JUST SAY NO TO E-WASTE: BACKGROUND DOCUMENT ON HAZARDS AND WASTE FROM COMPUTERS

Photo courtesy of Recycling Council of Ontario

Electronics Sustainability Commitment

Each new generation of technical improvements in electronic products should include parallel and proportional improvements in environmental, health and safety as well as social justice attributes.

Adopted by the Trans-Atlantic Network for Clean Production, May 16, 1999

Introduction

Most consumers are unaware of the toxic materials in the products they rely on for word processing, data management, and access to the internet, as well as for electronic games.

In general, computer equipment is a complicated assembly of more than 1,000 materials, many of which are highly toxic, such as chlorinated and brominated substances, toxic gases, toxic metals, biologically active materials, acids, plastics and plastic additives.

The health impacts of the mixtures and material combinations in the products often are not known. The production of semiconductors, printed circuit boards, disk drives and monitors uses particularly hazardous chemicals, and workers involved in chip manufacturing are now beginning to come forward and reporting cancer clusters. In addition, new evidence is emerging that computer recyclers have high levels of dangerous chemicals in their blood.

The fundamental dynamism of computer manufacturing that has transformed life in the second half of the 20th century -- especially the speed of innovation -- also leads to rapid product obsolescence.. The average computer platform has a lifespan of less than two years, and hardware and software companies – especially Intel and Microsoft -- constantly generate new programs that fuel the demand for more speed, memory and power.

Today, it is frequently cheaper and more convenient to buy a new machine to accommodate the newer generations of technology than it is to upgrade the old. This trend has rapidly escalated due to widespread Y2K concerns. Yet we have no solution in North America for the rising quantities of computer junk that people are discarding. Three quarters of all computers ever bought in the US are sitting in people's attics and basements because they don't know what to do with them.

A May 1999 report -– "Electronic Product Recovery and Recycling Baseline Report" --published by the well-respected National Safety Council's Environmental Health Center, confirmed that computer recycling in the US is shockingly inadequate:

- In 1998 **only 6 percent** of computers were recycled compared to the numbers of new computers put on the market that year.
- By the year 2004, experts estimate that we will have **over 315 million obsolete computers in the US**, many of which will be destined for landfills, incinerators or hazardous waste exports.

The European Union is developing a solution that will make producers responsible for taking back their old products. This legislation – which includes "take-back" requirements and toxic materials phase-outs -- also encourages cleaner product ddesign and less waste generation. To date no such initiative has occurred in North America and in fact, the US Trade Representative – at the request of the American electronics trade associations -- is currently lobbying against this European Union initiative!

We need your help to ask producers here in North America to take back their products and ddesign them for safer use, reuse and recycling.

Please join the Clean Computer Campaign!

1. COMPUTER JUNK IS GROWING

There is a growing and imminent waste crisis about to hit the USA – computer junk.

"I have discovered that they are excellent at collecting dust and holding up bags of rice, but other than that, I am at a loss to know where to unload this stuff."

"USA sitting on mountain of obsolete PCs", USA Today, June 22, 1999.

Computer junk is growing at an escalating rate in the USA and Canada and consumers do not know what to do with it. **It has been estimated that over three-quarters of all computers ever bought in the USA are currently stored in people's attics, basements, office closets and pantries. (1) If everyone disposed of these the US would face a huge waste problem all at once.**

A recent US study found that over 315 million computers will become obsolete by the year 2004 – and this is an underestimate. Reliable numbers were not available for the number of computers manufactured between 1980 and 1992.(2)

Americans are buying more computers than people in any other nation. Currently over 50% of US households own a computer.(3)

Computer junking is also happening at a faster rate. The lifespan of computers is decreasing. In 1997 the average lifespan of a computer tower was 4-6 years and computer monitors 6-7 years.(4) This will soon fall to 2 years before 2005.

By the year 2005, one computer will become obsolete for every new one put on the market.(5)

By the end of this year (1999), another 24 million computers in the United States will become "obsolete". Only about 14 % (or 3.3 million) of these will be recycled or donated. The rest - **more than 20 million computers** in the U.S. -- will be dumped, incinerated, shipped as waste exports or put into temporary storage in attics, basements, etc.(6)

For the three years between 1997 and 1999, it is estimated that some 50 million U.S. computer towers will have been dumped, burned, shipped abroad or stored to await eventual disposal.

Recycling of computer monitors is no better**. Over 300 million computer monitors** have been sold in the USA since 1980. Yet, in 1997 only about 1.7 million monitors in the US were "recycled," the majority of which - about 1 million monitors - were shipped abroad to countries such as China.

In 1998 only 6 percent of older computers were recycled compared to the numbers of new computers put on the market that year. In contrast, for major appliances such as washing machines, air conditioners, refrigerators, dryers, dishwashers and freezers, the proportion recycled in 1998 was about 70 percent of the number put on the market that year. (7)

Of the small amount recycled, more than three-quarters come from large-scale users of the equipment. Individual users and small businesses contribute only a small fraction of the equipment that is recycled because no collection, or recycling program is in place.(8)

2. E-TOXICS IN COMPUTERS AND E-WASTE

"Printed Circuit Boards contain heavy metals such as Antimony, Silver, Chromium, Zinc, Lead, Tin and Copper. According to some estimates there is hardly any other product for which the sum of the environmental impacts of raw material, extraction, industrial, refining and production, use and disposal is so extensive as for printed circuit boards. "

- CARE conference, Vienna, 1994

"In short, the product developers of electronic products are introducing chemicals on a scale which is totally incompatible with the scant knowledge of their environmental or biological characteristics."

- Mans Lonnroth, Swedish Secretary of State , 1997

Materials used in a desktop computer and the efficiency of current recycling processes

Composition of a Desktop Personal Computer
Based on a typical desktop computer, weighing ~60 lbs.

Table presented in: Microelectronics and Computer Technology Corporation (MCC). 1996. Electronics Industry Environmental Roadmap. Austin, TX: MCC.

