UNEP

E-waste,

the hidden side of IT equipment's manufacturing and use

The production of electrical and electronic devices is the fastest-growing sector of the manufacturing industry in industrialised countries. At the same time, technological innovation and intense marketing engender a rapid replacement process. Every year, 20 to 50 million tonnes of electrical and electronic equipment waste ("e-waste") are generated world-wide, which could bring serious risks to human health and the environment.

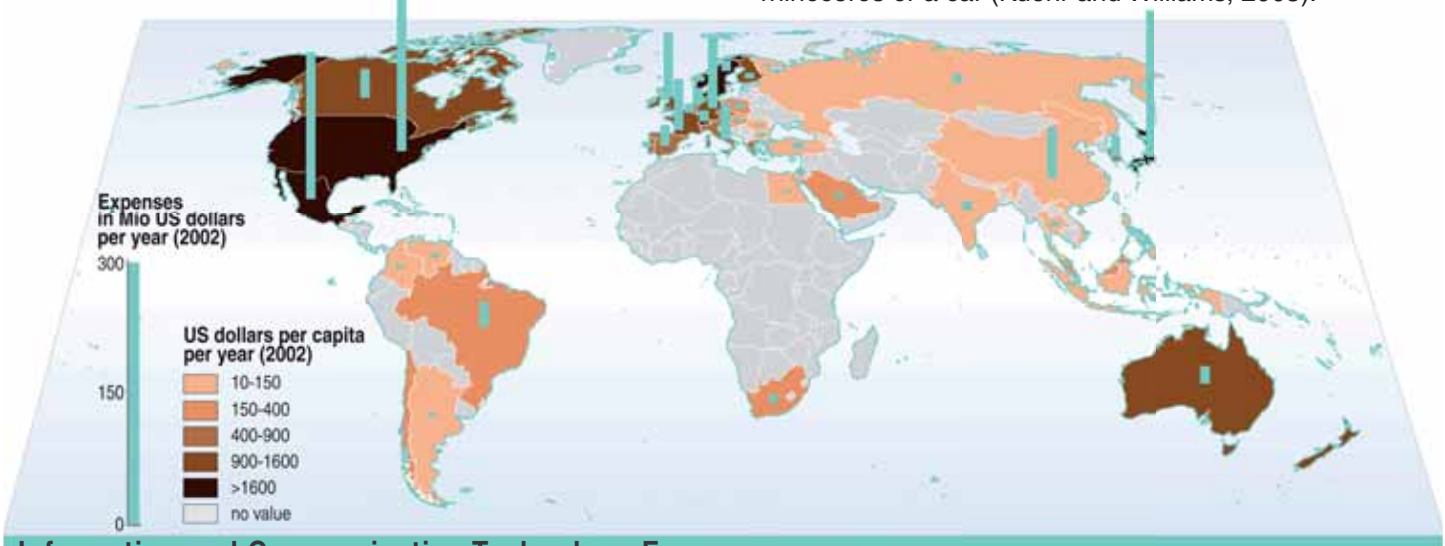
Background

Industry seduces with gadgets and utilities that can lead to a more convenient, flexible and independent life. The production of electric and electronic equipment is a fast-growing industry. It ranges from large household appliances such as refrigerators and air conditioners, computers and stereo systems, to hand-held digital apparatuses and cell phones. Recent digital equipment has a life-cycle of only a few years; frequently, even less. E-waste differs from the normal municipal waste stream.

Firstly, it is generated at alarming rates. In 1998, six million tonnes of e-waste were generated (Arensmann, 2000), which represents 4% of the municipal waste stream. Its volume is expected to increase by at least 3-5% per annum, a rate nearly three times faster than the municipal waste streams' general growth.

It can also be hazardous. Electronic devices form a complex mixture of materials and components, often containing several hundreds of different substances, many of which are toxic and create serious pollution upon disposal. These include heavy metals such as mercury, lead, cadmium, chromium and flame retardants such as polybrominated biphenyls (PBB) and polybrominated diphenylethers (PBDEs).

Finally, the production of electric and electronic devices is a very resource-intensive activity. The environmental burden due to the production of electrical and electronic products ("ecological baggage") exceeds by far the one due to the production of other household materials. A UN study found that the manufacturing of a computer and its screen takes at least 240 kg (530 pounds) of fossil fuels, 22 kg (48 pounds) of chemicals and 1.5 tonnes of water - more than the weight of a rhinoceros or a car (Kuehr and Williams, 2003).



Information and Communication Technology Expenses

Data source: World Bank "World Development Indicators 2004"

What there is ...

Radios and televisions are devices that can be found in nearly every home. Personal computers (PCs) assisted us first in our offices, then in our homes, and now during our travels as laptops as well as pocket-PCs. Personal digital assistants (PDAs) are expected to make our lives easier.

