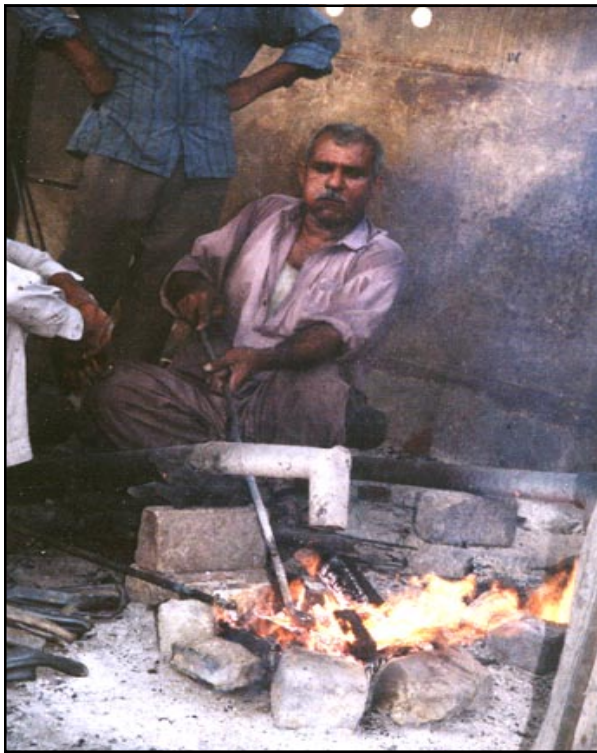
CD and Floppy Drives

If drives are repairable or usable they are sold in the market; if not, they are broken into pieces with circuits and other parts separated accordingly.

Circuit Boards, including Motherboards, Cards, Chips and Processors

The methods by which these metals are extracted are very harmful to the workforce due to the fumes emitted during their burning and melting. The circuit boards are first heated by blow-torch and then the valuable chips are removed for further sale or precious metal extraction. Flame is directly applied to the board to remove the remaining solder which is sold at the rate of 120 Rupees per kg.

The material removed from the boards that is suspected of containing gold is taken to another operation known as



"Goldsmith" at the "adda" melting down gold bead extracted after acid stripping process. © SCOPE

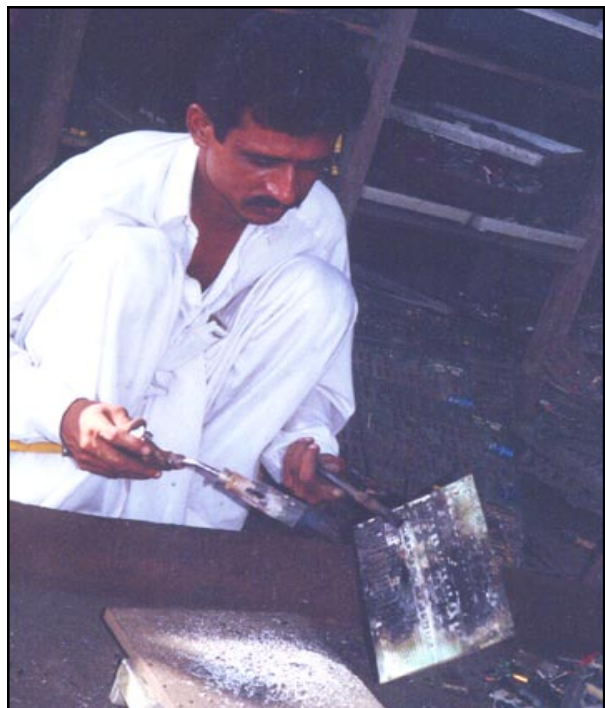
"Adda" (in local language). It is a very primitive smelting operation where workers sit before a small fire-pit fueled by wood and coal and where air is forced by fans and pipes into the fire to increase the heat. Here the material is melted to form a ball which in the local language is called a "sikka". After this melt, the ball of metal is then placed into acid baths. The effect of the acid segregates the metals



Worker de-soldering circuit boards with a Bunsen burner in Sher Shah. © SCOPE

from one another. A chemical powder is then applied to further segregate the copper and gold. Platinum can also be removed but this is not done frequently. Then the "goldsmiths" reduce the gold further by melting it into a small bead.

Interviews reveal that the workers and the general public are completely unaware of the hazards of the materials that are being processed and the toxins they contain. There is no proper regulatory authority to oversee or control the pollution nor the occupational exposures to the toxins in the waste. Because of the general poverty people are forced to work in these hazardous conditions. Some say that they don't like the putrid smell, but now claim they've become accustomed to it.



Worker using propane torch to de-solder circuit boards. © SCOPE

E-Waste in New Delhi, India

In New Delhi the E-waste trade is a thriving business. Areas visited in Delhi included Mandoli, Sader Bazar, Kanti Nagar Extension, Old Sealampur and Turkmangate. Indian E-waste dealers make bids on sea-going containers at the inland depot situated at Okhala. The material is taken out, sorted and distributed between various recyclers according to areas of specialization.

Mr. Chander Mohan, Director of PRCM Metal Limited described the trade. He obtains scraps from



Women plucking components from circuit boards with pliers and wire cutters in New Delhi. © Toxics Link India



Burning of circuit boards for solder and copper in Delhi. © Toxics Link India

abroad as well as domestically. He revealed that the Gulf countries and in particular the city of Dubai serve as centers where scrap and wastes of all kinds from America, Europe, and West Asian countries are collected and re-exported. Major buyers from Dubai include China, Pakistan, and India. Mr. Mohan also disclosed that Dubai-based exporters are well aware of the Indian domestic scrap market and due to this they keep the price of any scrap at par with the Indian market price.

The circuit board recycling process involves either open burning of the circuit boards or using acid stripping. Both processes first involve removal of the chips, condensers and capacitors from the boards. Very often child labor

is employed to separate the parts from the circuit boards utilizing wire cutters and pliers. After some pin straightening, some of the IC chips and components are old for re-use. The items that are not worthy of re-use go directly to the outdoor fires to reduce them to metals. Following the chip extraction and burning, the boards themselves are burned in an open pit to retrieve the rest of the solder and copper. After burning, the ashes are floated in water to remove lighter ash.

Another process involves utilizing nitric acid on the circuit boards to remove gold and platinum. Both methods, open burning and acid baths, are fraught with occupational health risks as well as risks to the people living in the surrounding community. Investigators from Toxics Link India became dizzy within just an hour of breathing the heavy air pollution.



Young boy separating parts from circuit boards, Delhi. © Toxics Link India

Environmental and Occupational Impacts in Asia

Computer / E-Waste Component	Process Witnessed in Guiyu, China	Potential Occupational Hazard	Potential Environmental Hazard
Cathode ray tubes (CRTs)	Breaking, removal of copper yoke, and dumping	- Silicosis - Cuts from CRT glass in case of implosion - Inhalation or contact with phosphor containing cadmium or other metals	Lead, barium and other heavy metals leaching into groundwater, release of toxic phosphor
Printed circuit boards	De-soldering and removing computer chips	- Tin and lead inhalation - Possible brominated dioxin, beryllium, cadmium, mercury inhalation	Air emission of same substances
Dismantled printed circuit board processing	Open burning of waste boards that have had chips removed to remove final metals	- Toxicity to workers and nearby residents from tin, lead, brominated dioxin, beryllium, cadmium, and mercury inhalation - Respiratory irritation	- Tin and lead contamination of immediate environment including surface and groundwaters. - Brominated dioxins, beryllium, cadmium, and mercury emissions
Chips and other gold plated components	Chemical stripping using nitric and hydrochloric acid along riverbanks	- Acid contact with eyes, skin may result in permanent injury - Inhalation of mists and fumes of acids, chlorine and sulphur dioxide gases can cause respiratory irritation to severe effects including pulmonary edema, circulatory failure, and death.	- Hydrocarbons, heavy metals, brominated substances, etc. discharged directly into river and banks. - Acidifies the river destroying fish and flora
Plastics from computer and peripherals, e.g. printers, keyboards, etc.	Shredding and low temperature melting to be reutilized in poor grade plastics	Probable hydrocarbon, brominated dioxin, and heavy metal exposures	Emissions of brominated dioxins and heavy metals and hydrocarbons
Computer wires	Open burning to recover copper	Brominated and chlorinated dioxin, polycyclic aromatic hydrocarbons (PAH) (carcinogenic) exposure to workers living in the burning works area.	Hydrocarbon ashes including PAH's discharged to air, water, and soil
Miscellaneous computer parts encased in rubber or plastic, e.g. steel rollers	Open burning to recover steel and other metals	Hydrocarbon including PAHs and potential dioxin exposure	Hydrocarbon ashes including PAH's discharged to air, water, and soil
Toner cartridges	Use of paintbrushes to recover toner without any protection	- Respiratory tract irritation - Carbon black possible human carcinogen - Cyan, yellow, and magenta toners unknown toxicity	Cyan, yellow, and magenta toners unknown toxicity
Secondary steel or copper and precious metal smelting	Furnace recovers steel or copper from waste including organics	Exposure to dioxins and heavy metals	Emissions of dioxins and heavy metals

Legal Implications of Export

Is E-Waste A Hazardous Waste?

There is no question that much of E-waste is a hazardous waste from a scientific/toxicological standpoint. From a legal standpoint, however, the issue has become murky and is dependent on how seriously a government intends to deal with the hazards. In the following sections we will observe how various governments have regulated E-waste and additionally, we will look at the international common denominator – the Basel Convention.

With the exception of Canada and the United States, governments around the world consider E-waste components hazardous wastes and thus tightly control their disposal and export. For most of the industrialized countries, this means banning the export to non-OECD countries and requiring a form of notification and consent to all others. Even those that have not yet implemented the Basel Ban Amendment are expected to abide by it prior to its legal entry into force. Virtually all governments, except the U.S., require *at least* “prior informed consent” for toxic E-waste exports.

It is ironic that a landmark toxicity indicator – the Toxic Characteristic Leachate Procedure test (TCLP) developed by the U.S. is, nevertheless being ignored by it, through various legal exemptions (see the following section on U.S. Law). These exemptions are not based on science but rather on politics and economics.

