



SCRAPPING THE HI-TECH MYTH

Computer Waste in India

Toxics *Link*
February 2003

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Who We Are

Toxics Link's goal is to develop an information exchange mechanism that will strengthen campaigns against toxics pollution, help push industries towards cleaner production and link groups working on toxics issues.

"We are a group of people working together for environmental justice and freedom from toxics. We have taken it upon ourselves to collect and share both information about the sources and dangers of poisons in our environment and bodies, and information about clean and sustainable alternatives for India and rest of the world."

Toxics Link is an information, clearing house on environmental toxicity and related issues. It exchanges information with experts, organisations and individuals working on toxics in India and internationally.

Report Team

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EXECUTIVE SUMMARY

The changing lifestyle of people, coupled with urbanisation, has led to increasing rates of consumption of electronic products. This has made electronic waste management an issue of environment and health concern. The dumping of e-waste, particularly computer waste, into India from developed countries because the latter find it convenient and economical to export waste has further complicated the problems associated with waste management. The knowledge society is creating its own toxic footprints.

In terms of production, and internal consumption the electronics export industries have emerged as the fastest growing segment of Indian industry. Computer waste is generated from individual households; the government, public and private sectors; computer retailers; manufacturers; foreign embassies; secondary markets of old computers; and computer waste dumped in India. Of these, the biggest source of PC scrap are foreign countries that export huge quantities of computer waste in the form of monitors, printers, keyboards, CPUs, typewriters, PVC wires, etc. In a single month, there is a reported case of import of 30 metric tones (MT) of e-waste at Ahmedabad port in India

The current study has been carried out through field work in Delhi, one of the backyard recycling centers in India, and has led to many yet unexplored leads in other parts of the country. It is clear that there are no specific laws dealing with the problem in India, and its import. E Waste comes in mixed with other categories of computers, including second hand computers as donations, and there is no specific check to monitor its entry into the country. In fact the problem is an unacknowledged one.

It is estimated that the total number of obsolete personal computers emanating from business and individual households in India will be around 1.38 million. Manufacturers and assemblers in a single calendar year are producing around 1,050 tones of electronic scrap. Rapid obsolescence has made computers even a couple of years old redundant and 'waste.'

In India, computer scrap is managed through various low-end management alternatives such as product reuse, conventional disposal in landfills, open burning, and back yard recycling. Children and women are routinely involved in the operations. While there are no figures, since e-waste comes in as second hand computers, a significant number of computers are imported for reuse in India, from the US and from Europe. Computer waste becomes a conglomeration of plastic and steel casings, circuit boards, glass tubes, wires and other assorted parts and materials. Much of the heavy metals (including mercury and cadmium) found in landfills are emanated from electronic discards.

Computer waste, which does not have any resale or reuse value, is openly burnt extract metallic parts from them. The minimum number of computers procured

by an average scale scrap dealer for recycling in Delhi is 20-25 per month. The large-scale scrap dealers handle thousands of PCs per month. The approximate number of scrap dealers in an around Delhi is around forty.

However, the disposal and recycling of computer waste in the country has become a serious problem since the methods of disposal are very rudimentary and pose grave environmental and health hazards. In addition, besides handling its own computer waste, India now also has to manage the waste being dumped by other countries. Solid waste management, which is already a mammoth task in India, has become more complicated by the invasion of e-waste, particularly computer waste.

The management of electronic waste has to be assessed in the broad framework of Extended Producer Responsibility and the Precautionary Principle, so that future policies can be made more responsive in addressing this issue. At present, management options for e-waste are extremely polluting and hence are of grave concern. Such an assessment is very important as only then can interventions be suggested to check the polluting systems of recycling and give viable options for better management of computer waste.

INTRODUCTION

Management of burgeoning solid wastes has become a critical issue for almost all the major cities in India. Increase in population, coupled with the rapid urbanisation of Indian cities, has led to new consumption patterns, which typically affect the waste stream in a noticeable manner through the successive addition of new kinds of waste.

A trend today is the growing dependence on information technology. The fast rate of technological change has led to the rapid obsolescence rate of electronic gadgets—generating electronic waste in the process that gets added to the waste stream.

The rapid growth of the electronics industry and the present consumer culture of increasing rates of consumption of electronic products have led to disastrous environmental consequences. This is because existing management options for e-waste are extremely polluting and hence are of grave concern. This problem has assumed a global dimension, of which India is an integral and affected part.

The problems associated with e-waste in India started surfacing after the first phase of economic liberalisation, after 1990. That year witnessed a shift in economic policy in turn triggering off an increase in the consumption pattern. This period also witnessed a shift in the pattern of governance. It ushered in an era of infrastructure reform and e-governance. This shift is marked by the application of information technology in a big way in all areas. These developments, along with indigenous technological advancement, have led to an addition of wide gamut of e-waste churned out from Indian households, commercial establishments, industries and public sectors, into the waste stream. Solid waste management, which is already a mammoth task in India, has become more complicated by the invasion of e-waste, particularly computer waste to India, from different parts of the world.

The import of hazardous waste into India is actually prohibited by a 1997 Supreme Court directive, which reflects the Basel Ban. The developed world, however, finds it more convenient and also economical to export e-waste to the third world countries like India, rather than managing and incurring high environmental and economic cost. So trade in e-waste is camouflaged and is a thriving business in India, conducted under the pretext of obtaining 'reusable' equipment or 'donations' from developed nations.

Today, personal computers are becoming widespread in homes and ubiquitous throughout business organisations. Primary investigations carried out for Basel Action Network revealed that indigenous as well as imported computer waste has led to the emergence of a thriving market of computer waste products and processing units for material recovery in different parts of India.