Name	**Content (% of total weight)**	Weight of material in computer (lbs.)	**Recycling Efficiency (current recyclability)**	**Use/Location**
Plastics	22.9907	13.8	20%	includes organics, oxides other than silica
Lead	6.2988	3.8	5%	metal joining, radiation shield/CRT, PWB
Aluminum	14.1723	8.5	80%	structural, conductivity/housing, CRT, PWB, connectors
Germanium	0.0016	< 0.1	0%	Semiconductor/PWB
Gallium	0.0013	< 0.1	0%	Semiconductor/PWB
Iron	20.4712	12.3	80%	structural, magnetivity/(steel) housing, CRT, PWB
Tin	1.0078	0.6	70%	metal joining/PWB, CRT
Copper	6.9287	4.2	90%	Conductivity/CRT, PWB, connectors
Barium	0.0315	< 0.1	0%	in vacuum tube/CRT
Nickel	0.8503	0.51	80%	structural, magnetivity/(steel) housing, CRT, PWB
Zinc	2.2046	1.32	60%	battery, phosphor emitter/PWB, CRT
Tantalum	0.0157	< 0.1	0%	Capacitors/PWB, power supply
Indium	0.0016	< 0.1	60%	transistor, rectifiers/PWB
Vanadium	0.0002	< 0.1	0%	red phosphor emitter/CRT
Terbium	0	0	0%	green phosphor activator, dopant/CRT, PWB
Beryllium	0.0157	< 0.1	0%	thermal conductivity/PWB, connectors
Gold	0.0016	< 0.1	99%	Connectivity, conductivity/PWB, connectors
Europium	0.0002	< 0.1	0%	phosphor activator/PWB
Titanium	0.0157	< 0.1	0%	pigment, alloying agent/(aluminum) housing
Ruthenium	0.0016	< 0.1	80%	resistive circuit/PWB
Cobalt	0.0157	< 0.1	85%	structural, magnetivity/(steel) housing, CRT, PWB
Palladium	0.0003	< 0.1	95%	Connectivity, conductivity/PWB, connectors
Manganese	0.0315	< 0.1	0%	structural, magnetivity/(steel) housing, CRT, PWB
Silver	0.0189	< 0.1	98%	Conductivity/PWB, connectors
Antinomy	0.0094	< 0.1	0%	diodes/housing, PWB, CRT
Bismuth	0.0063	< 0.1	0%	wetting agent in thick film/PWB
Chromium	0.0063	< 0.1	0%	Decorative, hardener/(steel) housing
Cadmium	0.0094	< 0.1	0%	battery, glu-green phosphor emitter/housing, PWB, CRT
Selenium	0.0016	0.00096	70%	rectifiers/PWB
Niobium	0.0002	< 0.1	0%	welding allow/housing
Yttrium	0.0002	< 0.1	0%	red phosphor emitter/CRT
Rhodium	0		50%	thick film conductor/PWB

Platinum	0		95%	thick film conductor/PWB
Mercury	0.0022	< 0.1	0%	batteries, switches/housing, PWB
Arsenic	0.0013	< 0.1	0%	doping agents in transistors/PWB
Silica	24.8803	15	0%	glass, solid state devices/CRT,PWB

*Note: plastics contain polybrominated flame retardants, and hundreds of additives and stabilizers **not** listed separately.*

Risks related to some e-toxics found in computers

Lead (9)
Lead can cause damage to the central and peripheral nervous systems, blood system and kidneys in humans. Effects on the endocrine system have also been observed and its serious negative effects on children's brain development has been well documented. Lead accumulates in the environment and has high acute and chronic toxic effects on plants, animals and microorganisms.(10)

Consumer electronics constitute 40% of lead found in landfills. The main concern in regard to the presence of lead in landfills is the potential for the lead to leach and contaminate drinking water supplies.

The main applications of lead in computers are:

(1) soldering of printed circuit boards and other electronic components

(2) glass panels in computer monitors (cathode ray tubes)

Between 1997 and 2004, over 315 million computers will become obsolete is the USA. **This adds up to about 1.2 billion pounds of lead!**

Cadmium (11)
Cadmium compounds are classified as toxic with a possible risk of irreversible effects on human health. Cadmium and cadmium compounds accumulate in the human body, in particular in kidneys. Cadmium is adsorbed through respiration but is also taken up with food. Due to the long half-life (30 years), cadmium can easily be accumulated in amounts that cause symptoms of poisoning. Cadmium shows a danger of cumulative effects in the environment due to its acute and chronic toxicity.(12)

In electrical and electronic equipment, cadmium occurs in certain components such as SMD chip resistors, infrared detectors and semiconductors. Older types of cathode ray tubes contain cadmium. Furthermore, cadmium is used as a plastic stabilizer.

Between 1997 to 2004 over 315 million computers will become obsolete and this represents almost 2 million pounds of cadmium content. (13)

Mercury (14)
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. Methylated mercury causes chronic damage to the brain.

It is estimated that 22 % of the yearly world consumption of mercury is used in electrical and electronic equipment. It is basically used in thermostats, (position) sensors, relays and switches (e.g. on printed circuit boards and in measuring equipment) and discharge lamps. Furthermore, it is used in medical equipment, data transmission, telecommunications, and mobile phones.

Mercury is also used in batteries, switches/housing, and printed wiring boards. Although this amount is small for any single component, 315 million obsolete computers by the year 2004 represent more than 400,000 pounds of mercury in total.

***Hexavalent Chromium* (Chromium VI)** (15)
Some manufacturers still apply this substance as corrosion protection of untreated and galvanized steel plates and as a decorative

and hardener for steel housing.

Chromium VI can easily pass through membranes of cells and is easily absorbed producing various toxic effects within the cells. It causes strong allergic reactions even in small concentrations. Asthmatic bronchitis is another allergic reaction linked to chromium VI. Chromium VI may also cause DNA damage.

In addition, hexavalent chromium compounds are toxic for the environment. It is well documented that contaminated wastes can leach from landfills. Incineration results in the generation of fly ash from which chromium is leachable, and there is widespread agreement among scientists that wastes containing chromium should not be incinerated.

