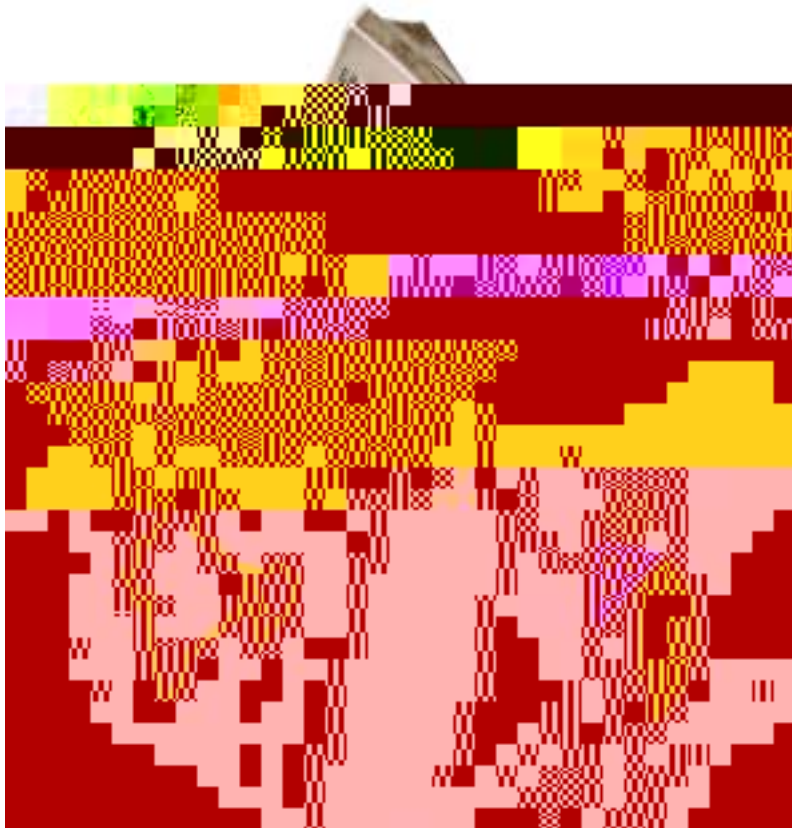




Toxics Link
for a toxics-free world

E-WASTE IN INDIA

System failure imminent – take action NOW!



Rapid obsolescence of electronics goods, compounded by dumping from developed countries, has brought the e-waste problem in India to the brink of spilling over into an acute crisis

What is e-waste?

From California to Calcutta, Stockholm to Sialkot or London to Lucknow, electronics are changing the lives of people everywhere. They are touching every aspect of our lives – the way we do business, keep in touch with family, bring up children or entertain ourselves. And in the wake of this 21st century revolution, looms a disaster that is sure to damage the quality of our lives and that of generations to come. The problem of electronic waste, or e-waste, requires urgent global action.

Discarded electronic waste is the fastest growing stream of waste in industrialised countries. Not surprising, when you consider that the electronics industry is the fastest growing manufacturing industry.

The industry thrives on new aspirational products. Consumers are drawn to the latest cellular phones, personal stereos, air conditioners, consumer electronics and computers. The extreme obsolescence of these products spawns a unique 'disposable' mindset where products are replaced rather than repaired. Though this rapid obsolescence is a result of rapidly evolving technology, it is clear that the throw-away principle yields great monetary benefits to corporates.



Major contributors to the e-waste stream

▲ **Individuals and Small Businesses:** The useful span of a computer has come down to about two years due to improved versions being launched about every 18 months. Often, new software is incompatible or insufficient with older hardware so that customers are forced to buy new computers.

▲ **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. 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.

▲ **Original equipment manufacturers (OEMs):** OEMs generate e-waste when units coming off the production line don't meet quality standards, and must be disposed off. Some of the computer manufacturers contract with recycling companies to handle their electronic waste, which often is exported.

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On the other hand, the waste generated contains many toxic substances that pose a serious threat to the health of communities and their environment. Disturbingly, the communities that are affected by the toxics in e-waste need not necessarily be those that are creating the waste. The large-scale unethical export of e-waste by industrialised nations to developing countries such as India, China and Pakistan is shifting the onus of development to communities that are ill-equipped to deal with such waste.