The TCLP is meant to replicate long-term conditions in a landfill which allow heavy metals or other toxic chemicals to leach out. The regulatory level for lead in the U.S. is a TCLP of 5.0 mg/L. TCLP levels for monitors due to lead concentrations in the glass test out to be on average about 18.5 mg/L for lead.⁴⁶ Thus monitors fail the TCLP. Circuit boards are far higher in leachable lead content. According to a study by the Australian government, TCLP levels of lead in circuit boards were found to range from 142 to 1,325 mg/L.⁴⁷

Import/Export Controls on Some E-Wastes due to their Hazardous Designation by Various Countries and the Basel Convention

	Whole Circuit Boards*	Shredded Circuit Boards*	Cathode Ray Tubes	PVC or Plastics Coated or Impregnated with Brominated Flame Retardants**	Whole Computers or Monitors***
Basel Convention	Controlled	Controlled	Controlled	?	Controlled
Australia	Controlled	Controlled	Controlled	?	Controlled
Austria	Not controlled for exports to OECD but controlled for non-OECD	Controlled	Controlled	?	Controlled
Switzerland	Controlled	Controlled	Controlled	?	Controlled
United States	Not controlled	Not controlled	Not controlled	Not Controlled	Not controlled
China	Import banned	Import controlled	Import banned	Import controlled	Import banned

** Circuit boards are considered hazardous by virtue of the fact that they contain lead, mercury, nickel-cadmium batteries, etc. If they did not contain these materials then they might not be considered hazardous.*

***Plastics containing BFRs and PVC are listed here to highlight the fact that most of the world is ignoring this serious issue. Under the Basel Convention they could be considered hazardous particularly if they are converted to dioxins and furans during the recycling or disposal process or contain brominated or chlorinated dioxins and furans as contaminants. But far too little study has been done on the downstream impacts of these “dirty” plastics.*

****The Basel Convention contains some vague language with respect to whether whole computer waste is hazardous but for those countries such as Australia that have carefully considered the Basel definitions, the conclusion is rather certain that these wastes are to be controlled as hazardous waste, unless they have been stripped of all hazardous materials*

On this page is a table showing how some countries and the Basel Convention look at computer wastes and the need for import/export controls on them based on their hazardousness.



U.S. Policy and Law

The Recycling Loophole

“The current situation is that the U.S. is exporting electronics and it is not being regulated, and we don’t intend to regulate it. . . . Our policy is that none of it should be hazardous waste; we want it recycled.”

— Bob Tonetti, US Environmental Protection Agency⁴⁸

If the United States were to finally ratify the Basel Convention and the Basel Ban Amendment then of course they would be obliged, as are the 15 member states of the European Union, to ban the export of hazardous E-wastes to China. The U.S. would also have to seriously revise its laws to remove gaping loopholes and exemptions allowed for recyclable wastes. The United States is the only developed country in the world that has not ratified the Basel Convention, even 13 years after its adoption.

In the U.S., not only is it legal to export hazardous E-waste, but in fact, the Resource Conservation and Recovery Act (RCRA)⁴⁹ has been amended and contorted over time to actually encourage its export by exempting it from export controls of any kind.

RCRA originally controlled more hazardous waste than it currently does. Over the years, RCRA has exempted more and more toxic wastes simply because they are claimed to be destined for recycling operations. The concept of pretending a material is not hazardous simply because it is being recycled is an unscientific, dangerous policy and in fact, is a uniquely North American one. Most countries have accepted and adopted the definitions and policies of the Basel Convention, which makes no distinction between wastes bound for recycling and final disposal in its hazardous waste definitions and controls.⁵⁰

The concept of pretending a material is not hazardous simply because it is being recycled is an unscientific, dangerous policy and in fact, is a uniquely North American one.

The U.S. has adopted this misguided policy despite the fact that historically hazardous waste recycling is responsible for about 11% of U.S. superfund sites and represents some of the most polluting enterprises ever known.⁵¹ The policy was adopted despite the fact that all recycling involves some final disposal of residues. Indeed, what we have discovered in Asia indicates that very much of the imported material ends up being dumped as non-recyclables or is released as residues, or emissions to air.

The deregulation of hazardous wastes for recycling is particularly troubling because RCRA controls exports of hazardous wastes. Thus, by exempting E-wastes from export regulations, the U.S. subjects the rest of the world to its policy of ignoring the inherent risks in a material simply because somebody claims on a bill of lading that the material will be recycled.

While in the past, RCRA never actually banned such exports; it did, however, require a regime of “prior informed consent” so that recipient countries would have to at least agree to importing the wastes prior to receiving them. Furthermore, the United States helped push the OECD into rescinding an earlier OECD Council Decision which bound the United States to “prior informed consent” controls.

By exempting E-wastes from export regulations, the United States subjects the rest of the world to its policy of ignoring the inherent risks in a material simply because somebody claims on a bill of lading that the material will be recycled.

It has been demonstrated too often in the history of waste trade schemes that waste traders can easily claim a recycling destination for any waste. Once the RCRA loophole is proclaimed, it is impossible for the EPA to have any authority to determine whether the exports are truly bound for recycling, whether the recycling is environmentally sound, or whether the wastes are simply being dumped abroad.

By providing this gaping recycling loophole the EPA no longer can enforce any controls over exports of hazardous wastes and its eventual disposal. This is a very dangerous policy not only for foreigners subjected to the hazards, but it could also come back to haunt the generators and exporters in the form of liability and compensation claims.

The Australian government, in a rare rebuke, said this about the U.S. recycling loophole:

“This distinction does not make it possible to ensure that exports are truly for legitimate recycling as opposed to “sham” recycling or final disposal. . . . In general, the US EPA position is based on assumptions of environmentally sound recovery that are appropriate at a domestic level, but which do not accommodate the requirements of the Basel Convention, that exports to other countries be managed in an environmentally sound manner.”⁵²

Promoting Environmental Injustice

The Basel Convention calls for all countries of the world to become self-sufficient in waste management and to minimize all transboundary movements of hazardous wastes. The Basel Ban Amendment forbids the export of hazardous wastes from Organization of Economic Cooperation and Development (OECD) to non-OECD countries.

However, rather than working to fulfill the global obligation of national self-sufficiency in waste management set forth in the Basel Convention, the U.S. is actually investing time and money in developing a program to establish minimum criteria for environmentally sound management (ESM) for countries to follow. The U.S. then hopes to eventually promote exports to developing countries who meet this minimum criteria. This work is being heavily promoted by the U.S. and is being formulated within the OECD's framework.⁵³ The goal of all of this is to be able to continue exporting wastes to developing countries in Asia and elsewhere via the password of "recycling" and with an ESM seal of approval.

Because the series of OECD meetings on ESM in Recycling Operations have pointedly been designed and funded by countries wishing to undermine the Basel Ban, non-governmental organizations, Clean Production Action, Basel Action Network, and Greenpeace International, have all boycotted and denounced the meetings.⁵⁴

Even if one did not believe in the principle that wastes should be handled by those responsible for creating them; and even if one somehow believed, against all evidence, that it would be possible in developing countries to operate state-of-the-art hazardous waste recycling facilities; even if one further believed that the infrastructure and resources in developing countries would be present to ensure optimal operation of such recycling technologies (when we can't even manage our own smelters in this country without grotesque levels of pollution) - the fact would remain that the waste exporting country would have transferred the inevitable by-products of hazardous waste recycling to the recipient country. These would include: harmful residues, emissions, and mountains of non-recyclable trash to be dealt with. Why should Asia be the recipient of all of the world's E-waste simply because they are relatively poor?

While the United States talks a good talk about the principle of Environmental Justice at home for their own population, they work actively on the global stage in direct opposition to it.

This mentality now perpetuated by the United States is an affront to the principle of environmental justice, which ironically was pioneered in the United States and championed by the EPA domestically.⁵⁵ The principle states that no people because of their race or economic status should bear a disproportionate burden of environmental risks. While the United States talks a good talk about the principle of environmental justice at home for their own population, they work actively on the global stage in direct opposition to it.

Indeed, facilitating the rapid departure of toxic E-waste from U.S. soil seems to be a priority for the EPA. According to Bob Tonetti, of the EPA Office of Solid Waste:

"I feel strongly about preserving the export markets for electronics because otherwise we would not be collecting electronics in the U.S. Do you think we're going to build new smelters in the U.S.? No, I don't think so."⁵⁶

In other words, as we're closing down heavy metal emitting smelters across the U.S. in order to protect our own people and environment, we are more than ready to export to smelters and other dangerous technologies abroad.

Exemptions, Exemptions, Exemptions

It is abundantly clear under RCRA that without the recycling loopholes and exemptions, circuit boards and CRTs would be considered hazardous waste as these materials exceed the threshold for lead in the EPA's Toxic Characteristic Leaching Procedure (TCLP) test. This means that the materials are expected to leach lead over time when deposited on land or in a landfill. Under RCRA these circuit boards and CRTs have an EPA hazardous waste number of D008 under 40 CFR 261.24, and thus meet the determination of hazardous waste under 40 CFR 261.3.

But rather than controlling these toxic materials as intended under RCRA, numerous exemptions are now available to avoid regulation. These exemptions make no scientific sense but are a result of an industrial lobby, eager to remove EPA controls and avoid manufacturer responsibility for creating hazardous materials.