However, experts estimate that:

- more than 500 million computers will become obsolete in the USA alone between the years 1997 and 2007.
- 130 million cellular phones will be discarded in the USA by the year 2005, resulting in 65 000 tonnes of phone waste (BAN 2004).
- 610 million mobile phones are to be disposed of in Japan by 2010 (Uryu et al. 2003).
- every year, an EU citizen leaves behind 25 kg of e-waste (SECO & EMPA 2003).
- 20 to 50 million tonnes of e-waste are generated per year world-wide.

Today, e-waste comprises more than 5 per cent of all municipal solid waste, which is nearly the same amount as all plastic packaging, and is growing steadily.

What happens with it ...

The steps towards the end of the life-cycle of a device are storage, re-use and recycling, before ending as waste.

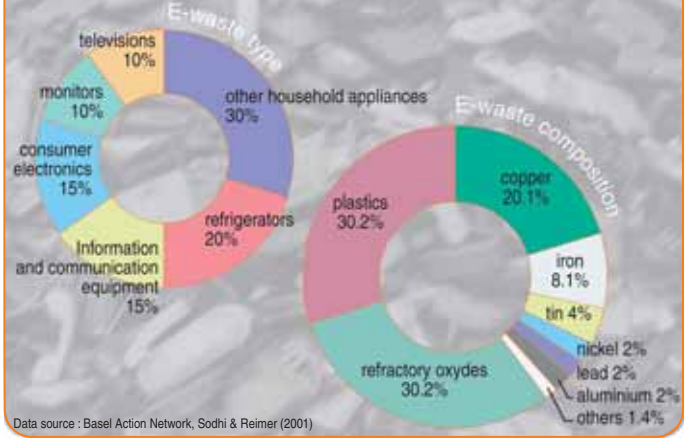
Storage

Consumers in the USA have an average of two to three obsolete computers in their garage, closet or storage space. Other researchers estimate that three-quarters of all computers ever sold in the USA remain stockpiled, awaiting re-use, recycling or disposal.

Re-use

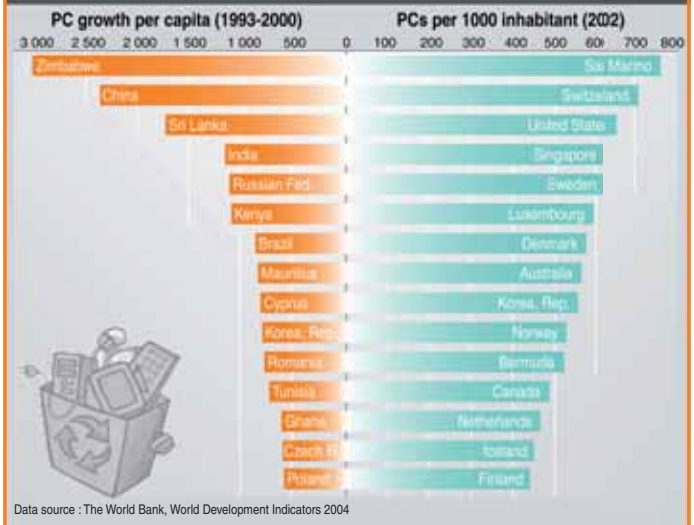
Obsolete devices from industrialised countries can find their way to developing countries, where old computers and cell phones are often used for a few more years. For instance, out of nearly 5 million PCs in India, 1.38 million are either model 486s (thus, some eight years old) or even older. Re-use is a good way to lengthen a product's life-span. But in India, as in other developing countries, it means that a vast amount of equipment will soon be added to the waste stream. Rich countries, dumping their old devices in developing countries - sometimes legally as "charity", sometimes illegally as waste - are thus liberating themselves of the waste disposal problem.

E-waste type and composition



Data source : Basel Action Network, Sodhi & Reimer (2001)

Growth in the Number of Personal Computers



Data source : The World Bank, World Development Indicators 2004

This graphic shows a classification of the top 15 countries in the growth of the number of personal computer per capita (on the left, in orange). By comparison, the countries' number of PCs per 1000 inhabitants is shown on the right, in blue.

Today's e-waste - including used computers - is mainly generated by industrialized countries which already have a high number of personal computers. But in the near future, a large quantity of waste will be coming from countries in economic transition such as Zimbabwe, China, Sri Lanka, India, and Eastern European countries.

Recycling

Electronics "recycling" is a misleading characterisation of many disparate practices, including de-manufacturing, dismantling, shredding, burning or exporting. Recycling is mostly unregulated and often creates additional hazards itself. Although the amount of e-waste rises steadily, the industry has not yet developed very sophisticated or

Data sources : The World Bank, World Development Indicators 2004, The Electronic Wast Guide, Basel Action Network, Silicon Valley Toxic Coalition, Toxic Link India, SCOPE (Pakistan), Greenpeace China, 2002..

automated recycling procedures. In 2001, only 11 percent of personal computers retired in the USA were recycled. Nevertheless, modern recycling plants can recover 80% of the material and use another 15% for burning. Only 5% finishes as waste.