What does the Basel Convention say?

The Basel Convention defines waste by its disposal destination or recovery processes. These various processes are listed in Annexure 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 used without further processing are not likely to be defined as a waste.

The Convention has provided for two lists. List A, found in Annexure VII, is presumed to be hazardous and thus covered by the Basel Convention; and List B, found in Annexure IX, is presumed to be non-hazardous and thus not subject to the Basel Convention. The waste listed in List A is waste that poses serious threats to environment and human health. As a result of their adverse effects these substances require special handling and disposal processes.

The Annexure VIII hazardous waste list has the following entries applicable to e-waste:

▲ **A1180:** Waste electrical and electronic assemblies or scrap containing components such as accumulators and other batteries included in List A, mercury-switches, glass from cathode-ray tubes and other activated glass, and PCB-



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capacitors, or contaminated with Annex I constituents (for example, cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they possess any of the characteristics contained in Annexure III.

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 for including

US refuses to adopt the Basel Convention

To date, the United States is the only developed country in the world that has not ratified the Basel Convention. In fact, US officials have actively worked to defeat and weaken the Basel waste export ban. The US government policies appear to be designed to promote sweeping the e-waste problem out the Asian back door. Not only has the US refused to ratify the Basel Convention and Ban, but in fact, the United States government has intentionally exempted e-waste materials, 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 US e-waste disposal strategy and the only issue of concern for the US might be how to ensure minimal environmental standards abroad.

*Source: Exporting Harm:
the High-tech Trashing of Asia*

Annexure VII of the Basel convention includes almost same entries applicable to e-waste as in Schedule 3 of the Indian Hazardous Waste manual. However, there are some provisions, which are in direct opposition to what has been outlined in the Basel convention.

One such conflicting provision of the Hazardous Waste manual is the grant of trade in electronic assemblies like printed circuit board, electronic components and wires for recycling and not for direct reuse. This provision is contradictory to the Basel Convention, which allows trade only for reuse and not for recycling. There is another confusing provision on the trade of precious metal ash from the incineration of printed circuit boards. These imply that ash containing many carcinogens could be imported for reuse or recycling against a license from concerned authority. There are no analogous provisions in the Basel Convention.

plastics that are impregnated with brominated flame retardants and are exported for remelting and recycling.

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.

Export of e-waste violates the Convention since the wastes are not being exported to operations that have “environmentally sound management” in accordance with the Convention.

How hazardous is e-waste?

E-waste contains over 1,000 different substances and chemicals, many of which are toxic and are likely to create serious problems for the environment and human health if not handled properly. However, classification of e-waste as hazardous, or otherwise, depends on the amount of hazardous constituents present in it.

E-waste contains many toxics such as heavy metals, including lead, cadmium, mercury, Polychlorinated Biphenyls (PCBs), Poly Vinyl Chloride (PVC), etc, in some components.

Lead: Lead causes damage to the central and peripheral nervous systems, blood systems, kidney and reproductive system in humans. It also affects the endocrine system, and impedes brain development among children. Lead tends to accumulate in the environment and has high acute and chronic effects on plants, animals and microorganisms.

- ▲ *Used in glass panels and gaskets in computer monitors*
- ▲ *Solder in printed circuit boards and other components*

Cadmium: Toxic cadmium compounds accumulate in the human body, especially the kidneys.

- ▲ *Occurs in SMD chip resistors, infra-red detectors, and semiconductor chips*
- ▲ *Some older cathode ray tubes contain cadmium*

Mercury: Mercury can cause damage to organs including the brain and kidneys, as well as the foetus. The developing foetus is highly vulnerable to mercury exposure. When inorganic mercury spreads out in the water, it is transformed to methylated mercury which bio-accumulates in living organisms and concentrates through the food chain, particularly via fish.