Most E-waste is essentially exempt from federal regulation, one way or another, unless the waste generator is a large volume generator who has spent the money to test the hazardous material, notifies the EPA, and admits that the waste is going to be disposed of rather than recycled. RCRA exemptions for hazardous electronic waste include:

- **Household E-waste Exemption** -- No matter how toxic the waste, if it is generated by any household in the U.S., it is exempt from federal regulations.⁵⁷ This is why many toxic electronics are ending up in landfills. Although there are no figures available for the amount of household E-waste generated on a national scale, local jurisdictions have produced some interesting data. (see “The Story of Seattle, King County” section for some numbers).
- **Conditionally Exempt Small Quantity Generators** -- Small businesses are exempt as long as certain conditions are met: they must generate less than 220 pounds/month (about 7 - 8 computers/month) of hazardous waste; and the waste must be placed in sufficient containers, etc. This is a loophole created for small businesses.⁵⁸
- **Large volume generators** -- Corporations and institutions are not exempt from regulation completely, like households and small businesses; *however*, their E-waste falls out of RCRA through other exemptions:
 - **Processed Scrap Metal Exemption** -- Circuit boards with lead and mercury are exempt from the definition of solid waste, and therefore from designation as a hazardous waste because of the processed scrap metal exemption for recycled materials.⁵⁹ This exemption applies as long as they have “minimal quantities” of mercury and nickel-cadmium or lithium batteries. “Minimal quantities” is not defined by the EPA but left up to the waste generator to determine, should they desire. Processed scrap metal must also be stored in “sufficient containers” (cardboard boxes are acceptable) and must be recycled (including export) in order to qualify as exempt.
 - **Precious Metal Exemption** -- If a company generating shredded circuit boards admits to having more than the undefined “minimal quantities” of mercury and batteries, their toxic material can still avoid regulation under the “precious metal exemption” simply because it has economic value. This conditional exemption is based on the presumption that because they have precious metals in them, “these materials will be handled protectively as valuable commodities”.⁶⁰ Thus despite the presence of lead, tin, brominated flame retardants, more

than “minimal quantities” of mercury and cadmium or lithium batteries, they are still exempt from regulation.

- **Computer Monitors** from large volume generators are not handled as hazardous waste if they are going for recycling, even though they have failed the EPA’s test for lead toxicity. Because of poor federal regulation of monitors, some states such as Massachusetts and California have gone beyond RCRA regulations and have banned them from their landfills, even if they originate from households and small quantity generators.
- **Plastics** with toxic brominated flame retardants are going to landfills and incinerators around the U.S. as they are not considered hazardous under RCRA.

The EPA is in the process of proposing a “Special Rule” for CRTs that would control CRTs if they are broken, but would continue to allow all households and small quantity generators to send toxic monitors and circuit boards to landfills, and continue to lift controls on exports as long as recycling destinations are claimed.

In sum, the widespread exemptions for electronic waste have been specifically designed to remove regulatory barriers not only from domestic recycling, but also from exporting these hazardous wastes offshore. While other countries are accurately identifying the lead, mercury, cadmium, and brominated flame retardants in some electronic waste and treating them accordingly as hazardous waste, the United States is facilitating the departure of these toxic wastes to developing countries where people and environments are being impacted at alarming rates.

Chinese Law

China was one of the first global proponents for an international ban on the export of toxic waste from developed to developing countries. It is significant that the 1994 proposal which became the basis for the decision to ban such waste trade in the Basel Convention on the Transboundary Movements of Hazardous Wastes and Their Disposal was sponsored by the Group of 77 (G-77) and China. Further, in the late 1990’s, China and Hong Kong became the recipients of unwanted imports of hazardous and other nuisance wastes from North America, Australia, and Europe. These rogue imports persuaded China to pass swift orders to halt such hazardous waste trade.

Does RCRA Regulate the Most Toxic Computer Parts?

	CRT (Cathode Ray Tube) / Monitor			Circuit Boards (Whole or Shredded)			Plastics Coated or Impregnated with Brominated Flame Retardants	
Toxins	Lead, Phosphorus, Barium, Cadmium, other heavy metals			Lead, Cadmium, Mercury, Tin, and Brominated Polymer Resins			Polybrominated Diphenylethers (PBDE); Polybrominated Biphenyls (PBB)	
Does it pass US EPA TCLP Test?	No*			No**			No known test	
Activity or Destination	Domestic Recycling	US Landfill (except MA)	Export	Domestic Recycling	US Landfill	Export for Recycling	Landfill	Export for Recycling
Exempt or Regulated under current law and/or practice?	Not regulated	Exempt - if coming from household and small quantity generators (with minimal conditions); Regulated - if coming from large generators and identified by the generator as hazardous waste.	Not regulated if claimed for recycling	Exempt	Exempt - if coming from household and small quantity generators (with minimal conditions); Regulated - if coming from large generators and identified by the generator as hazardous waste.	Exempt	Not regulated	Not regulated

* Study conducted by University of Florida (please refer to endnote 46)

** Result cited by Environment Australia (please refer to endnote 47)

China was one of the first global proponents for an international ban on the export of toxic waste from developed to developing countries.

In 1996, China passed the Law on the Prevention and Control of Solid Waste Pollution to the Environment which, among other things, (a) prohibits the import of solid wastes which are unusable as raw materials, and (b) strictly regulates the imports of solid wastes that can be used as raw materials.⁶¹

Indeed the law stipulates, *“Anyone who, in violation of the provisions of this Law, dumps, piles, or disposes of solid wastes moving into the territory from outside the territory of China, or imports solid wastes for use as raw materials without obtaining approval from the competent department*

concerned under the State Council, shall be ordered to transport back and return the solid wastes and may be imposed a fine exceeding 100,000 yuan and not exceeding 1,000,000 yuan concurrently by the Customs. Anyone who evades Customs supervision and control and constitutes a crime of smuggling shall be investigated for criminal responsibility according to the law.”⁶²

The law contains annexes of wastes that are allowed or prohibited as raw material imports. As a result, many hazardous wastes are forbidden from being imported.

Still it surprised many, that in February 2000, China made public SEPA Document No. 19/2000 of January 24, 2000. This document entitled, “Notification on Import of the Seventh Category of Wastes,” announced the following new law: *“From February 1, 2000, the seventh category of wastes*

approved by the State Environmental Protection Administration for import shall not include the following:

- computers, monitors, and CRTs
- copiers
- microwave ovens
- air conditioners
- video cameras
- electric cooking devices, rice cookers
- telephones (except for pay-phones)
- video games (except for processing for re-export)
- televisions and picture tubes
- refrigerators.

From April 1, 2000, the Customs Administration will not allow the entry of the above mentioned abandoned electrical appliances.”

From the results of our mission to China, and the common knowledge in the recycling community in developed countries of the OECD group, this law appears to be poorly enforced. The reasons for this are as yet unclear. It is not known whether this widespread flouting of the national law is due to a lack of enforcement will or infrastructure. Likely it has to do with both – a lack of will on the part of local officials and a lack of infrastructure on the part of the central government.

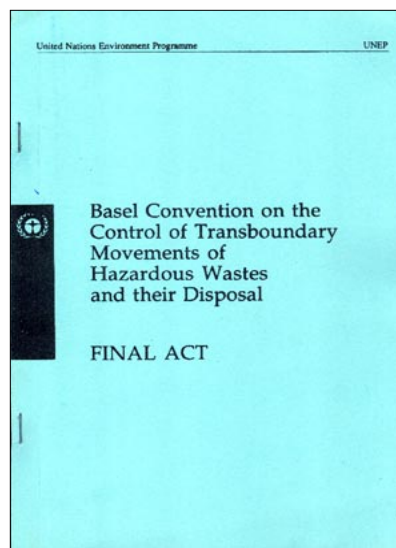
In January of 2002, representatives of the Basel Action Network (BAN) raised the issue of E-waste exports to China and our recent discoveries with Mr. Zhong Bin, Program Officer of SEPA and delegate to the Basel Convention’s most recent meetings of their Legal and Technical Working Groups. Mr. Zhong Bin expressed gratitude for our information and further expressed real concern. He reiterated that whole computers, CRTs, monitors, printers, etc. were strictly forbidden from entry into China.⁶³

He reiterated that whole computers, CRTs, monitors, printers, etc. were strictly forbidden from entry into China.

According to Mr. Ma Hongchang of the Solid Waste Management Division of SEPA in Beijing, a possible revision and further elaboration of the existing rules will be forthcoming this year.⁶⁴

Finally, it must be noted that on May 1, 2001, China ratified the Basel Ban Amendment which effectively will forbid the export of Basel hazardous wastes from OECD, EU, and Liechtenstein to all non-OECD countries including China. While there is no legal obligation placed on China from this

Amendment (as they would not be OECD exporters), this move nevertheless demonstrates conclusively China’s support for the Basel Convention and its overarching goal of national self-sufficiency in waste management.



The Basel Convention and the Basel Ban Amendment

The Basel Convention on the Control of the Trans-boundary Movement of Hazardous Wastes and Their Disposal was adopted in 1989 and entered into

force in 1992. It was created to prevent the economically motivated dumping of hazardous wastes from rich to poorer countries. There are now, as of this printing, 149 countries that have ratified the Convention and are thus “Parties” to it.

In its original version, the Convention called for national self-sufficiency in hazardous waste management, and for the overall minimization of hazardous waste generation and transboundary movements of such wastes.

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If wastes are to be moved under the Basel Convention—for example if a country lacks adequate technical capacity to deal with a waste domestically - the exporting country must not allow the export “if it has reason to believe that the wastes in question will not be managed in an environmentally sound manner (ESM).”⁶⁵ The Convention defines “environmentally sound management” as “taking all practicable steps to ensure that hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes.”⁶⁶

The Convention also requires that such export must utilize a paperwork authorization regime known as “prior informed

consent” or PIC. PIC calls for exports of hazardous wastes to be allowed only with the written consent from the recipient country.⁶⁷ However, despite these original obligations stipulated in the Convention, the enormous economic pressures to import hazardous waste faced by many developing countries, threatened to undermine the Basel Convention’s goals of national self-sufficiency, waste minimization and minimization of its transboundary movements.

For this reason the Parties to the Basel Convention adopted a decision⁶⁸ in 1994 calling on all countries belonging to the OECD⁶⁹ group of states to ban the export of hazardous wastes to non-OECD countries. Then in 1995 the Parties reiterated their concern by installing the ban as an amendment to the Convention.⁷⁰

The Basel Ban Amendment effectively prohibits all exports of hazardous wastes from member states of the OECD, the European Union (EU), and Liechtenstein to all other countries.