Of the more than 315 million computers destined to become obsolete between 1997 and 2004, about 1.2 million pounds of hexavalent chromium will be present.

Plastics

Based on the calculation that more than 315 million computers will become obsolete between 1997 and 2004 and that plastics make up 13.8 pounds per computer on average, there will be more than **4 billion pounds of plastic** present in this computer waste.(16) An analysis commissioned by the Microelectronics and Computer Technology Corporation (MCC) estimated that the total electronics plastic scrap amounted to more than **1 billion pounds per year (580,000 tons per year).** This same study estimated that the largest volume of plastics used in electronics manufacturing (at 26%) was polyvinyl chloride (PVC), which creates more environmental and health hazards than most other type of plastic (see below). While many computer companies have recently reduced or phased out the use of PVC, there is still a huge volume of PVC contained in the computer scrap that continues to grow – potentially up to 250 million pounds per year.(17)

PVC (18)

The use of PVC in computers has been mainly used in cabling and computer housings, although most computer moldings are now being made of ABS plastic. PVC cabling is used for its fire retardant properties, but there are concerns that once alight, fumes from PVC cabling can be a major contributor to fatalities and hence there are pressures to switch to alternatives for safety reasons. Such alternatives are low-density polyethylene and thermoplastic olefins.

PVC is a difficult plastic to recycle and it contaminates other plastics in the recycling process. Of more importance, however, the production and burning of PVC products generates dioxins and furans. This plastic commonly used in packaging and household products is a major cause of dioxin formation in open burning and garbage incinerators. Hospitals are now beginning to phase out the use of PVC products such as disposal gloves and IV bags because of the dangers of incinerating these products.

Many local authorities in Europe have PVC-free policies for municipal buildings, pipes, wallpaper, flooring, windows and packaging. Recent concerns about the use of softeners in PVC plastic toys leaching out into children's mouths have lead to further restrictions on PVC.

Brominated Flame Retardants

Brominated flame-retardants are a class of brominated chemicals commonly used in electronic products as a means for reducing flammability. In computers, they are used mainly in four applications: in printed circuit boards, in components such as connectors, in plastic covers and in cables. They are also used in plastic covers of TV sets and in domestic kitchen appliances.

Various scientific observations indicate that Polybrominated Diphenylethers (PBDE) might act as endocrine disrupters.. Research has revealed that levels of PBDEs in human breast milk are doubling every five years and this has prompted concern because of the effect of these chemicals in young animals.(19)

A recent study found that newborn mice fed PBDEs show abnormal behavior when placed in new surroundings. Normal mice become very active when first transferred to a new environment but gradually slow down as they complete their explorations. However, treated mice were less active at first but became more active after being in new surroundings for an hour. Researchers concluded that exposure to the chemicals in early life could induce neurotoxic effects similar to those caused by other toxic substances such as PCBs and some pesticides.(20)

Other studies have shown PBDE, like many halogenated organics, reduces levels of the hormone thyroxin in exposed animals and have been shown to cross the blood brain barrier in the developing fetus. Thyroid is an essential hormone needed to regulate the normal development of all animal species, including humans.(21)

Researchers in the US found exposure to Polybrominated Biphenyls (PBBs) may cause an increased risk of cancer of the digestive and lymph systems. The study looked at cancer incidence in individuals exposed to PBBs after a 1973 food contamination incident in Michigan. About a ton of PBB fire retardant was added to cattle feed in error and contamination spread through the animal and human food chain. Some nine million people were affected. A study published in 1998 found that the group with the highest exposure was 23 times more likely to develop digestive cancers, including stomach, pancreas and liver cancers. Preliminary results also found a 49-fold increase in lymph cancers.(22)

The presence of PBBs in Arctic seal samples indicates a wide geographical distribution. The principal known routes of PBBs from point sources into the aquatic environment are PBBs plant areas and waste dumps. PBBs are almost insoluble in water and are primarily found in sediments of polluted lakes and rivers. PBBs have been found to be 200 times more soluble in a landfill leachate than in distilled water, which may result in a wider distribution in the environment. Once they have been released into the environment, they can reach the food chain, where they are concentrated. PBBs have been detected in fish from several regions. Ingestion of fish is a source of PBB transfer to mammals and birds. Neither uptake nor degradation of PBBs by plants has been recorded. In contrast, PBBs are easily absorbed by animals. (23)

These chemicals make computer recycling particularly hazardous to workers

The presence of polybrominated flame-retardants in plastic makes recycling dangerous and difficult. It has been shown that Polybrominated Diphenylethers (PBDEs) form the toxic polybrominated dibenzo furans (PBDF) and polybrominated dibenzo dioxins (PBDD) during the extruding process, which is part of the plastic recycling process. As a consequence, the German chemical industry stopped the production of these chemicals in 1986.(24)

In addition, high concentrations of PBDEs have been found in the blood of workers in recycling plants.(25) A recent Swedish study found that when computers, fax machines or other electronic equipment are recycled, dust containing toxic flame-retardants is spread in the air. Workers at dismantling facilities had 70 times the level of one form of flame retardant than are found in hospital cleaners. Because of their common presence in air, clerks working full-time at computer screens also had levels of flame-retardants in their blood – slightly higher than for cleaners. Humans may directly absorb PBDEs when they are emitted from electronic circuit boards and plastic computer and TV cabinets.

In May, 1998 Sweden's National Chemicals Inspectorate called for a ban on PBB and PBDE while urging their government to work for a European wide ban and for controls on the international trade in these chemicals.(26)

As a consequence, PBBs should no longer be used commercially.

- Between 1997 and 2004 over 315 million computers will become obsolete.
- Calculations for the amount of brominated Flame retardants(27) present in monitors total over 350 million pounds.

This is an underestimate because it does not take into account the amount present in the computer tower or printed wiring boards.

3. DISPOSING OF COMPUTERS IS HAZARDOUS

In addition to the recent evidence of worker exposure to flame retardants, the environmental risks posed by landfilling and burning are also significant. In particular, when computer waste is landfilled or incinerated, it poses contamination problems in leachate to water sources and toxic air emissions.