A computer contains different types of elements, including valuable components (gold, silver, platinum, etc) as well as hazardous materials (cadmium, mercury, lead,

brominated flame-retardants, etc). Apart from these, computers, printers and other equipment contain sophisticated blends of plastics. These materials are complex and difficult to recycle in an environmentally sound manner even in developed countries. The recycling of computer waste requires sophisticated technology and processes, which are not only very expensive, but also need specific skills and training for the operation. Most of the recyclers currently engaged in recycling activities do not have this expensive technology to handle the waste.

The highly toxic chemicals found in the different components of computer parts can contaminate soil, groundwater and air, as well as affect the workers of the unit and the community living around it. Moreover, the workers in computer waste recycling operations may face dangerous working conditions where health and environmental conditions are compromised. Hence there is a clear reason to be concerned about the trade, the technology in practice and the existing poor disposal practices of computer waste in India.

An assessment of the above is very important as only then can interventions be suggested to check the polluting systems of recycling and give viable options for better management of computer waste. It is against this backdrop that this study has been conducted: to effectively bridge the gaps in understanding the knowledge of computer scraps' trade and its reprocessing technology. It involves the study of the market, nature and present practice of reprocessing of computer waste components and government policies for e-waste management. It further gives recommendations in the broad framework of Extended Producer Responsibility and the Precautionary Principle so that future policies can be made more responsive in addressing this issue.

Report structure

The report is divided into five sections:

Section 1: This section examines electronic waste generation in India, focussing on computer waste. It explains the objective of the study and the methodology adopted.

Section 2: In this section the management of computer waste in India, especially in Delhi, is discussed. The problems associated with computer waste (both global as well as in the Indian context), the causes of concern and the management options are examined in detail based on data obtained after field investigations complemented with secondary data collection.

Section 3: This section examines the economics in the trade of e-waste, particularly computer waste

Section 4: This section looks into the trade practices prevalent in India regarding electronic waste.

Section 5: Our findings are discussed in this section and an attempt is made to link them with the existing policy. Suitable recommendations are suggested so that future policies made by the government are more responsive in addressing the problems created by electronic waste in India.

SECTION 1 WHAT IS E-WASTE?

'E-waste' is a collective name for discarded electronics devices that enter the waste stream from various sources. It includes electronic appliances such as televisions, personal computers, telephones, air conditioners, cell phones, electronic toys, etc. The list of e-waste is very large and can be further widened if we include other electronic waste emanating from electrical appliances such as lifts, refrigerators, washing machines, dryers, and kitchen utilities, or even airplanes, etc. Driven primarily by faster technological innovation and consequently a high obsolete rate, this catalogue of new wastes poses a direct challenge, for its proper disposal or recycling in the present set up is expensive and technical. The issue has assumed serious global dimensions; e-waste creates serious worker, community and environmental problems, not only in production but also at the waste end.

Computer waste

Of the entire e-waste generated, computer waste poses significant environmental and health hazards. Rapid advances in information technology, with new and varied innovation in computers, have led to parallel product obsolescence – adding to the toxic waste stream. According to a recent US study, over 315 million computers will become obsolete by 2004; by 2005, there will be one obsolete computer for every new one put on the market.

It is understood that the IT sector moves according to Moore's Law whereby the chip processing power doubles every 18 months. Due to this rapid advancement, the average computer life span has shrunk to less than two years. Each new discovery has the capability of doubling the obsolescence rate as the consumer, targeted by advertisements and offers, finds it cheaper and more convenient to buy a new computer machine than to upgrade his old one. Computers that cannot be upgraded increasingly become waste. Due to the absence of proper mechanisms and standards of disposal, these toxics-laden high tech products often end their lives in the waste stream meant either for recycling or are landfilled.

Computer waste in the Indian context

The electronic industries have emerged as the fastest growing segment of Indian industries in terms of production, internal consumption, and export.

In the last five years (1995-2000), the Indian IT industry has recorded a CAGR (Compounded Annual Growth Rate) of more than 42.4 per cent, which is almost double the growth rate of IT industries in many of the developed countries. Over the decade the industry has developed more than 150 major hardware players, supported by over 800 ancillary units and small time vendors engaged in sub-assemblies and equipment manufacturing. All this has increased the installed base to more than 5 million PCs and the penetration rate to more than 5 PCs per

¹Source:www.Mait.com 1,000 people (as on December 31, 2000).¹

From the humble 8080 to the PIV, India has made impressive progress in the international IT market. The government has conventionally been recognised as a key driver of the domestic IT demands in India and around the world. For example, in the USA, about 23 per cent of total domestic IT spending is derived from government and public sector units. In 1999-2000, government spending in India constituted more than 34 per cent of total IT spending. An entire gamut of projects envisaged in Central and State government policies were put into action during this decade. Beside this, increasing demand for personal computers and the rising popularity of the Internet were another two major forces driving the growth of the domestic IT industry.

In the IT action plan, the government has targeted to increase the present level of penetration, from 5 per 500 people to 1 for 50 people, by 2008. This envisages applying IT in every walk of the economic and social life of the country. Another study has forecast that the market for PCs 2001-02 will be around 1,650,000 (NASSCOM)².

When compared to the USA, the Indian configuration of 5 PCs per 500 people does not represent any sign of massive rise in PCs' obsolescence rate. Though invisible and slow, however, this annual growth rate of 1.65 million PCs has begun to work in increasing obsolescence rate of IT product. In any case, this invisibility has started blurring with the huge import of junk computers that, in turn, create ugly situations for solid waste management in India.