The Basel Ban Amendment prohibits all exports of hazardous wastes from member states of the OECD, the European Union (EU), and Liechtenstein to all other countries, and will enter into legal force after it receives 62 ratifications. Currently, while the total number of ratifications has reached 28, it is being honored by most Basel Parties and in fact has already been implemented by the majority of OECD countries including all EU member states, Norway, Liechtenstein, Monaco, and Iceland.⁷¹

It must be stated that among OECD countries, the United States stands alone in not having even ratified the original Basel Convention, let alone the Basel Ban Amendment. This is significant, as it allows the U.S. to escape the Basel obligation for national self-sufficiency and the assurance of ESM in recipient countries. It is also significant in that the Basel Convention forbids Parties from trading with non-Parties. Thus, under Basel, it is illegal (even without the ban) for India, Pakistan, China, and other Basel Parties to import hazardous E-waste from the United States.

Among OECD countries, the United States stands alone in not having even ratified the original Basel Convention, let alone the Basel Ban Amendment.

Further, Canada, Australia, Japan, and South Korea, although Parties to the Convention, have a well known antipathy towards the Basel Ban Amendment and continue to work with the United States to undermine its efficacy and entry into force.

Among developing countries that are the subject of this report, it must be noted that China, an ardent sponsor and supporter of the Basel Ban, has ratified it. The Indian Supreme Court has likewise reflected the Basel Ban in their directive of May 1997, still in force, prohibiting the import of hazardous wastes into India. Pakistan, as a Basel Party, will respect the decision even prior to its strict entry into legal force.

Basel “Waste” and “Hazardous Waste” Definitions

The Basel Convention defines waste by disposal destination or recovery processes. These various processes are listed in Annex IV of the Convention. For example, virtually any material that will be recycled or processed in order to reclaim a metal, or to reclaim an organic or inorganic substance for further use, is deemed a waste. Electronic components that are re-used without any further processing are likely to not be defined as a waste.

The Basel Convention does not cover all wastes but rather is meant to control “hazardous wastes” as well as “wastes collected from households” and “residues arising from the incineration of household waste”.⁷²

In 1994, to better clarify what wastes are controlled under the Convention, the Basel Parties established two lists of wastes that correspond to common waste streams: List A, found in Annex VIII, is presumed to be hazardous and thus covered by the Basel Convention; and List B, found in Annex IX, is presumed to be non-hazardous and thus not subject to the Basel Convention.

The Annex VIII hazardous waste list has the following applicable entries to E-waste:

- A1010 Metal wastes and wastes consisting of alloys of any of the following: antimony, arsenic, beryllium, cadmium, lead, mercury, selenium, tellurium, thallium.
- A1020 Waste having as constituents or contaminants, excluding metal waste in massive form, any of the following: antimony, antimony compounds, beryllium, beryllium compounds, cadmium, cadmium compounds, lead, lead compounds, selenium, selenium compounds, tellurium, tellurium compounds.
- A1030 Wastes having as constituents or contaminants any of the following: arsenic, arsenic compounds, mercury, mercury compounds, thallium, thallium compounds.

- A1160 Waste lead-acid batteries, whole, or crushed.
- A1170 Unsorted waste batteries excluding mixtures of only List B batteries. Waste batteries not specified on List B containing Annex I constituents to an extent to render them hazardous. [List B batteries include: waste batteries conforming to a specification, excluding those made with lead, cadmium, or mercury]
- A1180 Waste electrical and electronic assemblies or scrap containing components such as accumulators and other batteries included on List A, mercury-switches, glass from cathode-ray tubes and other activated glass, and PCB-capacitors, or contaminated with Annex I constituents (e.g., cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they possess any of the characteristics contained in Annex III.
- A2010 Glass waste from cathode-ray tubes and other activated glasses destined for direct reuse, and not for recycling or final disposal.

It is also important to note that the Basel Convention's List B includes:

- B1110 Electrical and electronic assemblies (including printed circuit boards, electronic components, and wires) destined for direct re-use, and not for recycling or final disposal.

From the above we can gather that at the very least, circuit boards, CRTs, and other electronic boards or components and assemblies containing lead based solders and copper beryllium alloys (which includes most computer circuit boards and much other electronic equipment), are indeed hazardous wastes according to the Basel Convention. Likewise, whole, used, discarded computers, printers, and monitors that contain such circuit boards or CRTs that are not to be re-used directly are to be considered as hazardous waste and subject to the Basel Convention.



A strong case could also be made that plastics that are impregnated with brominated flame retardants and are exported for remelting and recycling are also covered under the Convention.⁷³

Witnessed E-Waste Exports are Illegal

Clearly, from the above review, we can see that the export of E-waste as it has been witnessed in China, India, and Pakistan is in violation of the Basel Convention and the Basel Ban Amendment.

Such export of E-wastes violates the Convention since the wastes are not being exported to operations that have "environmentally sound management" in accordance with the Convention. Such exports also violate the PIC procedures outlined in the Convention.

Furthermore, the exports are in violation of the spirit, if not, the letter of the Basel Ban. For the countries that implemented the Basel Ban, including all of the countries of the European Union, exports to a non-OECD country are illegal. For all other OECD countries, the exports will violate the decisions that created the Basel Ban. While some claim such decisions are not strictly legally binding, they are considered morally binding on all Parties.

Finally, with respect to the United States, it is illegal for all other Basel Parties, including India, Pakistan, and China to import wastes from the United States due to the fact that the U.S. is not a Party to the Convention.

The export of E-waste as it has been witnessed in China, India, and Pakistan is in violation of the Basel Convention and the Basel Ban Amendment.

To date, such violations of the Convention and the Basel Ban Amendment have gone unnoticed or ignored. It is imperative that these illegal practices be terminated at once.

The Dilemma of Local Governments

Saddled with the Problem

Increasingly, all over the United States, state and local governments are caught in a bind from an E-waste crisis not of their making. In order to protect their local environment and landfills from excessive toxic waste dumping and avoid future liability from polluting landfills, the order of the day has so far been to try and divert as much E-waste as possible from landfills to recyclers. Yet local solid waste agencies have no real authority to prevent dumping of E-wastes into landfills as long as state and federal laws exempt households and small generators from regulation. Thus, conscientious governments have initiated advertising and voluntary campaigns aimed at educating consumers and promoting recyclers.

The principle of diversion of waste from landfill to recycling has become a holy grail for solid waste officials despite the fact that many of them have not really investigated what or where they are diverting the waste to.

The principle of diversion of waste from landfill to recycling has become a holy grail for solid waste officials despite the fact that many of them have not really investigated what or where they are diverting the waste to. They have, like far too many, held a blind faith in the word “recycling” without considering the implications of export and the basic fact that where hazardous materials are concerned, “recycling” can be a very dirty, polluting business.

The Story of Seattle and King County in Washington State

King County, the largest county in Washington State, includes the City of Seattle as well as 37 other municipalities. Although geographically located within King County, the City of Seattle is responsible for managing its own solid waste and recycling programs. With 60% of local households owning at least one computer⁷⁴ and a massive high-tech industry in the area, the solid waste agencies are faced with rapidly increasing levels of electronics in the waste stream and no easy solutions to the problem.

As studies have shown, TV and computer monitors, circuit boards and coated plastics are laden with lead, mercury, brominated organic compounds, etc. and many of these

components fail the EPA's TCLP test.⁷⁵ This means that these materials should be handled as hazardous waste and diverted from landfills. The state is the authority charged with implementing federal regulations. However, Washington State is not enforcing state codes that would control these E-wastes as hazardous wastes. In light of that, the City and County agencies are having a very difficult time preventing E-wastes from entering local area solid waste landfills.

King County

The King County Solid Waste Division manages ten former landfill properties; additionally, mixed municipal solid waste is collected from ten transfer stations and two drop boxes located in urban areas (except Seattle), and transferred to the Cedar Hills Regional Landfill for disposal in a lined landfill. To better understand the types and quantities of solid waste being disposed, and to develop strategies to increase recycling, the Solid Waste Division began the Waste Monitoring Program in 1990 in which they systematically collect samples of waste from both residential and commercial customers, sorting it into categories by weight.

In the April 1999-March 2000 Comprehensive Waste Stream Characterization Study,⁷⁶ extrapolation of monthly samples led the County to estimate that the total tonnage of “Small Appliances”, including all computers and TV's, that ended up in the Cedar Hills Landfill was 9,050 tons for that period. At that time the County lumped all electronics into one category (“Small Appliances”), but now that they are aware of the magnitude of the E-waste problem, the County has created more specific categories for electronic waste for future studies.

The City of Seattle

The City of Seattle collects waste at four transfer stations where 40-foot shipping containers are filled with compacted municipal waste and sent by rail to the Columbia Ridge Landfill in northern Oregon, where it is dumped into a 640-acre lined landfill. A train-load of approximately 100 containers of compacted garbage leaves Seattle five evenings a week and arrives in Oregon early the next morning for unloading and spreading in the landfill.⁷⁷

Included in this massive volume of city waste is a rapidly increasing quantity of E-waste. Like King County, the City of Seattle monitors the type and quantity of the waste it handles, accomplishing a biennial Waste Characterization Study alternating between residential and commercial waste every two years. In the year 2000, the Seattle Public Utilities completed a Waste Characterization Study⁷⁸ of

commercial sector waste (as opposed to residential waste), and came up with the following results, calculated at a 90% confidence level:

Commercial Sector E-waste dumped in Seattle's landfill in 2000 (not including residential waste):

Monitors and TVs	740 tons
Other Computer Components	1,723 tons
A/V Equipment	636 tons
Small Appliances	632 tons
TOTAL	2,731 tons

Monitors and computer waste from Seattle residents were not separately identified in the 1998 residential sector Waste Characterization Study, but the following two categories include all electronics:

Residential sector E-waste dumped in Seattle's landfill in 1998 (not including commercial waste):

A/V Equipment	640 tons
Small Appliances	571 tons
TOTAL	1,211 tons

If we assume that each of the three waste characterization studies above (City and County) represent one year of electronic waste in local landfills (although they were sorted in three different years), we come up with a total of 12,992 tons of electronics that theoretically represent one year's worth of combined commercial and residential electronic waste from all of King County inhabitants. It is essential to remember that the E-wastes heading for the local area landfills are hazardous due to, for example, their lead content.

City and county solid waste officials find themselves in the unenviable position of accepting huge volumes of material they know contain hazards while the general public has little knowledge of the problem and precious few recycling options.