The Hazards of Incinerating Computer Junk

The stream of Waste from Electronic and Electrical Equipment (WEEE) contributes significantly to the heavy metals and halogenated substances contained in the municipal waste stream.(28) Because of the variety of different substances found together in electroscrap, incineration is particularly dangerous. For instance, copper is a catalyst for dioxin formation when flame-retardants are incinerated. This is of particular concern as the incineration of brominated flame retardants at a low temperature (600-800°C) may lead to the generation of extremely toxic polybrominated dioxins (PBDDs) and furans (PBDFs). (29)

Significant quantities of PVC are contained in WEEE(30) which makes the flue gas residues and air emissions particularly dangerous.(31)

The introduction of WEEE into incinerators results in high concentrations of metals, including heavy metals, in the slag, in the fly ash, the flue gas and in the filter cake. In this context, more than 90% of the cadmium put to an incinerator is found in the fly ash and more than 70% of the mercury in the filter cake.(32)

Municipal incineration is the largest point source of dioxins into the US and Canadian environments and among the largest point source of heavy metal contamination of the atmosphere.

Some producers send their electroscrap to cement kilns for use as an alternative to fuel. Smelting can present dangers similar to incineration. Indeed, there have been concerns expressed that the Noranda Smelter in Quebec, where much of the North American electroscrap is sent, is producing dioxins due to the residual presence of PVC or other plastics in the scrap. (33) Noranda has denied that their smelter presents a pollution hazard.

The Hazards of Landfilling Computer Junk

It has become common knowledge that all landfills leak. Even the best "state of the art" landfills are not completely tight throughout their lifetimes and a certain amount of chemical and metal leaching will occur.(34) The situation is far worse for older or less stringent dump sites.

Mercury will leach when certain electronic devices, such as circuit breakers are destroyed. The same is true for PCBs from condensors. When brominated flame retarded plastic or cadmium containing plastics are landfilled, both PBDE and the cadmium may leach into the soil and groundwater. It has been found that significant amounts of lead ions are dissolved from broken lead containing glass, such as the cone glass of cathode ray tubes, when mixed with acid waters which commonly occur in landfills. (35)

Not only the leaching of mercury poses specific problems. The vaporization of metallic mercury and dimethylene mercury, both part of WEEE, is also of concern. In addition, uncontrolled fires may arise at the landfills and this could be a frequent occurrence in many countries. When exposed to fire, metals and other chemical substances, such as the extremely toxic dioxins and furans (TCDD -Tetrachloro-dibenzo-dioxin, PCDDs, PBDDs and PCDFs - polychlorinated and polybrominated dioxins and furans) from halogenated flame retardant products and PCB containing condensers can be emitted.

The Hazards of Recycling Computer Junk

Recycling of hazardous products has little environmental benefit – it simply moves the hazards into secondary products that eventually have to be disposed of. Unless the goal is to reddesign the product to use non-hazardous materials, such recycling is a false solution.

The list of e-toxic components in computers include:

- computer circuit boards containing heavy metals like lead & cadmium
- computer batteries containing cadmium
- cathode ray tubes with lead oxide & barium
- brominated flame-retardants used on printed circuit boards, cables and plastic casing.
- Poly Vinyl Chloride(PVC) coated copper cables and plastic computer casings that release highly toxic dioxins & furans when burnt to recover valuable metals
- mercury switches
- mercury in flat screens
- Poly Chlorinated Biphenyl's (PCB's) present in older capacitors & transformers

Due to the halogenated substances found in plastics, both dioxins and furans are generated as a consequence of recycling the metal content of WEEE. Halogenated substances contained in WEEE, in particular brominated flame-retardants, are also of concern during the extrusion of plastics, which is part of plastic recycling. Due to the risk of generating dioxins and furans, recyclers usually abstain from recycling flame-retarded plastics from WEEE. However, due to the lack of proper identification of plastic containing flame retardants , most recyclers do not process any plastic from WEEE.(38)

Environmental problems during the recycling of WEEE are not only linked to halogenated substances. Hazardous

emissions to the air also result from the recycling of WEEE containing heavy metals, such as lead and cadmium.(39) These emissions could be significantly reduced by means of pre-treatment operations. Another problem with heavy metals and halogenated substances in untreated WEEE occurs during the shredding process. Since most WEEE is shredded without proper disassembly, hazardous substances, such as PCB contained in capacitors, may be dispersed into the recovered metals and the shredder waste.(40)

E- Waste Exports – an unknown, dangerous and secretive activity.

It is difficult to find data on the amount of computer scrap leaving the US for countries such as Taiwan and China. This is because of past bad publicity and the fact that producers will sell scrap to recyclers and not bother finding out the final destination and fate of their end of life product.

The export of scrap is profitable because the labor costs are cheap and regulations are lax compared to US law. **A pilot program 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 US**. (41)

The overwhelming majority of the world's hazardous waste is generated by industrialized market economies. Exporting this waste to less developed countries has 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.

In 1989 the world community established the Basel Convention on the Transboundary Movement of Hazardous Waste for Final Disposal to stop the industrialized nations of the OECD from dumping their waste on less developed countries. The USA, however, has declined to sign the Convention.

Electrical & electronic scrap, including computers, are considered hazardous according to the Basel Convention Technical Working Group (TWG) because they can contain many hazardous components including PCB's, mercury, lead & cadmium. Many of these hazardous substances are contained within individual components within the like circuit boards, batteries, switches and capacitors. WEEE will remain regulated under these provisions unless it can be proved it does not contain hazardous constituents.

In 1994 parties to the Basel Convention, now over 60 countries, agreed to an immediate ban on exports of hazardous waste destined for final disposal in non-OECD countries. It was clear however; that this was not enough to stop the transport of waste which countries claimed was being exported for recycling purposes.