Besides this, of the nearly 5 million PCs in India, 1.38 million are either 486s or below. This figure represents a vast amount of equipment soon to be added to the waste stream as upgradation beyond a point becomes uneconomical and incompatible with software in demand. Further, 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 these models have no demand. Due to the narrowing down of price difference in case of resale and dismantling, they also prefer to sell in the scrap market for material recovery. Thus, this equipment will undoubtedly some day become obsolete and thereby compound e-waste disposal crisis to a certain extent.

Although given that the figure of 1.38 million is quite low in comparison with the US estimate of 20 million obsolete computers, it represents a growing trend, particularly in the context of a rising annual growth of 1.65 million new PCs. It will be compounded if we add the unaccounted junk PCs imported from countries such as the USA, Singapore, Korea, etc, as well as 'home scrap' emanating from different production houses. As mentioned earlier, there are more than 150 major hardware players, supported by over 800 ancillary units and small time vendors engaged in sub-assemblies and equipment manufacturing. They also make a significant contribution in raising the total volume of waste.

Although there is very little information currently available on the extent of environmental damage caused by computer waste disposal, there is a clear reason to be concerned about the waste trade and poor disposal practices because of

² National Association of Software and Service Companies

the toxicity involved in its product life cycle. Due to the growing computer waste, the use of hazardous chemicals in the production process, the intricacies involved in the recycling process, and illegal dumping in India, computer waste is the focus of this report.

Sources of computer waste in India

Computer waste is growing exponentially in volume because of the increasing demand of information technology and its application in the national growth process. This is responsible for the addition of computer waste at the waste end point.

Driven by the concept of corporate governance, efficiency and e-governance, various departments of the government, public as well as private sectors are fast feeding old electronic appliances such as computers, telephones, etc, into the waste stream.

Other sources of e-waste are retailers, individual households, foreign embassies, PC manufacturing units, players of the secondary market, and imported electronic scraps from other countries. Out of these sources, individual households have the least contribution in rising genre of IT product obsolescences. Most Indian households prefer to pass their obsolete technology to near and dear ones or, at the most, exchange it from the retailer. Usually they avoid selling it to a scrap dealer as the momentary value of such an exchange is very insignificant. It is the illegal dumping of junked computers from other parts of the world that creates the problem of managing e-waste.

E-waste comes from:

- Individual households
- Government, public and private sector
- PC retailers
- PC manufacturers
- Foreign embassies
- Secondary market of old PCs
- Dumping from other parts of the world

Objective of the study

- To investigate the nature, range, market, and trade route of electronic waste, with special emphasis on computer waste.
- To determine the product life cycle, that is, the post consumer fate of computers.
- To find out the economics of trade, including the market for recycled/ reused products.
- To survey computer waste recycling units, and to assess not only the technology in practice but also the overall conditions of recycling.
- To scrutinise government policies and initiatives for the management of computer waste.

Methodology

Initially, a study was conducted between June 2001 to mid-January 2002 to assess the trade of recyclable components of municipal solid waste. In that study, an attempt had been made to understand the price mechanism of the waste trade, the role played by each stakeholder, their socio economic conditions, and the technologies used to recycle waste. Studies were conducted in various slums, markets dealing with waste and areas where recycling is done illegally. Various associations of waste dealers, recycling unit owners, organisations working on waste, etc, were contacted. During the course of the study, it was discovered that efficient management of electronic waste generated posed a major challenge in India. Hence a separate study was conducted in New Delhi, during February 2002 on electronic waste; the nature, range, market and trade route of electronic waste, with special emphasis on computer waste, was investigated.

The study undertaken was exploratory in nature. The study revealed that some approaches work, others do not. Initially, the study adopted the survey method to be supplemented with detailed questionnaires. However, it was soon realised that filling questionnaires were not possible as the electronic waste traders and recyclers were reluctant to disclose information. Discussions with the workers in recycling units could also not be held as they were afraid to be seen talking to strangers without the permission of the owners. Besides, rigorous working hours made it difficult to get workers to talk. It became evident that a proper understanding of the waste trade was possible only through informal discussions with various stakeholders.

Questions were asked to get a sense of the nature of electronic waste generated, the recyclable component of the waste, the hazards involved and the economics in the trade of electronic waste with special focus on computer waste. The interviewer, in most cases, recorded verbatim the responses of the respondents. The interview was kept as informal as possible to elicit detailed information.

Difficulties faced in the field during investigation

On the whole, responses to the survey questions were more or less satisfactory. However, answers to certain questions were difficult to elicit, particularly questions related to the pollution caused due to recycling, profit made by the traders, problems faced by workers, etc. In most cases, while questioning the workers, the presence of the unit owners affected the answers. It was found that the workers were more forthcoming when the owner or people from the management are not around. However, it became very difficult to prevent them from being present. To ensure better responses certain questions were usually asked towards the end of the interview. By this time, a good rapport had been established between the interviewer and the respondent. Initially, detailed probing to certain questions was very difficult as the respondents were suspicious of our intentions. This problem was gradually overcome by frequent visits to a particular area, which led to trust-building. At times the owner did not want to reveal his identity. In addition, sometimes the owner did not allow photographs to be taken.