City and county solid waste officials find themselves in the unenviable position of accepting huge volumes of material they know contain hazards while the general public has little knowledge of the problem and precious few recycling options other than a small infrastructure in the private sector and occasional weekend collection programs. As a result of mercury, lead, cadmium, and bromine going into municipal landfills, local governments anticipate that they may well have to pay very large cleanup costs in the future. This future liability is of great concern to government officials,

particularly risk managers and solid waste division directors. If they are knowingly allowing toxic materials that fail the TCLP test into landfills, and anyone becomes ill as a result of this waste, the culpability may be provable.

Diversion: From Landfill to Export

Faced with wholly inadequate regulations governing household and small-quantity generator waste, and fearing future liability for hazardous electronics deposited in their landfill, King County has taken the initiative to try and divert electronic waste from landfill to recycling. In fact, King County has drawn national attention for its voluntary Computer Recovery Project, a partnership between the County and private recycling businesses to collect and recycle or re-use computers, done in conjunction with the City of Seattle. Started in July 2000, the Computer Recovery Project is aimed at encouraging residents and small businesses to take their unwanted computers to a list of local recyclers rather than dump them at transfer stations. The County decided to focus on the individual and small business waste generators as these are the primary sources of computers in the landfill; most large corporations send their unwanted computers to large waste recyclers or asset recovery groups who only deal in large volumes of E-waste.

The heart of the County's Computer Recovery Project is providing a local recycling option for monitors when there was none before. King County requested that Total Reclaim, a local recycler of other materials, start recycling monitors, charging customers to safely crush and transport the high-lead glass to a domestic recycling facility. Total Reclaim now provides the only local option for properly and domestically recycling monitors.

In addition to setting up a domestic recycler for monitors, King County identified and advertised a few dozen local computer-recycling businesses willing to sign an agreement in 2001 stating that they would either send nonworking monitors to a county-approved recycling operation, or discuss with the County any intentions to export nonworking monitors.

The economies of the CRT export market, however, have far more power than King County to dictate the region's end markets for toxic monitors. None of the recyclers who signed the County agreement have indicated they are exporting, while many of them are.

Despite this valiant effort to keep E-wastes out of the landfill, the wastes continue to get dumped in large quantities. Without closing the federal and state loopholes excluding households and small quantity E-waste generators from regulation, the County has little authority to prevent this.

Local governments are also scared of doing anything that would result in illegal dumping of electronics. Making disposal burdensome in any way (e.g. charging end-of-life fees, making it illegal for households to dump monitors, etc.) could result in costly, dangerous illegal dumping outside the solid waste system, particularly if there is no alternative infrastructure to handle the material.

Despite this valiant effort to keep E-wastes out of the landfill, the wastes continue to get dumped in large quantities.

King County has officially prohibited monitors from the commercial sector in the landfill, but has few resources to bring to bear for effective enforcement of this policy, nor do they have a “persuasion” mechanism to divert all E-waste to recycling programs. Rather, King County has a small advertising budget to educate and persuade consumers.

Most residents don’t know that computer waste is hazardous and don’t realize that it has grown into a massive problem. Also working against the program is the fact that many consumers are unwilling to pay to do the “right thing”, i.e. deliver their computers to a recycler where they will have to pay the \$8 - \$10/monitor fee required by the recycler. This fee is ostensibly charged to cover the extra costs of properly recycling the leaded glass with a domestic recycler. Unfortunately, it’s currently cheaper and acceptable for households and small quantity generators of E-waste to deliver their monitors to the transfer stations.

Most residents don’t know that computer waste is hazardous and don’t realize that it has grown into a massive problem.

The paradigm of diversion from landfill to recycler, which local governments have been scrambling to implement, is significantly flawed in practice, from an environmental perspective. First, recyclers are often forced to landfill a lot of material because there is little to no market for it. This frequently includes keyboards, printers, and coated plastics which contain brominated flame retardants.

More likely, however, is the scenario where the recyclers export the material or sell to brokers who export. As long as recyclers can simply export the material, there is absolutely no guarantee that the result is better for the global environment than landfilling the E-waste here at home.

A third flaw in the diversion of E-waste to recyclers is that some, but not all, recyclers are unscrupulous, and charge

customers to take their monitors, and then, rather than paying to have those monitors properly recycled domestically, they are sold again to brokers sending them offshore. Meanwhile, the unscrupulous recyclers have done nothing to protect the environment and human health that would justify collecting the front-end fee of \$8-\$10, plus they have turned around and sold the monitors on the export market. This is a form of consumer fraud.

As long as recyclers can simply export the material, there is absolutely no guarantee that the result is better for the global environment than landfilling the E-waste here at home.

Unfortunately, the results of government programs like those of King County and others struggling with the E-waste problem focus on landfill diversion and increased recycling. But they don’t place strict definitions on acceptable recycling processes. Nor can they likely place restrictions on the E-wastes that are exported to foreign destinations. For local governments the issue is an especially difficult one as it falls on the shoulders of those with little authority to address the upstream solutions required.

For local governments the issue is an especially difficult one as it falls on the shoulders of those with little authority to address the upstream solutions required.

Finally, it must be noted that in Seattle and King County, and likely many local governments in the current recession, there are dwindling budgets to deal with the problem, just at the same time the E-waste problem is coming home to roost.

The California Story

In 2001, the U.S. EPA and the California Integrated Waste Management Board sponsored a “Working Group” comprised of non-governmental organizations (NGOs), local government, recyclers, and electronic industry representatives to recommend infrastructure development for recycling electronic products in California.

However, the Working Group could not get past the issue of hazardous waste regulations. CRTs found in televisions and monitors contain 3-8 pounds of lead. The federal regulations for large generators were clear. Institutions such as universities, banks, and computer manufacturers who threw away more than 220 pounds of CRTs a month were hazardous waste generators and prohibited from disposing of the CRTs in municipal landfills. The hazardous

waste laws for the California residential households, however, were not as clear. The law was very loosely interpreted by city-sponsored garbage programs, electronic recyclers, landfill operators, and non-profit retail shops who routinely threw away CRTs into the local landfills.

In November 2000, the Materials for the Future Foundation (MFF) wrote a letter to the Department of Toxic and Substance Control (DTSC) asking for clarification of the CRT hazardous waste regulations. The three-page letter to DTSC was meant to get answers to questions that had plagued the electronic recycling industry for at least a decade.

In response to MFF, the DTSC issued a regulatory “clarification” declaring that all lead-containing CRTs *are* hazardous waste and *cannot* be disposed of in solid waste landfills. DTSC stated specifically that they were issuing their position based on both U.S. and California law.⁷⁹

The DTSC’s clarification of the CRT hazardous waste regulations meant that just about every California city, as well as every landfill operator and waste hauler handling municipal solid waste, were violating the law.

The clarification of the CRT hazardous waste regulations meant that just about every California city, as well as every landfill operator and waste hauler handling municipal solid waste, were violating the law.

DTSC also recognized that this new regulatory interpretation constituted an emergency that required immediate action. In order to prevent a crisis, the DTSC used its authority to declare CRTs a Universal Waste.

The Universal Waste Rule (UWR)⁸⁰ “streamlines” (i.e. deregulates) the collection and management regulations for certain wastes that are considered common. Under the Universal Waste Rule, CRTs are conditionally exempt from hazardous waste regulations, if they are going to be recycled.

By deregulating CRTs, the UWR has had the unintentional result of saddling the cities with recycling costs while lowering recycling standards, encouraging exports to foreign markets, and encouraging the use of prison labor.

The UWR also eliminates any system of tracking of hazardous waste movement once it leaves California’s borders. For example, under the UWR, CRT recyclers that are not using chemical or thermal treatment do not require a full hazardous waste facilities permit and the transporters are not required to

carry a manifest. CRTs are exempted from the requirement of using registered hazardous waste haulers.

By deregulating CRTs, there was an unintentional result of saddling the cities with recycling costs while lowering recycling standards, encouraging exports to foreign markets, and encouraging the use of U.S. prison labor.

While the UWR may be appropriate for addressing a temporary crisis situation, the UWR is *not* a substitute for state policy that promotes environmental and economic sustainability and protects human health and safety.

California “Universal Waste Rule” Loopholes

The emergency UWR makes the cities responsible for writing the check to pay for CRT recycling. Each computer monitor or television costs \$15-40 dollars to recycle properly. The emergency UWR does not extend the responsibility for end-of-life management of hazardous waste to the hazardous waste producer (the manufacturer). High-tech manufacturers who design and produce toxic CRTs should take responsibility for building an efficient recycling infrastructure and paying to recycle CRT products.

The cities are, instead, burdened with the responsibility of using garbage ratepayer and taxpayer funds to contract recycling services and to build a CRT collection and recycling infrastructure.

Tracking CRTs

Because the UWR streamlining process eliminates the need for a waste tracking manifest, the recycler is not obligated to prove that the material actually gets to its final destination or how it is processed once it gets there. Under this rule, California’s hazardous waste can be disposed of in another state’s landfill, illegally dumped or even burned without the knowledge of the municipality.

The EPA isn’t any help in tracking CRTs to legitimize recycling facilities here in the U.S. or abroad. The EPA CRT hazardous waste regulations are poorly enforced and the EPA doesn’t keep an updated database of actions taken by individual states against companies that violate federal hazardous waste regulations.

Exports

The UWR was developed with the purpose of encouraging recycling and proper disposal of materials that do not

create significant hazardous problems, while keeping the regulatory burden to a minimum, on all but the final receiving facility (final destination).

The UWR does not apply to facilities that use external heat, water or chemicals to process CRTs. Such chemical process are performed by out-of-state recyclers or under crude conditions in developing countries where hazardous waste regulations are poorly enforced or non-existent. One of the most significant consequences of California's decisions about CRTs is that the pressures to export have been increased as the landfill option is being cut off.

One of the most significant consequences of California's decisions about CRTs is that the pressures to export have been increased as the landfill option is being cut off.

Another unintended consequence of California's actions is that U.S. recyclers who currently pay a living wage, and who obtain a third party environmental management certification or certify that their end markets meet high environmental standards will be placed at an even more severe competitive disadvantage with those "recyclers" who take the "low road" approach by shipping the CRTs overseas or by subcontracting with prison labor.