Seventy-seven non-OECD countries, and China, pushed heavily for a ban on the shipping of waste for recycling. As a result, the **Basel Ban** was adopted, promising an end to the export of hazardous waste from rich OECD countries to poor non-OECD countries for recovery operations by December 31st 1997. The USA has declined to participate.

The US has lobbied Governments in Asia to establish bilateral trade agreements to continue dumping their hazardous waste after the Basel Ban came into effect on January 1st 1998. The amount of computer scrap exported from the USA will continue to grow as product obsolescence increases.

4. A STEP IN THE RIGHT DIRECTION: EXTENDED PRODUCER RESPONSIBILITY AND E-TOXICS PHASE-OUTS

Europe has taken the lead on reducing E-waste from electronic products by making producers responsible for taking back their products.

This is known as Extended Producer Responsibility. 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 ddesign and process technology. In its widest sense, Producer Responsibility is the principle that producers bear a degree of responsibility for all the environmental impacts of their products. This includes upstream impacts arising from the choice of materials and from the manufacturing process as well as the downstream impacts, i.e. from the use and disposal of products. However, product take-back needs to go hand-in-hand with mandatory legislation to phase-out e-toxics.

Extended Producer Responsibility (EPR) focuses on the responsibility that producers assume for their products at the end of their useful life (post-consumer stage). 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. Other terms used are '*take-back*', '*product liability*' or *'life cycle product responsibility*.'

The European Union (EU) has drafted legislation on Waste from Electrical and Electronic Equipment (the WEEE Directive) based on the concept of Extended Producer Responsibility.

The Europeans have taken the lead on this because:

- The rapid growth of WEEE is a growing concern. The growth of WEEE is about 3 times higher than the growth of the other municipal waste streams.(42)
- The hazardous nature of the products pose significant waste management problems. There are estimates that the 90% of WEEE that is landfilled, incinerated or recovered without any pre-treatment constitutes an important share of various pollutants found in the municipal waste stream(43) (this, of course, does not include the old computers that are in "temporary" storage in people's garages, basements, etc.)
- Various member states within Europe have already drafted legislation on this subject. This includes the Netherlands, Denmark, Sweden, Austria, Belgium, Italy, Finland and Germany. The new draft WEEE Directive, therefore, harmonizes all these countries' initiatives to allow industry to operate uniformly throughout Europe.

The objective of the WEEE draft directive is to require manufacturers to improve the ddesign of their products in order to avoid the generation of waste and to facilitate the recovery and disposal of electronic scrap. This can be achieved through the phase out of hazardous materials, as well as the development of efficient systems of collection, re-use and recycling. The ultimate aim is to close the loop of the product life cycle so that producers, who manufacturer the product in the first place and who are ultimately in charge of ddesigning the product, get their products back and assume full responsibility for life cycle costs. 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 ddesign their products with less hazardous and more recyclable materials. This change in the market economics – in effect the internalization of costs that are currently passed off to the general public – will encourage the ddesign of products for repair, upgrade, re-use, dismantling and safer recycling.

What the European Union has proposed as a solution for E-scrap:

- The draft WEEE Directive will phase-out the use of mercury, cadmium, hexavalent chromium and two classes of brominated flame-retardants in electronic and electrical goods by the year 2004.
- It puts full financial responsibility on producers to set up collection, recycling and disposal systems.
- Between 70% to 90% by weight of all collected equipment must be recycled or re-used. In the case of computers and monitors, 70% recycling must be met.
- "Recycling" does not include incineration, so companies won't be able to meet recycling goals by burning the waste.
- For disposal, incineration with energy recovery is allowed for the 10% to 30% of waste remaining. However, components containing the following substances must be removed from any end of life equipment which is destined for landfill, incineration or recovery:

  lead, mercury, hexavalent chromium, cadmium, PCBs, halogenated flame-retardants, radioactive substances, asbestos and beryllium.

- Member states shall encourage producers to integrate an increasing quantity of recycled material in new products. Originally the EU stipulated that by 2004 new equipment must contain at least five percent of recycled plastic content but this provision was recently dropped because of intense industry lobbying. This is a major weakening of the directive, since on the one hand it encourages recycling but then does not stipulate recycled content in new products. Instead the revised Directive 'encourages' member states to set recycled content in their procurement policies.
- Producers must ddesign equipment that includes labels for recyclers that identify plastic types and location of all dangerous substances.
- Member states must collect information from producers on a yearly basis about quantities of equipment put on the market, both by numbers of units and by weight, as well as on the market saturation in the respective product sectors. This information will be transmitted to the EU Commission by 2004 and every three years after that date.
- Producers can undertake the treatment operation in another country, but this should not lead to shipments of WEEE to non-EU countries where no or lower treatment standards than in the EU exist. Accordingly, producers shall deliver WEEE only to those establishments which comply with the treatment and recycling requirements set out in the proposal and producers shall verify compliance through adequate certifications.

It is envisaged that the extra costs of waste management will be reflected in 1% to 3% higher retail price on some items. However, the EU believes this is likely to diminish as economies of scale and innovation bring down the costs of separately collecting and treating WEEE. Also, the issue of who should pay is at the heart of Extended Producer Responsibility, since it is actually an extension of and mechanism to implement the "polluter pays" principle. Consumers who buy the product should pay the full price of that product's waste management rather than the general taxpayer who may never purchase that particular product. Companies that learn how to produce products that are less hazardous and easier and less costly to recycle will develop a competitive advantage, since their recycling costs will be lower.

What has been the response of industry, member states and the US government?

Some industry representatives support harmonized legislation and the objectives of the WEEE proposal. However, many object to mandatory phase-outs of the most toxic materials, although most agree in principle with the need to minimize their use. Industry objects to the financial responsibility for collection of WEEE from private households but accepts a certain involvement in the recycling stage of their products.

The 15 Member States of the EU in general welcome the directive. No country favors a voluntary approach and there is general agreement about involving producers in the waste management phase of electrical and electronic equipment. Some countries favor the involvement of municipalities in the collection of WEEE, but maintain that the responsibility for treatment, recovery and disposal should be assigned to producers.

US government is lobbying heavily against the mandatory bans on e-toxics, e-waste and recycling quotas.