E-waste contains the following toxic substances – lead, cadmium, mercury, hexavalent chromium, plastics, including PVC, BFRs, barium, beryllium, carcinogens such as carbon black, phosphor and various heavy metals. This deadly mix can cause serious, even fatal, health problems for those who have to handle the waste

- ▲ *It is estimated that 22 % of the yearly world consumption of mercury is used in electrical and electronic equipment*
- ▲ *Mercury is used in thermostats, sensors, relays, switches, medical equipment, lamps, mobile phones and in batteries*
- ▲ *Mercury, used in flat panel displays, will likely increase as their use replaces cathode ray tubes*

Hexavalent Chromium/Chromium VI 29: Chromium VI can cause damage to DNA and is extremely toxic in the environment.

- ▲ *Chromium VI is used as corrosion protector of untreated and galvanized steel plates and as a decorative or hardener for steel housings*

Plastics (including PVC): Dioxin is released when PVC is burned.

- ▲ *The largest volume of plastics (26%) used in electronics has been PVC. PVC elements are found in cabling and computer housings*
- ▲ *Many computer moldings are now made with the somewhat more benign ABS plastics*

Brominated flame retardants (BFRs):

BFRs are used in the plastic housings of electronic equipment and in circuit boards to prevent flammability. Some BFRs have been targeted for phase out by the European Parliament between the years 2003 and 2006.

Barium: Studies have shown that short-term exposure to barium causes brain swelling, muscle weakness, damage to the heart, liver, and spleen.

- ▲ *Barium is a soft silvery-white metal that is used in computers in the front panel of a CRT, to protect users from radiation*

Beryllium: Exposure to beryllium can cause lung cancer. Beryllium also causes a skin disease that is characterised by poor wound healing and wart-like bumps. Studies have shown that people can develop beryllium disease many years following the last exposure.

- ▲ *Beryllium is commonly found on motherboards and finger clips*
- ▲ *It is used as a copper-beryllium alloy to strengthen connectors and tinypugs while maintaining electrical conductivity*

Toners: Inhalation is the primary exposure pathway, and acute exposure may lead to respiratory tract irritation. Carbon black has been classified as a class 2B carcinogen, possibly carcinogenic to humans. Reports indicate that colour toners (cyan, magenta and yellow) contain heavy metals.

- ▲ *Found in the plastic printer cartridge containing black and color toners*

Phosphor and additives: The phosphor coat-

Salient features of Manufacturers Association of Information Technology (MAIT) report

- ▲ Total PC sales for the period April-September 2003 stood at 12.58 lakh units, a 32% increase over the same period the previous year.
- ▲ MAIT has revised its growth projections for the full year from 20% to 30% following the bullish market conditions.
- ▲ There is a fall in entry-level prices of PCs, notebooks, servers, inkjet and laser printers.
- ▲ Households bought 88% more PCs compared to the first half of the previous year.
- ▲ The trend of increased PC purchase in smaller towns and cities continued as in the previous year.

Source: The Hindu, 7/01/04;
Business Line, 6/01/04



ing on cathode ray tubes contains heavy metals, such as cadmium, and other rare earth metals, for example, zinc, vanadium as additives. These metals and their compounds are very toxic. This is a serious hazard posed for those who dismantle CRTs by hand.

- ▲ *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*

How much e-waste is there?

India's rate of PC obsolescence is growing dangerously. Of the nearly 8 million PCs in India, 2 million are either of the generation represented by the chip Intel 486 or lower. As upgradation beyond a point becomes uneconomical and incompatible with new software, a vast amount of hardware will soon be added to the waste stream.

Further, as most owners of these technologies are from the government, public or private sectors, they prefer replacing an old computer with a new one, rather than upgrading it. Even in the secondary market the older models have little demand. Owing to the narrowing profit margins between resale and dismantling, the sale of these computers to the scrap market for material recovery is rising.

Various departments of the government, public as well as private sectors are feeding old electronic appliances such as computers, telephones, etc, into the waste stream, at an increasingly fast rate. Other sources of e-waste are retailers, individual households, foreign embassies, PC manufacturing units, players of the secondary market, and imported electronic scrap from other countries.