Impact of U.S. Prison Labor on Recycling

A federal penitentiary in Atwater, California will soon begin to process CRTs in a new 50,000 square foot facility. Recycling companies that subcontract prison labor are already undercutting those companies that pay a living wage and benefits to free-labor market workers. California's prison industry has experienced unprecedented growth in the last ten years, incarcerating more than 626 out of every 100,000 Californians. The use of an incarcerated labor force raises moral issues as well as serious concerns about infrastructure development and the future of recycling in California.

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California has one of the highest prison populations in the world and an extremely poor record of prisoner rehabilitation. The statewide recidivism rate is 75 percent. Private companies that sustain their operations by warehousing prisoners and selling prison labor rather than rehabilitating inmates increasingly operate the prison system. That means that 75 percent of California prisoners are more likely to

return to prison and earn \$1.10 per hour job, than to receive a living wage recycling the same materials in the free-labor market.

The prison industry is also killing public and private investment in the recycling industry. The labor unions and the U.S. Chamber of Commerce are on record opposing the monopoly that prison industries have on federal procurement contracts. According to the U.S. Chamber of Commerce, products and services rendered by the prison industries are frequently more expensive, poor quality and not delivered on time. Private sector start-up companies are in no position to compete with prison industries that receive the benefit of warehouse facilities and utilities paid for by the taxpayers and prison workers that receive as little as 26 cents an hour.

California's prison system also competes with university research funds and community economic development funding. In California, the state prison system's \$5.6 billion budget is larger than the \$4.3 billion combined budgets of the state's two premiere university systems (the University of California and the California State University).

Supporting prison labor sustains a policy that is morally corrupt and that invests in low tech, labor intensive recycling processes rather than investing in public education and research, or California EPA's recycling business development programs that attempt to attract legitimate recycling businesses to the state.



The Solution Lies Upstream

Recommendations for Action

The fundamental dynamism of computer manufacturing that has transformed life in the last quarter of the 20th century has led to rapid product obsolescence which has created a waste crisis that is out of control. The ability of our own country to manage this problem has been overwhelmed and so we now resort to immoral and unsustainable export. Yet it is clear that the answer to our E-waste crisis lies not in finding new downstream hiding places for this waste, it lies not in exporting it to the desperately poor, but in moving upstream to prevent the problem at its manufacturing source.

Today it is frequently cheaper and more convenient to buy a new machine to accommodate the latest software and hardware technology and their increasing demands for more speed, memory, and power, than it is to upgrade the old. Yet this rapid “trash and buy” cycle comes with a monumental price that we as humans are just beginning to pay. We need to change the dominant paradigm that has prevailed over the past three decades. The lust for faster, smaller and cheaper must be governed by a new paradigm of sustainability that demands that our products are cleaner, long-lived, up-gradable, and recyclable.

It is time to strengthen the call for sustainable production, environmental justice, and corporate and government accountability in order to achieve these goals. The following are our recommendations for action.

Recommendation 1: Ban Hazardous Waste Exports

The most immediate recommendation consistent with the Basel Ban Amendment decision by the Basel Convention to ban all exports of hazardous wastes from OECD to non-OECD countries is for the United States to ban such all exports of E-wastes that are hazardous wastes including computer monitors, whole computers, and circuit boards. It is unacceptable that the United States, the world's most wasteful nation, has not yet ratified the Basel Convention and the Basel Ban Amendment that were passed by a consensus of all of the Parties. Even in the absence of actual ratification of the agreements, the United States must implement these decisions and do so immediately.

The United States must practice environmental justice on the global stage. The poor of the world should not have to bear a

disproportionate burden of environmental risk – particularly when they have not benefited from the products and services that created that risk. All industrialized countries of the world should become self-sufficient in managing their own hazardous wastes so that they will not victimize other peoples, particularly in developing countries, but moreover so that they will realize an immediate incentive to eliminate such hazards at the source. Developing nations should be given the tools and training necessary to develop preventative waste management strategies.

Recommendation 2: Get the Poisons Out

Pollution prevention does not just mean recycling waste already produced – rather it means clean production — producing less quantity of waste and less hazardous waste in the first place. Recycling has an important role to play in reducing the E-waste crisis, but recycling can hardly be seen as the only solution particularly when hazardous inputs are involved. Recycling hazardous waste often involves re-exposing the environment and our health to hazards via either pollution or re-introduction into products where the recycled waste will eventually surface later as pollution.

If E-waste were not hazardous, it would still be a nuisance but it would no longer be *deadly* and destructive to human health and viable ecosystems. Likewise, if the process of manufacturing computers were done cleanly without hazardous inputs and processes, it would be possible to overcome the worst of the high-tech environmental nightmare. Clearly then, the first and most important solution to the E-waste crisis involves getting the poisons out.

Before that happens, manufacturers of computer monitors, televisions and other electronic devices containing hazardous materials must be responsible for educating consumers and the general public regarding the potential threat to public health and the environment posed by their products and for raising awareness for the proper waste management protocols. At a minimum, all computer monitors, television sets, and other electronic devices containing hazardous materials must be clearly labeled to identify environmental hazards and proper materials management.

Recommendation 3: Exercise Precaution - Don't Let New Poisons In

Increasingly, the world has embraced the common sense policy known as the precautionary principle as it applies to industrial

activity. This principle is based on the old well-accepted adages of “look before you leap”, “when in doubt, do without” or “an ounce of prevention is worth a pound of cure”. For some reason, this vital precautionary wisdom seems to be missing when it comes to placing new chemicals into commerce and the environment. The chemical industry has been allowed to proceed on the basis of chemicals being “innocent until proven guilty”, exposing potential hazards to our health as if chemicals had constitutional rights. Yet by the time conclusive scientific evidence exists that a chemical is dangerous, it is often too late – the compound has already done significant damage.

This approach has caused serious problems with chemical compounds in the past (e.g. with DDT, PCBs) and continues to cause grave and, at times, irreversible harm. For example, it is likely that in the next few years the United States will be forced to follow the European Union’s initiative and ban the use of brominated flame retardants because we did not foresee the likelihood that such compounds would be persistent and bio-accumulative. This will likely take place after too much damage has already been done. It is essential that where there is reason to believe that there is likely a threat to health or the environment, one must exercise precaution even before there is conclusive scientific evidence that harm is occurring. The federal government must, in accordance with the precautionary principle, develop and implement strict protocols for testing all new chemicals and mixtures before they are introduced into the markets. And when there is doubt – do without!

Recommendation 4: Make the Producer Responsible

Increasingly it is being recognized that producers of products must be financially, physically or legally responsible for their products. The principle of “Extended Producer Responsibility” (EPR) requires continuing accountability on producers over the entire life cycle of their products. This is an absolutely necessary policy as it has been too easy in the past for manufacturers of products to externalize environmental costs to the public, to consumers, to developing countries and future generations without those burdens ever being realized or accounted for by those responsible for them.

The aim of EPR is to encourage producers to prevent pollution and reduce resource and energy use in each stage of the product life cycle through changes in product design and process technology. By ensuring this feedback to the producer and by making them financially responsible for end-of-life waste management, producers will have a

financial incentive to design their products with less hazardous and more recyclable materials.

Currently the expense of collecting, managing and disposing of discarded electronics -- including household hazardous waste collection and hazardous waste site clean-up -- is born by taxpayer-funded government programs, primarily at the local level. Manufacturers and distributors should assume responsibility for these costs, so that they can be internalized and reflected in the product prices. This change in the market economics -- in effect the internalization of costs that were previously passed off to the public -- will create powerful incentives for manufacturers of electronics to reduce such costs by designing products that are clean, safe, durable, reusable, repairable, upgradeable, and easy to disassemble and recycle.

There are many mechanisms to ensure EPR. One of the most useful and urgent with respect to E-waste is known as “Take Back” requirements.

Recommendation 5: Require Producers to “Take it Back!”

The model example of EPR is product take-back where a producer takes back a product at the end of its useful life (i.e., when discarded) either directly or through a third party. However, product take-back needs to go hand-in-hand with mandatory legislation to phase out E-waste. Take back for E-waste is necessary to place the burden of a product’s environmental impact clearly back into the hands of those who design it in order to provide immediate incentive for improvement. It is also necessary to provide downstream consumers and local governments with an immediate answer to the question, “What can I ethically do with this obsolete machine?” Clearly, in the case of E-waste, as demonstrated in this report, an immediate and ethical choice is needed as a matter of urgency. Should we place our old computers in landfills? No. Should we give it away to a recycler or broker who will simply turn around and export it to Asia? No. The obvious answer is that manufacturers must be required to take these products back and devise and implement environmentally sound and ethical recycling/re-use solutions.

The ultimate aim is to close the loop of the product life cycle so that producers, who manufacture the product in the first place and who are ultimately in charge of designing the product, assume full responsibility for life cycle costs.

Thus, as consumers, we must demand that corporations make available and transparent mechanisms for product take-

back. This free-of-charge takeback should include products that are obsolete or broken.

Many grassroots groups around the country have come together to develop a comprehensive platform to address the growing E-waste crisis. Called the Electronic Take It Back! Platform, it has been endorsed by hundreds of groups around the U.S. and throughout the world (see www.svtc.org/cleancc/e_platform.htm) for the full platform and a chance to sign on and participate!

Recommendation 6: Design for Longevity, Upgradability, Repair and Re-use

Once the hazardous inputs are eliminated, the next priority is to counter the rapid obsolescence of computers. Ingenuity must be applied to producing computers that avoid the gross wastefulness seen in the industry to date. A distinction must be made between design for recycling and design for long-life.

While it is clear that the rapid advances of technology have dictated much wastefulness and obsolescence, it is also clear that electronics and software engineers could provide us with more flexible software and hardware systems that are capable of being up-graded and compatible through time. In that way, only small component parts of a computer would need to be replaced rather than the whole machine. For example, when technological advances create faster processors, it should be made easier to insert the new ones in place of the older ones rather than throwing out the whole computer or motherboard. Many companies have the technological and financial resources to implement such changes; they often lack the political will.