The US Trade Representative, the US Mission in Brussels and US trade associations such as the American Electronics Association (AEA) and the Electronics Industry Alliance (EIA) have expressed strong disagreements with the EU initiative.

In a September 9, 1998 letter from the American Electronics Association, the Electronics Industry Alliance and other trade groups, several high-tech trade associations sought assistance from the US State Department and the US Trade Representative to de-rail the proposal. They reiterated that the prohibition on the use of certain materials "that are essential to the functionality, safety and reliability of electronic and electrical products will impede the development of new technologies and products, increase costs, and restrict global trade in these products." The AEA also lobbied against the 5% mandatory recycled content in new products, and the financial responsibility of producers for collection and treatment.(44)

In a January 11, 1999 position paper that cited "Trade Concerns", the US Mission in Brussels has stated that the directive may constitute "unnecessary barriers to trade, particularly the ban on certain materials, burdensome take-back requirements for end of life equipment, and mandated ddesign standards." They further state that substitutes may be 'as problematic or more problematic than the materials they are replacing' and exemptions for certain uses 'could lead to uncertainty and confusion in the marketplace. (45)

In response, to the lobbying position of the trade organizations and the US government's apparent support, a coalition of public advocacy groups, organized by the International Campaign for Responsible Technology based in Silicon Valley, California petitioned the European Union not to cave in to US lobbying.(See http://www.svtc.org/cleancc/gorelet.htm) At this year's meeting of the President Council on Sustainable Development in April, they issued a press release supported by 100's of Non-Governmental Organizations (NGOs) from around the world, asserting that the US had no right to interfere in other countries' environmental protection.

In response to this NGO position, the American Electronics Association wrote to Vice President Gore defending their position. They reiterated that they shared the goal of waste minimization and increased recycling but that the material bans and ddesign requirements went "...'far beyond the establishment of environmental standards applicable to 'waste' of electrical and electronic equipment, and will hamper global trade of high-tech products, impede technological innovation and fail to benefit the environment." (46)To see the letter written by the AEA and the EIA to Vice-President Gore, visit the AEA Website Click on the public policy tab, then the international tab, then Europe.

In August, 1999 a legal opinion prepared for the AEA and EIA asserted again that the WEEE directive would violate several international trade rules and would be an invitation to further trade disputes. A previous assessment by the same law firm that the 5% recycled plastic content in new products posed a serious barrier to trade, was successful in getting the EU to drop this recommendation in the latest draft legislation. It now seems that the toxic material phase-outs are the next main focus in the US high-

tech lobbyists.

The European Union has always maintained that the directive does not impose a barrier to trade and that European legal experts had studied the draft thoroughly. The EU also maintains that the phase-outs only apply when technically feasible and safer substitutes already exist.

5. WHAT IS A CLEAN COMPUTER?

"Electronic products should actually be considered chemical waste products. Their number is increasing and their life is decreasing. Electronic waste piles are growing, as is their pollution potential. Most of these problems have their source in the development and ddesign of the products concerned."

Dr J.C. van Weenan, Chair of the UNEP workgroup on Sustainable Product Ddesign

Many companies have shown they can ddesign cleaner products. Industry is making some progress to ddesign cleaner products but we need to move beyond pilot projects and ensure all products are upgradeable and non-toxic

Some examples:(47)

- Hewlett-Packard Company has developed a safe cleaning method for chips using carbon dioxide cleaning as a substitute for hazardous solvents.
- Printed circuit boards can be reddesigned to use a different base material, which is self-extinguishing, thereby eliminating the need for flame-retardants.
- Matsushita is "accelerating efforts to eliminate toxic substances and develop more environmentally benign materials such as lead-free solder, non-halogenated lead wires and non-halogenated plastics. Matsushita also developed "the first ever lead-free solder for flow soldering applications and have recently launched, in Japan, their first totally-recyclable television sets." Sony Corp has developed a lead-free solder alloy, which is usable in conventional soldering equipment. There is a range of lead-free solders now available. Obviously, substitutes need to be proven for safety.
- Pressures to eliminate halogenated flame-retardants and ddesign products for recycling have led to the use of metal shielding in computer housings.
- In 1998 IBM introduced the first computer that uses 100% recycled resin (PC/ABS) in all major plastic parts for a total of 3.5 pounds of resin per product.
- Researchers at Delft University in Holland are investigating the ddesign of a wind up laptop similar to the wind-up radio that plays one hour for every 20 seconds of hand winding.
- Toshiba is working on a modular upgradable and customizable computer to cut down on the amount of product obsolescence. They are also developing a cartridge which can be rewritten without exchanging parts or modules allowing the customer to upgrade at low cost.

Sustainable product ddesign asks that we consider:

1. Rethink the product ddesign. To first ask what is a clean computer, we need to ask what function the computer serves. Is it something to transmit information, data and graphics? Can we achieve that without this amount of hazardous material sitting on our work desks?

Efforts to reduce material use are mirrored in some new computer ddesigns that are flatter, lighter and more integrated. Other companies propose centralized networks similar to the telephone system. Here consumers would have only a simple screen and keyboard at home or in the office and we would pay a monthly fee based on the level of software complexity we would want to access. Some think this could lead to information control and lack of privacy. Others think this would make access to the internet cheaper, less materials intensive, and more accessible to everyone, while achieving comparable privacy as is found with the current use of PCs anyway.

2. Use renewable materials and energy. Bio-based plastics are plastics made with plant-based chemicals or plant produced polymers rather than from petro-chemicals. Bio-based plastics exist but they do not see common use because of lack of market demand and the low price of petroleum-based plastics. Bio-based toners, glues and inks also exist and are used more frequently. Solar computers also exist but they are currently very expensive.

3. Use non-renewable materials that are safer. Because many of the materials used are non-renewable, ddesigners could ensure the product is built for re-use, repair and/or upgradability Some computer manufacturers such as Dell and Gateway lease out their

products thereby ensuring they get them back to further upgrade and lease out again.