Individual households contribute the least to this, being only 20 per cent of the overall market. Most

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Protecting the worker

Even though the recycling operation is covered under various labour and industrial laws in India, almost none of them are implemented in the 'informal' sector. Applicable laws include the **Factories Act**, which lays down stringent requirements for industrial operations including some concerning health and safety conditions as well as working hours. There are requirements of worker compensation and medical insurance under the **Employees State Insurance (ESI) Act**. The ESI Act also covers areas such as maternity benefits and hospital care. The **Provident Fund Act** and **The Workmen's Compensation Act** provides for a savings to protect against old age and joblessness.

There are also threshold limit values (TLVs) set for the concentration of chemicals in the air for worker exposure. Many of the small-scale enterprises recycling e-wastes are illegal or semi-legal, and because of this, checks are difficult. In order to implement laws, information on the dangers in the workplace needs to be disseminated and labour unions must deal with issues of worker safety adequately.

Finally a significant number of workers are children. Many policy-makers understand child labour as a consequence of poverty, and do not take initiatives to curb it. For a manufacturer, however, child labour is merely a cheap source of work.





The major sources of e-waste in India – departments of the government, the public and private sectors, retailers, individual households, foreign embassies, PC manufacturing units, the secondary market, and imported scrap

of them prefer to pass old computers to friends and family or exchanging them through retailers, rather than sell them as junk.

PC manufacturers and retailers are next on the list of contributors to e-waste in India. The waste from this sector comprises defective integrated chips, motherboards, CRTs and other peripheral items produced during the production process. Though no major companies revealed the amount of scrap produced by them, scrap dealers can project an estimate on the basis of the frequency of tenders and costs involved in the procurement of those tenders.

On the basis of scrap handled by Delhi-based scrap dealers, the total number of PCs meant for dismantling would be around 15,000 per year. This figure does not include PCs handled by large dealers who get scraps from foreign sources. Visual identification of their storehouses revealed more than 1,000 monitors being kept at a time for dismantling. The computers handled by these dealers are 486s, 386s and 286s, and few with defective Pentium processors. The 486s or lower con-

E-waste recycling areas in Delhi with specific functions

Location	Component recycled
Turkman Gate	Disassembly of computer, CRT breaking
Mayapuri	Disassembly of every kind of electrical goods, open and drum wire burning
Old Seelampur	Market of every kind of electronic scrap
Shastri Park	Computer dismantling, recharging of CRTs
Lajpat Nagar	Disassembly of computer
Kirti Nagar	Mainframe computer disassembling
Karkarduma	Trade and recharging of CRTs
Mustafabad	Lead recovery
Mandoli	Circuit board recycling
Meerut (near Delhi)	Gold recovery
Ferozabad (near Delhi)	Glass recovery

figurations include both working and non-working computers.

Anecdotal evidence on e-waste exported by USA to Asia reveals that substantial percentages of their e-waste moves quickly off-shore. What cannot be recycled readily or economically is sent to markets in Asia.

A study compiled by the Graduate School of Industrial Administration of Carnegie Mellon University, estimates that in the year 2002, 12.75 million computer units went to recyclers in the US. Based on this, and with a rate of 80 per cent moving offshore to Asia, the total amount sent to Asia was about 10.2 million units.

E-waste recycling in India

In the industrial areas of Delhi, e-waste recycling is a clandestine operation. Tonnes of e-waste lie hidden behind high fenced walls of recycling units. Work carries on round the clock, for over 12 to 14 hours a day. Within these secure quarters, workers sit on the ground amongst piles of computer parts, separating them with amazing dexterity. All of them work with bare hands, without masks, cleaning, crushing or heating the parts. It is a far cry from the sight one would see at a computer manufacturing unit where workers would sit in clean rooms donning protective masks and gloves.

The workers in both the collection as well as recycling operations in Delhi are part of the urban labour force. Most of them are migrants from the poor states of Uttar Pradesh, Bihar, Orissa and West Bengal. They come from socially and economically underprivileged groups, many being landless, or small and marginal farmers.

Computer waste is often routed through mainstream channels such as customs ports, computer service centres, etc, and then passes onto the 'grey' market. Much of the recycling activity is in the nature of a 'backyard' operation, using rudimentary technology, and in an environment where la-

bour is exploited without batting an eyelid.