Areas surveyed in Delhi

- Turkman Gate
- Mayapuri
- Old Selampur
- Shastri Park
- Lajpat Nagar
- Kirti Nagar
- Karkarduma
- Mustafabad
- Mandoli
- Ferozabad

SECTION 2 COMPUTERS IN THE WASTE STREAM

Obsolescence rate in India

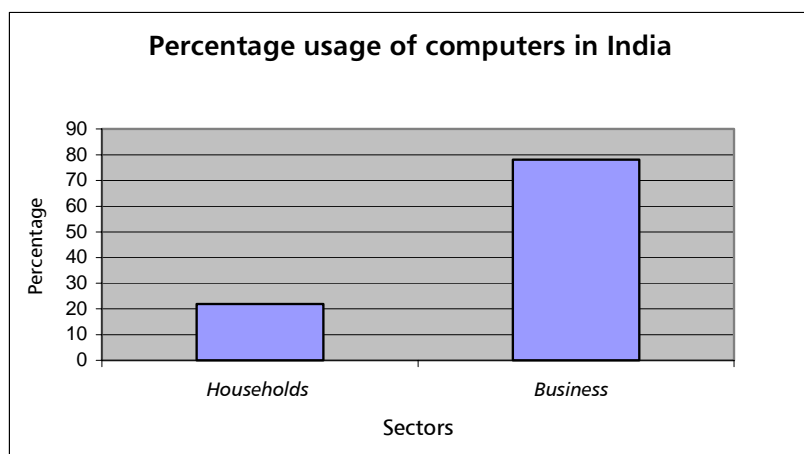
In order to get information about obsolescence rates, conditions or total number of computers being pumped into the recycling chain in India, scrap dealers and retailers from secondary as well primary market were questioned. Based on surveys and answers by the interviewee, only 486s or PCs below this configuration has the highest obsolescence rate. The traders confided that such PCs have no demand for reuse and are thus disassembled for recycling. The other configurations of Caldron and PI were also observed, but their numbers were insignificant. As revealed by retailers and calculated on the basis of year of introduction of these technology – and also keeping in mind the background of rapid technological innovation and changing economic consumption patterns – the average life span of a single PC will be around five to six years.

Sources of computer waste and how they end up in the recycling stream

The model, condition and configuration of computers depend upon the sources from which they are being introduced into the recycling chain.

From individual households

As far as PCs emanating from individual households are concerned, it is difficult to know their condition after leaving the user, as most of them do not directly sell obsolete computers into the scrap market. The preferred practice is to get it exchanged from retailers while purchasing a new computer, or pass it to relatives or friends.



In former case, it is the retailer's responsibility to dispose off the computer. Also, no figure of the total junk computers emanating from this section was available as they were passed off to relatives or retailers. In any case individual household are not major contributors of junk computers in the recycling chain of India. They account for 22 per cent of total computers in India. The consumption of computers by urban households has increased in the last four to five years. The rest of the share, that is, 78 per cent, comes from

the business sector. Nearly 83 per cent of households are first time buyers. Therefore, computer waste being generated from households is minimum.

From the business sector

The business sector (government departments, public or private sector, MNC offices, etc) were the earliest users of IT and IT products; today they account for 78 per cent of total installed PCs. Hence they are the major producers of obsolete

Total amount of e-waste in India

- 1.38 million PCs will be obsolete technology from the business sector and individual households.
- Around 1,050 tonnes of electronic scrap is being produced by manufacturers and assemblers in a single calendar year
- In a single month, there is a reported case of import of 30 metric tonnes (MT) of e-waste at Ahmedabad port.
- The minimum number of computers procured by an average scale scrap dealer is 20-25 per month. The approximate number of scrap dealers specialising in electronics, in and around Delhi, is more than 40. This figure also includes large scale dealers who handle thousands of PCs per month.

technology in India. The incompatibility of old systems to cater to present needs and requirement prompts them to pass the obsolete technology to the recycling chain. Most old PCs auctioned are in good working conditions and could have been donated or sold for the right purposes. Visual identification of tender procedure conducted by few offices, information given by waste dealer as well as from secondary sources like auction journals revealed that the maximum percentage of PCs originating from these sources are 486s, 386s and lower versions.

Given the fact that the maximum percentage of use of these configurations is in this sector and also that the technology in question has been in the process of being replaced, we can assume that the total number of obsolete PCs emanating from business as well as from individual households will be around 1.38 million. This represent the total installed capacity of such PCs. Out of this percentage

9,60,000 are 486s, and 5,20,000 are 386s and 286s. If we calculate in terms of weight, it comes to around 4,14,000 tonnes.



Computer waste generated from an office in Delhi

From manufacturers and retailers

PCs manufacturers and retailers are next on the list of contributor to e-waste in India. The waste from this sector comprises defective IC chips, motherboards, CRTs other peripheral items produced during the production process. It also includes defective PCs under guarantee procured from consumers as replacement items. Though none of the big companies revealed the amount of scrap produced by them, scrap dealers can project an estimate of that amount on the basis of the frequency of tenders and cost involved in the procurement of tenders.

The frequency of such tenders depends on the collected scrap; usually it is quarterly. Local scrap dealers accepted that tender amount to be around Rs 40,000 to 1,00,000. One kg of scrap costs Rs 20, as disclosed by dealers. Thus the total amount of waste will be around 2,000 to 5,000 kg from a single company. The revealed amount can be estimated if we multiply the mean of the given amount $\{2[(2000+5000)/2]\}$ with the total number of major hardware manufacturers. Over the decade, the PC industry has developed more than 150 major hardware players, supported by over 800 ancillary units and small time vendors engaged in sub-assemblies and equipment manufacturing. Rough estimates come to around 1,050 tonnes per year. This amount does not include the scrap emanating from ancillary units and small time vendors engaged in sub-assemblies and equipment manufacturing.

The old computers originating from foreign embassies are in good working condition and consist of all types of models and processors. While no data could be furnished on the total amount of e-waste being generated from this source, an inference could be drawn that the obsolescence rate is high, as most of the embassies prefer to have newer technology and sell off old ones.