6. WHAT YOU CAN DO

IF YOU OWN A COMPUTER:

1. Write to or phone your computer manufacturer asking them to take back your old computer free of charge to you, or just bring it back to them and tell them that you want them to take it back!

2. Sign the letter to the European Union, urging them to stand strong against aggressive lobbying efforts by the high-tech industry and the US Trade Representative.

3. Ask the manufacturer to phase out hazardous materials in your computer. URL to be provided soon.

4. Write to the US State Department telling them you do not support oppose their lobby against European take-back plans. Europe should be able to protect its own environment. Tell them you want to see take-back legislation here too. A sample letter and people to address the letter will be provided soon. The letter to Vice-President Gore from the International Campaign for Responsible Technology can be used as a model.

5. 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. They can help to promote computer re-use and recycling infrastructure. They can support Extended Producer Responsibility for computer manufacturers.

IF YOU WORK FOR LOCAL GOVERNMENT:

- Save your own budget and save your taxpayers money: Promote Extended Producer Responsibility for waste and make producers pay the cost of managing their waste products. While product take-back legislation gathers popularity and gets implemented in other countries, the US is slow off the mark. Double standards by corporation are increasingly evident. Increasingly, local government representatives are developing solution that don't just rely on taxpayer financing.
- Find out what other states and provinces are doing to promote product take-back**.**

CONTACT AND RESOURCES TO GET STARTED

(A list of noon-governmental organizations will be posted shortly.)

:

Minnesota:

Contact: Garth Hickle
Policy Analyst,
MN Office of Environmental Assistance,
St. Paul, MN
Tel: 651 215 0271
Email: garth.hickle@moea.state.mn.us,

- **Wisconsin.**

Contact: John Reindl
John Reindl, Recycling Manager
Dane County, Wisconsin
reindl@co.dane.wi.us
(608)267-1533 – fax

(608)267-8815 – phone

- **US EPA** Office of Solid Waste Management.

Contact: Clare Lindsay
Project Director for Extended Product Responsibility
LINDSAY.CLARE@epamail.epa.gov
703 308-7266

- **British Columbia, Canada**

Society Promoting Environmental Conservation
Contact Helen Spiegelman
Vancouver, BC
Tel: 604/731-8464
Email: helens@axionet.com
The province of BC has some of the best product take-back programs in Canada.

- **Grassroots Recycling Network.**

Contact Bill Sheehan
Network Coordinator
P.O. Box 49283
Athens GA 30604-9283
Tel: 706-613-7121
Fax: 706-613-7123
zerowaste@grrn.org
http://www.grrn.org
The GRRN has a good on-line discussion concerning Producer Responsibility.

- **National Recycling Coalition.**

Contact: Dawn Amore
1727 King Street, Suite 105
Alexandria, VA 22314-2720
Phone: (703) 683-9025, ext. 205
Fax: (703) 683-9026
E-mail: dawna@nrc-recycle.org
The National Recycling Coalition is exploring voluntary product take-back programs with some industries.

- **University of Tennessee, Knoxville.**

Center for Clean Products and Clean Technology.
Contact: Gary A. Davis, Director
Director
University of Tennessee
Suite 311, Conference Center Building
Knoxville, TN 37996
USA

423-974-1835
423-974-1838 fax
The Center conducts research and publishes comprehensive news and reports on Producer Responsibility.

- **Product Stewardship Advisor.**

Cutter Information Corp., 37 Broadway, Arlington, MA 02474 USA
Phone: 1-800-964-5125 / or 781-641-5125 outside N America
Fax: 1-800-888-1816 / or 781-648-1950 outside N America
PSA specializes in product take-back around the world. See their website at
http://www.cutter.com

- **Environmental Data Services.**

ENDS Environment Daily.
Also on the web, at http://www.ends.co.uk/envdaily
E-mail: envdaily@ends.co.uk Fax: +44 171 415 0106
Subscriptions, Tel: +44 171 814 5353
Editorial, Tel: +44 171 814 5320
Post: 40 Bowling Green Lane, London EC1R 0NE, UK

- ENDS is an excellent journal on European environmental policy and news if you want to keep up to date with what's happening on the Precautionary Principle, new chemical policies, and product take-back, etc.

Let us know if you would like to be added to this list. And please let us know about other initiatives so that we can add them to this publication.

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Notes

1.Data excerpted from 1996 Electronics Industry Roadmap. Microelectronics and Computer Technology Corporation, Austin, TX.

2. "Electronic product recovery and recycling baseline report", National Safety Council, Washington, DC, 1999.

3. ibid.

4. Based on information from "Computer Display Industry and Technology Profile", EPA 744.R.98.005, December 1998 and based on figures presented by the National Safety Council, Washington DC, May 1999 "Electronic Product Recovery and Recycling Baseline Report"

5. National Safety Council, op.cit

6. ibid.

7. ibid.

8. ibid.

9. EXPLANATORY MEMORANDUM, WEEE (Third Draft) July 1999, Brussels, 05.07.1999

10. Compare Risk Reduction Monograph No 1 Lead - Background and national experience with reducing risk, OECD Paris, 1993

11. EXPLANATORY MEMORANDUM, WEEE (Third Draft) July 1999, Brussels, 05.07.1999

12. This information is based on the risk reduction monograph no 5, CADMIUM, Background and national experience with reducing risk (OCDE/GD894) 97; Health effects of cadmium exposure- a review of the literature and a risk estimate (Lars Jarup and others) Scand J Work Environ Health 98; Environmental impacts of cadmium, Gerrit H. Vonkeman 1995; Cadmium in Sweden-environmental risks, Helena Parkman and others 1997 and other research on this issue.

13. National Safety Council Report, Washington DC May 1999. From report "Electronic Product Recovery and Recycling Baseline Report".