Labour and environmental laws are peripheral and unimplemented. While the recycling unit owner makes profits, the workers subsist on less than a couple of dollars a day.

To unravel the actual process of import of obsolete PCs, enquiries revealed that the trade was a well-established one. Details of pricing and payment are often worked out in advance, and negotiated through international letters of credit. The shipment takes approximately one month to reach an Indian port of entry where it is the importer's responsibility to clear it through Customs.

Possibly, Dubai, and Singapore serve as transit points for e-waste from OECD countries. At these points waste is compacted according to its nature and label coded. International traders are well aware of legal loopholes in India and routinely help bypass them by labeling scrap as 'used working computers' or under-invoice to minimise custom's duty.

As we followed the money trail of e-waste recycling, we found actors at the top of the chain (traders and those who own recycling units) derive the highest profits. The recycling units are themselves located in dingy lanes and behind closed doors and survive through local political patronage,

Ports such as Dubai and Singapore might be serving as transit points for e-waste from OECD countries. International traders are aware of loopholes in India and help bypass laws by labeling scrap as 'used working computers'



Upstream impacts of the e-waste trade

Hazardous waste trade allows waste generators to externalise 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.

which keeps the law off their activities.

However, the economics of the backyard recycling units themselves are complex. Each component, or recovered item, has a value and a market. Every little bit which can be sold is recovered, no matter how small the profit margin for it may be. Different buyers buy different items, both local as well as from other parts of the country. However the pricing is a poor reflection of the hardships and working conditions of the recycling workers or the environmental damage that occurs.

Overall, the substantial margins in the trade, recycling and marketing of these products are prompting new entrepreneurs to enter the business. Yet, even though hundreds of small transactions take place between innumerable players in a complex recycling market, the trader makes the bulk of the profits. For example, a local trader buys a single PC with a color monitor at US\$ 10-15 per piece and sells it for up to US\$ 40-50 by selling the disassembled parts separately to different recyclers or re-users. Auctioned lots are even cheaper to procure and go by weight prices being as low as 40 cents per kg of scrap.

To understand the complexity of the operation, take the case of a Cathode Ray Tube (CRT).

Colour CRTs, which are sold for regunning, fetch US\$ 25 to 30 while black and white monitors reap US\$ 2 to 3. The broken glass from a CRT is purchased by glass dealers as low as 2 cents per kg, which is then sold at over 4 cents per kg to upcountry glass manufacturers in the nearby state of Uttar Pradesh. The iron frames extracted from a color computer screen, which weigh from 200 to 250 gm, are sold to an iron scrap dealer at the 15 cents per kg. Copper from picture tube yokes is sold to copper smelters from US\$ 1.3 to 1.5 per kg, a black and white or color picture tube yielding from 60 gm and 200 gm, respectively. The CRT circuit tray also contains a number of condensers of different sizes and depending upon their type, condition and demand, their price varies from 4 to 40 cents apiece. The PVC plastic casings are sold at 2 cents per kg while the more commonly used ABS plastics ones fetch 32 cents per kg.



Every little bit which can be sold is recovered no matter how small the profit margin for it may be. The price, though, is a poor reflection of the hardships of the workers or the environmental damage

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In another example, the circuit board yields metals such as lead, copper alloy and gold. Recyclers buy circuit boards at US\$ 0.13 per kg and resell it for US\$ 0.10 per kg after lead recovery. About 3 kg of lead is recovered from 200 kg of motherboards. The market price of recovered lead is US\$ 2.17 per kg, supplied to lead acid battery manufacturers. The gold plated pins, (if any) locally known as '*kanga*', and laminated cores of gold are sold to goldsmiths from nearby cities like Meerut. Gold pins are sold at US\$ 60 per kg while laminated cores are priced at US\$ 30 per kg. Copper recovered from the plates is sold to copper wire manufacturers at US\$ 1.74 per kg. The de-soldered plates are sold at US\$ 0.43 cents per kg.

The price of a single chip can range from US\$ 0.21 to 1.08 depending upon its type, size and demand. Defective ICs, capacitors and transistors are reduced to aluminum, which is then sold between US\$ 0.87 to 1.08 per kg.