From import

The biggest sources of PC scraps are imports. Huge quantities of e-waste like monitors, printers, keyboards, CPUs, typewriters, projectors, mobile phones, PVC wires, etc are imported. The computers thus exported are of all ranges, models and sizes, and are functional as well as junk materials. However, due to existence of common HS code for new and old computers and peripheral parts, no data could be furnished on the total amount of obsolete computers being exported from other countries. In any case, existence of international as well local trade network and mushrooming of importers of old computers in far flung areas like Darjeeling, Kerala, Kochi, etc, indicate the huge import of obsolete technology in India. It is reported that about 30 metric tonnes (MT) of e-waste was imported and landed at Ahmedabad port. It consisted of monitors, printers, keyboards, CPUs, typewriters, projectors, etc. Out of this, 20 MT was pure scrap and 10 MT was in reusable condition. That the whole amount will occupy 30 full size trucks gives an idea of the volume of waste imported. The exporting country in this case was the USA.

Beside this, scrap of electrical items and copper wire, including jelly filled telephone cables, is also imported under Chapters 85 and 74 of the Customs Act, respectively. The total amount of circuit boards and other electrical appliances being imported as scrap under Chapter 85 is 866.28 and 4297.28 tones, respectively. This figure represents import data for the financial year 2000-01 only. The clubbing of copper wire and jelly filled telephone cable scrap, along with other copper waste, give rise to confusion in representing the actual proportions of copper wire being pumped into the recycling chain. The total amount of clubbed copper scrap imported during the financial year 2000-01 was 22316.8 tonnes.

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 storehouse 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 defective Pentium processors. The 486s or lower configurations include both working and non-working computers.

End of life: Management options of computer waste

The making of waste: From consumers' utility to scrap dealers' utility

Under ideal conditions, a desktop computer can last as long as it serves consumer utility. However, rapid technological changes are shortening the life span of IT

products. After serving the consumers' utility, the discarded computer goes to the scrap market to serve the utility of a different kind of player: the informal sector of recycling.

The journey from consumer to recycler is long and complex. It moves in a zigzag fashion. It involves players not only from the informal sector, that is, the recycling stream, but also players from the formal sector, that is, manufacturers and retailers of computer items.

Immediately after securing computers from various sources, scrap dealers face the dilemma of deciding which computer ought to be dismantled and which to be retained for resale. This dilemma arises because only a few models are in demand as second hand products. Once the decision is made, the not-to-be-resold computer components find their way to the storehouses for dismantling. Sometimes, even a computer meant for direct reuse may ultimately end up in the storehouse as dealers cannot wait long for a prospective buyer.

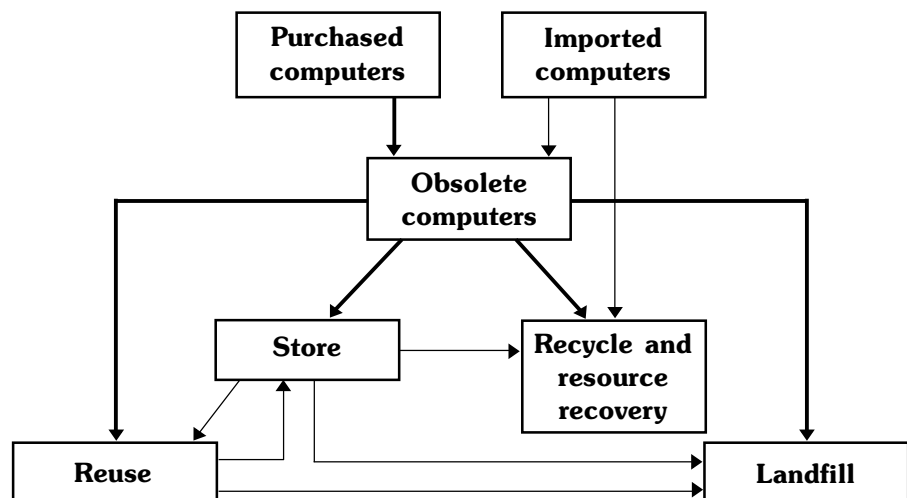


E-waste: Scrap dealers source of livelihood

The first step in the process of computer disposal practices is the separation of each and every component. Monitor, monitor casing, motherboard, keyboard, floppy drive, hi-index, different components of the printer, etc, are all taken out manually and clubbed separately. The retailers and computer repair shop owners also sometimes do the segregation. These groups purchase only a few working chips of higher value. Otherwise the majority of computer parts are broken up and sold off to different stakeholders for material recovery.

Flow diagram of computer waste

Due to the hazards involved, disposal of computer waste either in landfill, incineration or recycling poses significant threats to the environment. When



SECTION 2

landfilled, some components of personal computers have an essentially infinite lifetime and other leach toxins into the groundwater. When incinerated, they emit toxic air pollutants, including dioxins. Likewise, the recycling of computers has serious occupational and environmental implications. In a country like India, where there exists a 'normative gap' between environmental legislation and enforcement, disposal and recycling of electronic waste assume serious dimension particularly when the method of disposal is very rudimentary, posing environmental as well as health hazards.

Hence, the management of computer waste is of serious concern. The computer wastes may be managed in the following ways:

- **Product reuse:** Reuse constitutes direct second hand use, or use after slight modifications are made to the original functioning equipment, memory upgradation, etc.

The majority of old computers in India are often passed on to relatives and friends or are returned to retailers in exchange for money. Sometimes educational institutes or charitable institutions receive old computers for reuse.

While there are no figures available, it is believed that a significant number of computers are imported for reuse in India. These old computers have a limited life span and will end up as waste sooner or later, adding to the burden of computer waste.

- **Conventional disposal in landfills:** The product is dumped in landfill sites where it may remain indefinitely. According to the Environmental Protection Agency (EPA), more than 3.2 million tonnes of e-waste ended up in US landfills in 1997.