As more profit is likely to be made by forcing consumers to buy unnecessarily and thus waste inordinately, it may be necessary to mandate such design reforms through legislation.

Recommendation 7: Design for Recycling

When it finally becomes necessary to decommission an electronic device, the device must be designed to ensure clear, safe, and efficient mechanisms for recovering its raw materials. Input materials must be suitable for safe reconstitution and recycling and there must be a pre-identifiable recycling market and mechanism established for the input material. Equipment components must be properly labeled to identify plastic and metal types. Warnings must be placed for any possible hazard in dismantling or recycling and the product must be made for rapid and easy dismantling or reduction (e.g. shredding) to a usable form.

The European Model for Future Action

In the last five years the European Union has progressed rapidly on environmental and health concerns while the United States has taken significant steps backwards. Now the United States is in the embarrassing situation of being far behind the rest of the industrialized world in coming to grips with this century's environmental crises. This is certainly true with respect to the issue of toxic pollution and, in particular, the E-waste crisis. Japan also has surpassed the United States on progressively and meaningfully dealing with the issue. (see SVTC's clean computer report card at www.svtc.org/cleancc/pubs/pub_index.html)

First, all 15 countries of the European Union have already adopted the Basel Ban on the export of hazardous wastes to developing countries even prior to its legal entry into force. For more information on the Basel Ban and Convention see www.ban.org. Thus, it is currently illegal for any EU country to export E-waste that is hazardous.

Second, as adopted in the Commission Communication of February, 2000, the European Union has accepted the Precautionary Principle as a "key tenet of its policy". The United States still refuses to accept this common sense, prudent approach that might restrict some high-risk product development and has fought against its rapid adoption as a policy principle around the globe.

Finally, the European Union has recognized the scope and urgency of the E-waste problem and has taken the lead in addressing it by proposing an ambitious system of "Extended Producer Responsibility" (EPR). In May of 2001, the European Union (EU) Parliament approved a directive that requires producers of electronics to take responsibility—financial and otherwise—for the recovery and recycling of E-waste (Waste from Electrical and Electronic Equipment—WEEE). A second directive (Restriction on the Use of Certain Hazardous Materials—ROHS) has been readied that will require manufacturers to phase out the use of hazardous materials. These directives show that the continent's governing body understands the cost of cleaning up the legacy of waste and building a meaningful response to the crisis.

The WEEE Directive requires that all producers of electronic equipment are responsible for the product at the end of its consumer life. The ROHS takes prevention a step further by phasing out the use of hazardous substances in the production of electrical and electronics equipment by 2008.

Meanwhile, the United States continues to drag its feet. The U.S. government and American manufacturers have claimed

that the EU's environmental and health protections constitute "unnecessary barriers to trade, particularly due to the ban on certain materials, burdensome take-back requirements for end-of-life equipment and mandated design standards." Additionally U.S. high-tech companies, through their trade associations, have threatened to challenge the European initiative via the World Trade Organization (WTO) when the Directive goes into effect. However, in the face of these threats, the European Parliament not only approved the WEEE and ROHS Directives, but even went so far as to strengthen the directive initially proposed by the Commission. For more information see www.svtc.org/cleancc/weee/index.html.

U.S. companies will be forced to play catch-up with their counterparts in Europe and Japan. Many companies (European, U.S., and Japanese) operating in Europe instituted take-back programs there, operating without charge to the consumer. In the last few months, a few such programs have emerged in the U.S., but they are voluntary and consumers are often charged for participating in these recycling programs at the time of disposal, thereby discouraging participation.

Over the course of the last year, there has been some noticeable improvement by companies operating in the U.S. with respect to take-back. This improvement is seen as a result of international pressures, increased state and local government interest, and grassroots activism. Increased pressure by consumers, environmental, and consumer organizations, state and local government officials, and legislators will help ensure that electronics companies assume high levels of producer responsibility to solve the E-waste problem at its source and not to export it to foreign shores.

What We Can Do

- Write to your Congressperson and demand that the United States ratify the Basel Convention together with the Basel Ban Amendment. Only the Basel Convention with the Ban Amendment implements the American principle of environmental justice at the global level, and assures that all countries take responsibility for their own hazardous wastes. For more information on the Basel Convention and Ban visit www.ban.org.
- Sign onto the Electronics Take It Back Platform! and circulate it among friends and colleagues. (See www.svtc.org/cleancc/e_platform.htm)
- Buy only "necessary" computer/electronic products. Purchase products that utilize some of the emerging

technologies (i.e. lead-free, halogen-free, recycled plastics and from manufacturers or retailers that will 'take-back' their product, or have developed an easily upgradeable product. (See <http://www.svtc.org/cleancc/greendesign/index.html> for information on "greener products")

- Write to or phone your computer manufacturer asking them to establish a take back mechanism and demand that they take steps to phase out hazardous materials in your computer. (See www.svtc.org/cleancc/4ht_letters.htm)
- Contact you local or state government representatives. Explain to them why you are concerned. Ask them to get involved in developing solutions. They could ban the landfilling and incineration of electronic junk and support a re-use and recycling infrastructure that will not accept export as a solution. (See www.svtc.org/cleancc/usint/index.html for sample resolutions)
- Send your computer or monitor back to the corporate headquarters of the company that made it. Send it with a letter telling them that as they have externalized real environmental costs to the world, you are sending it back as a protest so that they will seriously begin to internalize such costs and solve the E-waste problems upstream through redesign and take-back programs. Although this may cost you as much as \$30, it does provide a powerful protest and prelude to the producer take-back programs that must be implemented.

Annex I

Composition of a Personal Desktop Computer

based on a typical desktop computer, weighing ~70lbs

Name	Content (% of total weight)	Recycling Efficiency (current recyclability)	Weight of Material (lbs.)	Use/Location
Plastics	22.9907	20%	13.8	Includes organics, oxides other than silica
Lead	6.2988	5%	3.8	Metal joining, radiation shield/CRT,PWB
Aluminum	14.1723	80%	8.5	Structural, conductivity/housing, CRT, PWB, connectors
Germanium	0.0016	0%	<0.1	Semiconductor/PWB
Gallium	0.0013	0%	<0.1	Semiconductor/PWB
Iron	20.4712	80%	12.3	Structural, magnetivity/(steel) housing, CRT, PWB
Tin	1.0078	70%	0.6	Metal joining/PWB, CRT
Copper	6.9287	90%	4.2	Conductivity/CRT, PWB, connectors
Barium	0.0315	0%	<0.1	Vacuum tube/CRT
Nickel	0.8503	80%	0.51	Structural, magnetivity/(steel) housing, CRT, PWB
Zinc	2.2046	60%	1.32	Battery, phosphor emitter/PWB, CRT
Tantalum	0.0157	0%	<0.1	Capacitors/PWB, power supply
Indium	0.0016	60%	<0.1	Transistor, rectifiers/PWB
Vanadium	0.0002	0%	<0.1	Red phosphor emitter/CRT
Terbium	< 0	0%	<0	Green phosphor activator, dopant/CRT, PWB
Beryllium	0.0157	0%	<0.1	Thermal conductivity/PWB, connectors
Gold	0.0016	99%	<0.1	Connectivity, conductivity/PWB, connectors
Europium	0.0002	0%	<0.1	Phosphor activator/PWB
Titanium	0.0157	0%	<0.1	Pigment, alloying agent/(aluminum) housing
Ruthenium	0.0016	80%	<0.1	Resistive circuit/PWB
Cobalt	0.0157	85%	<0.1	Structural, magnetivity/(steel) housing, CRT, PWB
Palladium	0.0003	95%	<0.1	Connectivity, conductivity/PWB, connectors
Manganese	0.0315	0%	<0.1	Structural, magnetivity/(steel) housing, CRT, PWB
Silver	0.0189	98%	<0.1	Conductivity/PWB, connectors
Antimony	0.0094	0%	<0.1	Diodes/housing, PWB, CRT
Bismuth	0.0063	0%	<0.1	Wetting agent in thick film/PWB
Chromium	0.0063	0%	<0.1	Decorative, hardener/(steel) housing
Cadmium	0.0094	0%	<0.1	Battery, blue-green phosphor emitter/housing, PWB, CRT
Selenium	0.0016	70%	.00096	Rectifiers/PWB
Niobium	0.0002	0%	<0.1	Welding alloy/housing
Yttrium	0.0002	0%	<0.1	Red phosphor emitter/CRT
Rhodium	< 0	50%	<0.	Thick film conductor/PWB
Platinum	< 0	95%	<0.1	Thick film conductor/PWB
Mercury	0.0022	0%	<0.1	Batteries, switches/housing, PWB
Arsenic	0.0013	0%	<0.1	Doping agents in transistors/PWB
Silica	24.8803	0%	15	Glass, solid state devices/CRT, PWB

Source: Handy and Harman Electronic Materials Corp.

72 Elm Street

North Attleboro, MA 02760

www.handyharman.com

Annex II -- Guiyu Sample Results and Sediment Quality Comparison

Metal	Guiyu Sediment Sample #1	Guiyu Sediment Sample #2	Guiyu Sediment Sample #3	Guiyu Sediment Sample #4	Guiyu Sediment Sample #5	NOAA Sediment Effects Range Low Benchmarks (mg/kg)	NOAA Sediment Effects Range Low Benchmarks (mg/kg)	EPA Reg. IV Soil Screening Benchmarks (mg/kg)	EPA Reg. IV Sediment Screening Benchmarks (mg/kg)	Netherlands Quality Criteria Dredged Material (mg/kg)
1. Antimony	0.3	<0.1	25	4.2	<0.1	2	25	3.5	12	
2. Arsenic	3.8	3.7	6.6	3.2	8.1	8.2	70	10	7.24	29
3. Barium	1620	230	1,330	920	300			165		
4. Cadmium	52	7.2	360	85	12	1.2	9.6	1.6	1	4
5. Chromium	70,000	17	70	6.8	12	81	370	0.4	52.3	120
6. Cobalt	<0.1	<0.1	160	<0.1	<0.1			20		
7. Copper	20,300	10,100	136,000	7,010	840	34	270	40	18.7	60
8. Iron	20,400	35,300	13,900	16,100	49,900			200		
9. Lead	23,400	1,890	17,700	8,460	300	47	220	50	30.2	110
10. Manganese	560	170	490	230	490			100		
11. Mercury	<0.1	0.4	<0.1	<0.1	0.4	0.15	0.71	0.1	0.13	1.2
12. Molybdenum	3.0	2.4	13	1.4	4.5			2		
13. Nickel	185	21	580	11	130	21	52	30	159	45
14. Selenium	<0.1	<0.1	<0.1	<0.1	<0.1			0.81		
15. Silver	11	5.3	150	<0.1	<0.1	1	3.7	2	2	
16. Tin	110	8,080	87	210	6.4			53		
17. Vanadium	<0.1	<0.1	<0.1	<0.1	<0.1			2		
18. Zinc	2,340	205	11,400	240	450	150	410	50	124	365

Samples analyzed by the Hong Kong Standards and Testing Centre Ltd.