Environmental laws

The classification of e-waste as hazardous in Indian legislation is unclear. Its status depends upon the extent of presence of hazardous constituents in it and there are no specific laws or guidelines for e-waste. Also none of the laws directly refer to e-waste or its handling. This lack of clarity and ambiguity makes the application of the regulations impossible, and encourages malpractices.

E-waste related laws of India

▲ **Hazardous Waste (Management and Handling) Amended Rules, 2003:** These define hazardous waste as "any waste which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when on contact with other wastes or substances."

In Schedule 1, waste generated from the electronic industry is considered as hazardous waste. Schedule 3 lists waste of various kinds including electrical and electronic assemblies or scrap containing compounds such as accumulators and other batteries, mercury switches, glass from cathode ray tubes and other activated glass and PCB capacitors, or contaminated with constituents such as cadmium, mercury, lead, polychlorinated biphenyl or from which these have been removed, to an extent that they do not possess any of the constituents mentioned in Schedule 2.

▲ **DGFT (Exim policy 2002-07):** Second hand personal computers (PCs)/laptops are not permitted for import under EPCG scheme under the provisions of para 5.1 of the Exim Policy, even for service providers. Second-hand photocopier machines, air conditioners, diesel generating sets, etc, can also not be imported under EPCG Scheme under the provisions of Para 5.1 of EXIM Policy even if these are less than ten years old.

Recommendations for action

Rapid product obsolescence in the electronic industry has created a waste crisis that is out of control. The answer to the looming 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 ‘trash and buy’ cycle comes with a monumental price that we 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, upgradable, 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. Given here are a few recommendations for the action that needs to be taken.

1 Ban hazardous waste imports

All imports of hazardous waste materials, including hazardous e-waste must be banned. This is consistent with the Basel Ban Amendment decision by the Basel Convention to ban all trade of hazardous wastes from OECD to non-OECD countries.

There is no reason for the poor of the world to bear the the burden of environmental risk, particularly when they have not benefited from the products and services that created that risk in the first place.

2 Make the producer responsible

Producers must be responsible for their products. The principle of ‘Extended Producer Responsibility’ (EPR) requires accountability on producers over the entire life-cycle of their products. So far, manufacturers have passed on these costs to the consumers, and now to developing countries where the products eventually land up for recycling.

By adopting EPR, producers will play their part in conserving resources through changes in product design and process technology. Making producers financially responsible for end-of-life waste will provide them with a financial incentive to design their products with less hazardous and more recyclable materials.

An effective example of EPR is product take-back where a producer takes the product back at the end of its life.

However, it must be borne in mind that product take-back needs to go hand-in-hand with manda-

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tory 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.

3 Inform the consumer

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.

4 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 to a usable form.

Some international responses to e-waste

- ▲ **United States:** In September 2003, California passed the "Electronic Waste Recycling Act of 2003" (SB20), USA's first comprehensive electronics recycling law, establishing a funding system for the collection and recycling of certain electronic wastes.
- ▲ **European Union:** On January 27, 2003, the EU parliament passed a directive that requires producers of electronics to take responsibility, financial and otherwise, for recovery and recycling of E-Waste (Waste from Electrical and Electronic Equipment-WEEE).
- ▲ **Japan:** Since April 2001, manufacturers have had to recycle appliances, televisions, refrigerators, and air conditioners. Under a new law, manufacturers would charge a recycling fee to consumers.
- ▲ **OECD:** The OECD has developed international guidelines on the "environmentally sound management" (ESM) of used and scrap personal computers.
- ▲ **China:** The Standing Committee of the 9th NPC promulgated a law in 2002, requiring compulsory retrieval of used industrial products.
- ▲ **Netherlands:** In 1998, passed, "The Disposal of White and Brown Goods Decree." It requires manufacturers and importers of electrical and electronic equipment sold in the country to take back their end-of-life products.
- ▲ **Austria:** Recycle-IT! Austria (RITA) is an initiative to collect used computers from manufacturers and other companies, upgrade and repair the computers, and then sell them at reasonable prices to low-income households or schools.



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