The plastics in the computer degrade extremely slowly and more so in dry conditions, and the latter is a requisite in landfills. In strictly regulated landfill sites degradation is even slower. Also, the highly toxic chemicals found in the different components of a computer have the potential to pollute soil and groundwater through leaching. The situation is far worse for the older dumpsites. When disposed off in landfills, computer waste becomes a conglomeration of plastic and steel casings, circuit boards, glass tubes, wires, and other assorted parts and materials. About 70 per cent of heavy metals (including mercury and cadmium) found in landfills come from electronic discards.¹ In 2001 cathode ray tubes were banned from municipal landfills in California and Massachusetts because of their recognised hazardous nature. No such precautions are taken in India.

- **Incineration or open burning:** After separating all remaining components, motherboards are put for open pit burning to extract the thin layer of copper foils laminated in the circuit board. After charring it is distilled through simple froth floating process. The ash is washed out and the copper, with some carbon impurity, goes to another recycling unit. The defective IC-chips and

¹ Report for the United States Environmental Protection Agency, Region IX, Computers, e-waste, and product stewardship: Is California ready for the challenge? p 31 (2001).



Open Burning

human health hazards associated with the process of recycling or reclamation of materials from components of computers are high. Besides this, the method of recycling is helpful only in the recovery of a few metals and non-metals, that is, copper, gold, silver, aluminum, iron, tin, lead and plastics. The present technology is not useful in recovery of the other items, such as germanium, barium, platinum, antimony, cobalt, nickel, etc.

condensers, which do not have a resale market, are burned in small enclosures with chimneys to extract metallic parts from them.

- **Recycling:** Recycling practices use discarded personal computers are highly local and rudimentary. No doubt, the valuable materials recovered from computer waste lessen the disposal problem and financial costs involved. Though a good fraction of computer waste is recycled, the method adopted for material salvaging has an extremely high environment and health cost attached to it. This is because the very process of resource recovery is very polluting. The

The recycling process

As mentioned earlier, personal computers are made up of thousands of materials including composite materials. Their recovery is very technical; it requires sophisticated technology and a high degree of safety consciousness and following rules during the whole procedure. Indian traders and recyclers currently engaged in material salvaging do not have these capacities. In spite of the absence of proper technology, each PC component is disassembled and recycled or reused in India. The general practices observed in case of recycling of the most complex parts of PCs, for instance, circuit boards and PVC wires, is open roasting and acid bath to recover different metals.

The open burning of PVC coated wires and circuit boards results in the formation of significant amount of toxic pollutants like dioxin and furan. The recovery of lead from circuit boards also emits dioxin and other chlorine compounds into the air. Broken picture tubes, contaminated with lead and barium, land up in glass manufacturing units. Thus, CRT glass, with a significant percentage of mercury and lead, again enters the consumer's dominion as a new recycled product. The glass so recycled into different consumer product has all the potential to transmit lead into the human body through leaching toxins via the food chain. The carcinogenic effect of lead on human body is well known.

In order to have a clear understanding of end-of-life of a computer and its peripheral parts, as well as the hazards involves in its recycling, it is important to know the disposal methodology adopted for different components of the computer.

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Different places and their relevance to recycling

Where	What
Turkman Gate	Disassembly of computer, CRT breaking
Mayapuri	Disassembly of every kind of electrical goods, open and drum wire burning
Old Selampur	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	Gold recovery
Ferozabad	Glass recovery
Chennai	Market of circuit board and speeder motor

Part	Recovered	Recovery process
Monitor	Cathode ray tube or glass, circuit board, copper, steel, and plastic casing	Manual with help of screwdriver and pliers. Useless CRT broken with hammer
CPU	Different metals and non-metals from hard disk, floppy drive and SNPS	Manual with help of screwdriver, hammer and pliers
Circuit board	Lead, IC, CPU, few capacitor and condenser, copper and gold	<ul style="list-style-type: none"> • After preheating plate, working IC chip and capacitor are removed with help of pliers • Open burn to recover copper film from circuit board • Gold is recovered through acid bath
Printer	Plastic, motor, cartridge	Motor reused in toy manufacture. Cartridge refilled. Process of refilling not known.
PVC wire	Copper or aluminum	Open and drum burning
Hard disk, floppy drive and SNPS	Copper and brass alloys, aluminum, iron, and magnet	Melted after manual separation of each part
Capacitor and condensers	Aluminum	Open, or <i>bhati</i> , burning to reduce metallic part



Monitors being stacked for disposal

Monitors

Monitors are much sought after by scrap dealers as they contain good quantity of copper yoke, besides circuit board and picture tube. The first step in monitor recycling involves physical removal of plastic casing, picture tube (cathode ray tube), copper yoke and plates. The intact and functional CRT is resold for regunning.

These re-charged tubes are used for the manufacture of colour and black and white televisions for local brands. Though the technology used for re-charging of CRTs was not disclosed, regunning is possible only for those

monitors whose terminal pin (diode pin) of electron gun has not broken in the process of removing yoke from gun. The success ratio of the regunning is 4:1. If it becomes defective, it is broken down to recover iron frames from the glass funnel. The iron frames are found only in colour CRTs and not in black and white monitors. The glasses and iron frames from picture tubes are given to waste traders or else dumped in the municipal bin.

Due to different uses of CRTs, India doesn't have huge waste stocks. The dispersed nature of the e-waste trade and market might be a reason for not having such obvious display of waste. Beside this, most markets are situated in the old walled city area of Delhi and it would have been difficult for traders to store their waste for long as municipals bodies are very prompt in imposing fines on offenders. Therefore, the waste is regularly disposed off in municipal bins.

Copper yokes

The copper recovered from yoke coils found around the picture tube end is sold to copper smelters. Apart from the yoke, copper is also recovered from transformers mounted on the circuit board of the computer. The circuit tray also contains a number of condensers of different sizes. Depending upon their condition and demand they again enter into the secondary market for reuse. If they are defective, they are sold along with the motherboard.