Sampling Locations: Sediment samples 1-4 were taken at [N 23 degrees 18' 09.5" , E 116 degrees 19' 53.4"]. Sediment sample 5 was taken at [N 23 degree 20' 00.4" , E 116 degree 21' 33.7"]. Sediment sample 1 was taken six inches below the surface of a river near a site where circuit boards were burned and processed. Samples 2 and 4 were taken along the same river in other locales, where much processing of circuit boards and open burning of circuit boards had taken place. Sample 3 was taken in a pile of blackened material of unknown origin just a few feet from the river. Sediment sample 5 was taken six inches below the surface along a river where open burning of wires, much sludge, and computer scrap dumping took place, as well as acid operations to recover gold from computer chips.

National Oceanic and Atmospheric Administration (NOAA) Sediment Benchmarks: In the absence of a U.S. national sediment standard, NOAA generated a non-regulatory sediment quality guideline for use in interpreting chemical data for sediment analysis. NOAA established two indicators:

Effects Range Low - refers to the level of contaminant concentration below which adverse effects rarely occur;

Effects Range Median - refers to the level of contaminant concentration above which adverse effects frequently occur.

U.S. Environment Protection Agency (EPA) Region IV: EPA Region IV is the only region to have published soil and sediment guidance for their use in screening ecological risks. The benchmarks are intended to be used to determine whether further study is warranted at a site.

Netherlands Uniform Quality Criteria (UQC): The UQC is the existing legal standard observed in the Netherlands for determining whether to allow dredged materials to be disposed of in the marine environment. When the contaminant level in the dredged material exceeds the UQC, the material is not allowed to be disposed offshore, and is required under Dutch law to be put in a depot or be subject to treatment.

Annex III -- Guiyu Sample Results and Water Quality Comparison

Metal	Liangjiang River outside of Guiyu Water Sample A (mg/L)	Liangjiang River outside of Guiyu Water Sample B (mg/L)	World Health Guideline Values* (mg/L)	EPA Drinking Water Standard** (mg/L)
1. Antimony	0.079		0.005	0.006
2. Arsenic	<0.01		1.01	0.05
3. Barium	<0.01		0.7	2
4. Cadmium	0.01	0.033	0.003	0.005
5. Chromium	0.02		0.05	0.1
6. Cobalt	<0.1			
7. Copper	1.3	2.6	2	1.3
8. Iron	2.8			
9. Lead	1.9	24	0.01	0.015
10. Manganese	0.2		0.5	
11. Mercury	<0.001	<0.001	0.001	0.002
12. Molybdenum	<0.1		0.07	
13. Nickel	<0.01	.02	0.02	
14. Selenium	<0.01		0.01	0.05
15. Silver	<0.1			
16. Tin	0.4			
17. Vanadium	<0.1			
18. Zinc	0.6			

Samples analyzed by the Hong Kong Standards and Testing Centre Ltd.

* Guidelines for Drinking Water Quality, 2nd ed. Vol. 2 Health Criteria and other Supporting Information, 1996 (pp. 940-949) and Addendum to Vol. 2 1998 (pp. 281-283) Geneva.

** Maximum Contaminant Level (MCL) - The highest level of a contaminant allowed in U.S. drinking water. MCLs are enforceable standards.

Sampling Location: Sample "A" taken by BAN in December, 2001. Sample "B" taken by Eastweek magazine. Both samples were taken at at [N 23 degrees 18' 09.5" , E 116 degrees 19' 53.4"]. Surface river water. It should be noted that the water samples were taken in a river adjacent to an area where circuit boards had been processed with acid and ultimately burned along the banks. However, since the magazine article was published the government halted the processing at that location.

Annex IV

Some of the Labels and Brands Found on Imported Computer Waste in Guiyu

Institutions	Corporate Brands, Names, Etc.
U.S. Mid-West	Honeywell - Emergency Switch Lever
Commonwealth of Kentucky Department of Education 313210	Eltron - Power Cords
Small Business Development Center Moorhead, MN 5653	Intermatic - Wireless Door Alarms - Night Light
Racine Unified School District ECIA CL2 PL97-355 4620-121-89	OES "Your Office Equipment Specialist" Tel. No. (6/8 30) 322.8616
Decision One 555 W. Layton Ave., Suite 460 Milwaukee, WI 53207	- HP Laser Jet 11P Plus -HP Laser Jet III Manufactured Feb. 1992 -HP LaserJet Toner Cartridge 92291A, 92276A -HP LaserJet Printer Cartridge 92250A
ABN AMRO Bank N.V. Chicago Branch 2247	Korean Telephone Label M-02510
Intermatic Incorporated Spring Grove, Illinois 60081	Brother Industries Model Intellifax 980 M Ser. No. H41844202 Made In Japan
Best Power Technology, Inc. Necedah, WI 54646	Minolta Copier RP-6072 Tel. No. (0120) 026-920
California	K-Mart \$29.97 Bottom of an answering Machine
Montebello Schools	VHS Tape - 1997 Abbott HPD Outreach Program, 18 March 1997 Honolulu, Hawaii
Special Day Class "For Special Services" Castaneda 301	Continental Cablevision "Our Quality Shows" Callahan, Hilliard, King's Bay, Nahunta (1-800-255-9371) Folkston (1-912-496-2581)
LA Unified School District 113747 Information Technology Division	Western Electric KS-20133149 Electrolytic Capacitor
IBM Monitor labeled "Property of the City of Los Angeles" Tag ID: A014438	Mallory Made in USA Type CGS (Blue Capacitor)
Hollywood High School Career Academy Nov. 95 Inventory	Apple Color High-Resolution Monitor
State of California Medical Facility	ATM - JCB Cards
Newport-Mesa Schools Foundation Grant Program	Intel Inside
Xerox Corp. Model No: DocuPrint 4512 El Segundo, CA	Energy Star
Textris Electrical Co. La Mesa, CA	IBM Keyboard and Monitor
Property of US Government D.I.A.(Defense Intelligence Agency) Monitor Color VGA 16" 72Hz MDL Sony	Dutch Phones - "Spreekamer"
Property of State University 1. OA 1035 2. A03032	Property of SBM 955-7141
X-Ray Display Technologies, Inc. Carthage, MO 64836	OKI Microline 400CL
Transformers and Rectifiers Ltd. Guildford, England	Diskette - Northern Telecom SIN Nortel India
IVES Division New Haven, Connecticut 06508 A Division of Leigh Products, Inc.	Ricoh

Annex V

Typical E-waste Export Broker Solicitation Received by Recyclers



Attn : The President
C.c : The Sales Manager
Date: 12 Aug 2001

Dear Sir

We've come to know your company's contact information via the NSC.ORG and taking this opportunity, we have pleasure to introduce ourselves to you as an Importer & Recycler of USED COMPUTER PARTS & ELECTRONIC COMPONENTS. Head office based in **Hong Kong** providing recycling, remanufacturing & remarketing services. With over **20 years** of experience in the computer and electronic field, we have successfully explore our market in the Pacific Asia region and we have built up a strong relationship with OEM Manufacturers for the recycling, asset recovery and excess stock clearance. We carried a minimum volume of 30 containers monthly for the new, used & defective computer & parts. Our Company are also invited by several European firms **AND** e-trade information exchange companies to be their **China** sourcing agent **AND** ambassador in **North East Asia** and **China**.

We are interested in importing **USED COMPUTER PARTS** in container loads or in smaller quantities, in particular:

1. **DEFECTIVE MOTHERBOARDS, Intel, Compaq, Dell&Pentium II and above**
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If you are in a position to offer any of the above items, please send us your offer indicating quantities (in pieces, by pounds and/or tons), if possible, please kindly provide photos and your best delivery terms, if your offer meet our requirements, we shall be in a position to order from you in a continuous basis. Our own international forwarder will pick up goods from your warehouse, we pay **top dollars** for our purchasing items and our payment will be *PO-confirmation-T/T in Advance or after inspection, Fly & buy*. We are **frequent travelers traveling monthly to buy our demanding materials on major deals**.

We would be obliged with your prompt reply and we look forward to establishing a mutually and beneficial relationship with your Company.

Yours faithfully

Maria da Luz
Director

API Recycle

Rm 1017, Unit B, Focal Industrial Center, 21 Man Lok St, Hunghom, Kowloon, Hong Kong.

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50. Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal, March 22, 1989, arts. 1(1) and 2(1) . [hereinafter, BASEL CONVENTION]
51. The Basel Action Network review of historical National Priority Listing under CERCLA (Superfund Law) available upon request.
52. ENV. AUSTRALIA, *supra* note 47, at 21.
53. The OECD with generous special funding from such countries as Canada and the United States has already held two workshops on Environmentally Sound Management of Wastes Destined for Recovery Operations. The third of such workshop is slated for Washington D.C., 20-22 March 2002. The primary goal of these work shops is the development of ESM guidelines including “core performance elements” for recycling operations. While these guidelines are presumably for use within the OECD area, as has been done in the past, the OECD then seeks to globalize the guidelines resulting in the promotion of free trade in hazardous waste.
54. *See* at http://www.ban.org/Library/oecd_let.html., for a copy of the letter sent by NGOs to the OECD.
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56. TONETTI, *supra* note 48.
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