"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." (BAN, SVTC)

Landfill-disposal

The vast majority of e-waste ends up in our landfills or incinerators. According to the US Environmental Protection Agency (EPA), in 2000 more than 4.6 million tonnes of e-waste ended up in landfills nationally. It has become common knowledge that all landfills leak. Even the best "state of the art" ones are not completely sealed throughout their lifetimes and a certain amount of chemical and metal leakage will occur. The situation is far worse for older or less stringently controlled dump sites. The vaporization of metallic mercury and dimethylene mercury is also of concern. Uncontrolled fires may begin at such landfills, posing additional health and environmental risks.

Export

Export to developing countries is a dangerous but cost-effective, and sometimes illegal waste management option chosen by some companies in industrialised countries. Sometimes illegal export is phrased as or hidden under the umbrella of charity ("computers for the poor") or as recycling. This comes from the fact that environmental and occupational regulations are lax or not well-enforced in some developing countries, and labour costs are much lower than in industrialised ones (for instance, $1.50 per day in China). A recent report by Toxics Link (2004) found that 70% of electronic waste collected at recycling units in New Delhi (India) was actually exported or dumped by developed countries.

The recycling and disposal of computer waste in these countries becomes a serious problem since their treatment methods remain rudimentary. Such activities pose grave environmental and health hazards; for example, the deterioration of local drinking water which can result in serious illnesses. A river water sample from the Lianjiang river near a Chinese "recycling village" revealed lead levels that were 2 400 times higher than World Health Organization Drinking Water Guidelines. Sediment samples there showed lead levels 212 times higher than what would be treated as hazardous waste had it been dredged from the Rhine River bottom in the Netherlands (BAN & SVTC 2002).

Often, workers in e-waste recycling operations in developing countries face dangerous working conditions, as they may be without protection (no masks or gloves, for example). Released gases, acid solutions, toxic smoke and contaminated ashes are some of the most dangerous threats for such people, and the local environment.

BAN investigator taking a soil sample along riverside where circuit boards were treated with acid and burned openly. Massive amounts of dumping of imported computer waste takes place along the riverways. Guiyu, China. (photo: BAN)

What to do about it ...

In order to cope with the challenges of resource consumption, and to enforce waste minimization and reduce pollution, different policies are being evaluated, developed, and implemented on different levels.

Basel Convention - Parties of the Basel Convention (2004)

The Basel Convention on the Control of the Trans-boundary Movement of Hazardous Waste 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 richer to poorer countries. The Basel Ban Amendment, adopted in 1995, prohibits all exports of hazardous wastes from Parties that are member states of the EU, OECD and Liechtenstein to all other Parties to the Convention. However, as of 23 March 2005, the Ban Amendment had not yet entered into force. The United States is the only OECD country not having ratified the original Basel Convention, nor the Basel Ban Amendment.

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

EU directives on Waste Electrical and Electronic Equipment (WEEE) and Reduction of Hazardous Substances (RoHS)

In order to prevent the generation of hazardous waste, Directive 2002/95/EC (RoHS) requires the substitution of various heavy metals (lead, mecury, cadmium, and hexavalent chromium) and brominated flame retardants

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. (photo: BAN)

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(polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE)) in new electrical and electronic equipment put on the market from 1 July 2006.

The Waste Electrical and Electronic Equipment directive, which takes effect 31 December 2006, mandates re-use and recycling of electrical and electronic equipment and will require manufacturers to report to the EU Council the material content of products.

Regulatory directives and legislation will dramatically change business models in the IT and electronics industry. The responsibility to reduce product toxicity is on the manufacturer, and hundreds of thousands, if not millions of dollars, are being spent monthly to comply with legislation. The money invested in research and development to respond to customer environmental requests and government legislation will eventually go into the price of the products.

Did you know ..?

- **People discard computers every two to four years on average.**
- **Cell phones have a life-cycle of less than two years in industrialised countries.**
- **315 million PCs will become obsolete in 2004 alone.**
- **130 million mobile phones will be disposed of world-wide in 2005.**
- **Each computer screen contains about 20% lead by weight.**

Extended Producer Responsibility

Some countries are implementing policies and programmes to prevent pollution and promote waste minimisation. Key among these approaches is the "Extended Producer Responsibility" (EPR). Its objective is to make manufactures (financially) responsible for the entire life-cycle of their products, especially when they become obsolete. The underlying assumption is the company's interest in easier recycling and decomposition, and as such resource use limitation, pollution prevention and waste avoidance through ecological ("green") design, re-use, re-manufacturing and efficient recycling.

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