Plastic

The plastic casing of monitors are made either of PVC (polyvinyl chloride) or ABS (acrylonitrile-butadiene styrene). PVC was used more commonly in the early models of computers. Now computer manufacturing companies have shifted to ABS plastic in the production of monitors. Though both types of plastics are currently being recycled in India, the PVC one cannot be recycled. This is due to the high percentage of silicate being added for making it fire retardant. The silicate plastic often ends up at kilns as an alternate source of energy. The plastic casing is recycled into EBS or High Impact Plastic. These kinds of plastics are frequently used in manufacturing toys. Though PVC has been abandoned in the manufacturing

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of plastic casing, it is still used as an insulator of copper wire and cable. The general practice for material recovery from wire is simply to put it in fire. At some places, such burning takes place in front of the storehouses and that too in broad daylight.

At a few places we observed the use of drums for recovery of copper from PVC wire. The top of a big sized drum is cut and a thin layer of iron net fixed in the middle. Sometimes drum is fixed to the ground with the help of mud, and a small opening is made to light the materials and to remove the sludge. This layer of iron act as a filter and allows only ash to go down. Both processes, open or drum burning, are extremely harmful and hazardous from environmental and occupation health safety point of view.

Circuit boards

The printed circuit boards contain heavy metals such as antimony, gold, 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 for raw material, industrial refining and production, use and disposal is so extensive as for printed circuit boards.² The methods of salvaging material from circuit boards are highly destructive and harmful as they involve heating and open burning for the extraction of metals. Even after such harmful methods are used, only a few of the materials are recovered.



Dismantling Circuit boards

The recycling of circuit boards, drawn from monitors, CPO, disc and floppy drives, printers, etc. involves a number of steps. First, there is manual removal of gold-plated pins and the few ICs that can be reused. The core of each motherboard has a flat laminated gold plate. These laminated parts are cut down and sold to gold-smiths for gold recovery. Then comes pre-

heating to remove resalable components like ICs, condensers, bearings (pulleys) from floppy drive and hard drive. Pre-heating means simply putting the motherboard on a burning stove. Low heat is maintained to loosen only the chemical bond between solder and plastic. Then resalable chips, condensers, etc, are plucked out from these pre-heated plates.

Then the pre-heated circuit boards are taken by other dealers for recovery of solder (which consists of lead and mercury). The method of solder recovery is very rudimentary. A burning kerosene gas kit is placed in a small water tub to store molten lead. The circuit boards are simply put on top of the stove; tongs are used on all sides. The lead extracted due to heat application goes into a water tub – it floats due to low density. After de-soldering, the circuit boards go for roasting or acid bath to recover copper from them. The copper retrieval is done through two processes:

² Care conference, Vienna 1994.

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- **Open burning** – After separating all remaining components, motherboards are put for open pit burning to extract the thin layer of copper foils laminated in the circuit board. After charring it is distilled through a simple froth floating process. The ash content is washed out and copper, with some carbon impurity, goes to another recycling unit. Defective IC chips and condensers, which do not have a resale market, are also burned in small enclosures with chimneys, to extract metallic parts.
 - **Acid Bath** – The workers usually stay in the units. The acid is applied on the motherboard through a iron brush to retrieve the metal. In all probability Aqua regia (a mixture of nitric acid and hydrochloric acid) is used.

Both methods, open burning and acid bath, are fraught with occupational health risks to workers as well as people living in surrounding areas as it has adverse effect on the environment and health of the workers. Circuit boards are charred only to extract copper and copper act as good catalyst for dioxin formation particularly when brominated flame retardants, which is one of constituents of circuit board, are incinerated.

Printers

Nowhere was recycling of cartridge toner observed. However, a secondary market for printers was observed at almost every place. Only dot matrix printers have a resale market. Inject printers are broken and find their way into the recycling market. The speeder motor is the only part of an inject printer that is reused for the manufacture of some toys.

In addition, there is a good market for old cartridges. They are refilled and resold. The refilling happens as long as the cartridge writer is intact. At the most, it can be refilled thrice. The regular wear and tear of the writer makes the cartridge obsolete. The metallic part of the cartridge is removed using a hammer, and the plastic component sold along with other plastic items.

In the process of dismantling a computer, a considerable amount of aluminum, tin, iron, etc, are also recovered. These items are sold either to a specialised dealer or to a metal recycler.

Recycling in Delhi

No sophisticated machinery or protective gear is used for the extraction of different materials. All the work is done by bare hands and only with the help of hammers and screwdrivers. Most often, child labourers are employed by the unit's owner for the reclamation of lead and pulling out ICs.

All market of e-waste and recycling units for computer waste are situated in populated areas of Delhi. While in the walled city area of Turkman Gate disassembling takes place in cramped rooms, in other areas such as Mayapuri the general practices is to spread out everything for disassembly. The burning of PVC coated wire was observed in most of the areas surveyed. It was seen that at



Waiting to be recycled

by the society at large is very high.

Mayapuri and Mandoli, both open burning and burning in drums were practiced to extract copper from wires. At places like Mandoli where massive reclamation of metals from circuit boards takes place, ashes and acid residues were disposed off in open grounds. As mentioned earlier, a circuit board contains many toxic substances such as lead, mercury, PCBs, etc. Their recycling according to the present set up causes leaching of mercury and lead into the ground, thereby contaminating groundwater and endangering public health. It is also an established fact that these substances are highly carcinogenic and cause cancer upon direct exposure. Thus, the recycling cost borne

Market of recycled products

The market of e-waste in Delhi is not centred in a single place, but spread over different areas, each handling a different aspect of recycling. However, the majority of them are found in Turkman Gate, Mayapuri, Old Selampur, Mundaka, Mandoli, Kanti Nagar, Sashtri Park, Karkarduma, etc. The scrap dealers spread over Delhi do the primary work of disassembling.