14. EXPLANATORY MEMORANDUM, WEEE (Third Draft) July 1999, Brussels, 05.07.1999

15. EXPLANATORY MEMORANDUM, WEEE (Third Draft) July 1999, Brussels, 05.07.1999

16. Citation to follow.

17. Adherent Technologies, citation to follow.

18. All references available from www.greenpeace.org/~toxics.html. See the report section. Also see ref. 12.

19. Persistent Organic Pollutants. Swedish Environmental Protection Agency. Monitor 16. http://www.environ.se

20. Evidence mounts on risks of brominated flame retardants. ENDS report 283. August 1998, London, UK

21. Ibid.

22.Hoque, A et al, 1998. Epidemiology Vol 9(4) P. 373-8.

23. WEEE Explanatory Notes, EU 1999

24. See "Formation of Polybrominated Dibenzofurans (PBDFs) and Dioxins (PBDDs) during extrusion production of a Polybutylenetenerephtalate (PBTP)/Glassfibre resin blended with Decabromodiphenylether (PBDPE)/Sb2O3; product and workplace analysis" Brenner, Knies, BASSF, 1986. Further information to be found in "Polybrominated Diphenyl Ethers in the Swedish Environment" Ulla Sellstrom. Stockholm, 1996.

25. Sjodin, et al. Flame Retardants Exposure--Polybrominated Diphenyl Ethers (PBDEs) in Blood from Swedish Workers. Environmental Health Perspectives. Vol 107, Number 8, August 1999.

26. Information and recommendation from Risk Reduction Monograph No 3; Selected Brominated Flame Retardants--Bakcground and national experience with reducing risk. OECD Paris 1994.

27. Taken from amount of PBDE present in the LCA study of product group personal computers in the EU Ecolabel Scheme, 1998. Atlantic Consultancy and IPU, European Community, Brussels. This calculation was made with numbers previously shown and by taking a monitor weight of 30 pounds, according to the National Safety Council Report, "Electronic Product Recovery and Recycling Baseline Report, Washington, DC May 1999.

28. See Chapter 4.2

29. "Bestimmung von polybromierten Dibenzofioxinen und-furanen in verschiedenen unweltrelavanten Materialien" U. Schacht B. Gras und S.Sievers in Dioxin-Informationsveranstaltung EPA Dioxin-Reassessment, edited by Otto Hutzinger and Heidelore Fiedler containing further references on this subject.

30. See footnote 29 above. This is a similar estimate as that made by M. Rohr, Umwelt Wirschaftsforum, No 1, 1992, who calculated

that more than 20% of the plastic used in electrical and electrical equipment is PVC.

31. Environmental aspects of PVC (Kopenhagen 1996) Danish Environmental Protection Agency and Position Paper of the Netherlands on PVC (The Hague 1997) Ministry of Housing, Spatial Planning and the Environment.

32. Further data are given ini"Messung der Gutter-und Stoffbilanz einer Mullverbrennungsanlage" (Wien 1994) Umweltbundesamt and MA 22.

33. Correspondence from Jean Lavergene, ingenieur, Direction de l'expertise scientique. Rapport de controle de qualite de l'echantillonnage des emissions atmosheriques de le-usine d'acide de Mineraux Noranda de Rouyn-Noranda. 30 janvier, 1992

34. For example, 5600 landfills are operated in Slovakia. It is estimated that only 11 of these landfills might meet the general requirements for all classes of landfills as set out in Annex 1 of Council Directive 99/ /EC of 27 April 1999 on the landfill of waste.

35. Environmental Consequences of Incineration and Landfilling of Waste from Electr(on)ic Equipment (Copenhagen 1995), Nordic Council of Ministers.

36. As an example, see the case of the metal reclamation plant Brixlegg/Austria ("Comparison of PCDD/PCDF levels in soil, grass, cow's milk, human blood and spruce needles in an area of PCDD/PCDF contamination through emissions from a metal reclamation plant" Riss, Hagenmaier, Chemosphere, Vol. 21, no. 12, pp 1451-1456, 1990)

37. See "Formation of Polybrominated Dibenzofurans (PBDF's) and Dioxins (PBDD's) during extrusion production of a Polybutyleneterephtalate (PBTP)/Glassfibre blended with Dicabromodiphyenylether (DBDPE/Sb203); product and workplace analysis" Brenner, Kniews, BASF, 1986.

38. Compare the example given on page 18 of the report C Voute, Recycling and Waste Control Officer, Corporation of London, on "electrical and Electronic products recycling in Germany" to ICER (Industry Council for Electronic Equipment Recycling).

39. The case of the Austrian copper recycler in Brixleg is well documented and confrims this stituation (compare "Montanwerke Brixlegg-Wirkungen auf die Umwelt"; Umweltbundesamt, Monographien Bd 25, Wien, Juni 1990)

40. When there is a lack of proper dismantling of WEEE, the shredder waste of white goods can have a high concentration of lead, ranging from 940 to 9,400 mg/kg. Around 95% of the PCB contained in condensors (617,500 mg/kg) ends up in the shredder dust. Therefore, the contaminated shredder has to be dealt with as dangerous waste. Compared to the incineration of ordinary wastes, the incineration of dangerous waste is an expensive process. As a consequence, the PCB contamination of shredder waste entails an enormous increase in costs.

41. USEPA report "Analysis of Five Community Consumer/Residential Collections of End-of-Life Electronic and Electrical Equipment", November 24, 1998) (full citation to follow)

42. AEA Technology, Recovery of WEEE, Economic and Environmental Impacts, June 1997.

43. Environmental Consequences of Incineration and Landfilling of Waste from Elect(on)ic Equipment (Copenhagen, 1995), Nordic Council of Ministers. According to the study, "Pilotsammlung von Elektroaltgeraten in Bregenz", 95% of the WEEE arising in Austria are either simply disposed of with the municipal waste or introduced into the metal recycling chain without any pre-treatment.

44. Letter to US State Dept. from EIA, Sept. 9, 1998.

45. Additional US Points on DG-XI's Draft Directive on Waste from Electronic and Electrical Equipment, January 1999.

46. Cite on AEA website forthcoming.

47. All examples taken from International Symposium on Electronics and the Environment. May 11-13, 1999. Danvers. Sponsored by the Institute of Electrical and Electronics Engineers.

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