Scrap dealers earn Rs 2,000 to 2,400 from colour PCs and Rs 400 to 600 from black and white PCs, by selling each component to a recycler and to the secondary market of electronics goods.

In the downward movement of PCs for material recovery, there are specialised players for the recovery of specific metals/materials. A single component moves to different places and people for the recovery of different metals. This is particularly more visible in case of material retrieval from a circuit board and PVC wire. After removable of reusable IC chips, the circuit board goes to another person for lead recovery. From the disassembled circuit board the embedded alloy of copper is recovered through open burning. In between these transits, the gold and silver plated part of the PCB is sent to another place for the recovery of these metals.

As far as cathode ray tubes are concerned, they are regunned or smashed to pieces. The regunning take place at Shastri Park, Selampur and Karkarduma. Colored CRTs sold for regunning fetch Rs 1,000 to 1,200 and black and white between Rs 100 to 125 per piece. The regunned picture tubes are used in the manufacture of televisions of local brands and screens for video games. Usually it goes to Lajpat Rai market situated in Old Delhi. Due to their larger screen, imported monitors are in greater demand for regunning. The broken glass from a CRT is purchased by a glass dealer at 50 paise per kg, which is then supplied to glass manufacturers of Muradabad in UP. The iron frames extracted from a color computer screen, weighing 200 to 250 gm, are sold to an iron scrap dealer at the rate of Rs 6 per kg.

The copper from picture tube yokes is sold to copper smelters. The average weight of copper recovered from colour and black and white picture tube yokes are 200 gm and 60 gm, respectively. The copper so extracted from CRT yokes is sold at the rate of 60-70 per kg.

Apart from yokes, copper is also recovered from wire and transformers mounted on PC circuit boards. Transformers from black and white monitors weigh 200 gm and that from colour monitors 250 gm. The circuit tray also contains a number of condensers of different sizes. Depending upon their condition and demand, they enter the secondary market for reuse. Their price varies from Rs 2 to 20.

The plastic casings of PCs are made either of PVC (polyvinyl chloride) or ABS (acrylonitrile-butadiene styrene). Due to the high percentage of silicate added in PVC casings, they land up at kilns as a source of energy. In this case they are sold at Rs 1/kg. But ABS, which is more commonly used these days, is sold at Rs 15/kg. Buyers for this kind of plastic come from Mundaka, perhaps Asia's largest market of plastic scrap. Recycling of casing is reported from Narela Industrial Area. Most often it is recycled as EBS and High Impact plastic. These kinds of plastics are frequently used in toy manufacture.

The metals recovered from circuit boards are lead, copper alloy and gold. Gold plated pins, locally known as 'kanga', and laminated plate of gold core are sold to goldsmiths from places like Meerut. Gold pins are sold at Rs 3,000 per kg and laminated cores at Rs 1,500 per kg.

The desoldering to retrieve lead from circuit boards takes place in Mustafabad and in some isolated areas of Yamuna Vihar. At one place desoldering was taking place in a cattle shed. The people engaged in desoldering buy circuit boards at Rs 6/kg and resell it for Rs 5/kg after lead recovery. About 3 kg of lead is recovered from a 200 kg motherboard. The market price of recovered lead is Rs 100 per kg. A single unit handles 150 kg of waste in two days. Buyer from Sadar Bazaar purchase the recovered lead. As revealed by an interviewee, these buyers supply lead to battery manufacturers.

The copper retrieval from circuit boards, through open burning, is done on the outskirts of Delhi, in places like Mandoli. The recovered copper is purchased by copper wire manufacturers of the same area at the rate of Rs 80 per kg. Dealers in Selampur and Shastri Park revealed that instead of giving motherboards to local recyclers, they sell it to some people from Chennai as they pay a good price for them. The desoldered plates are sold at Rs 20 /kg. One kg of plates contains approximately 2.5 plates of motherboard size.

From a single personal computer, ICs, transformers and condensers are separated. After preliminary repair some of the IC chips re-enter the market. Retailers or repair shop owners purchase the chips according to their requirements. In fact, there exists a group of intermediaries who collect functional items from the computer scrap market and sell it to assemblers centred in Nehru Place and other areas of Delhi. First they survey the market of the fresh computer assembler and

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get orders for different parts. The required items are bought from scrap dealers only after getting sufficient orders. The most popular items sought after by these intermediaries are processors (CPUs), parts of SMPS (power supply) and other chips, etc. The price of a single chip is between Rs 10 to 50 depending upon the demand of that particular item in the market. Defective ICs, capacitors and transistors are reduced to aluminum and are sold between Rs 40 to 50 per kg.

The price of dot matrix printers in the secondary market is Rs 1,000 per piece. An inkjet printer has no resale value; the only part that is reused is the speeder motor. This motor is sent to Chennai and reused in manufacturing toys. Old cartridges from inject printers are refilled and sold for Rs 50-60 each.

Component	Price	Price/kg/pc	Weight	Market of recycled product
CRTs intact (colour)	1000- 1200	1000- 1200		Lajpat Rai Market
CRTs intact (B&W)	100-125	100-125		Lajpat Rai Market
Glass from CRTs	1.50	Rs 0.50/kg	3000 gm (approx)	Recyclers from UP
Copper from yoke (colour)	14	Rs 60-70/kg	200 gm	Recyclers
Copper from yoke (B&W)	4.20	60-70	50-60 gm	Recyclers
Steel from yoke	3	20	100 gm	Local traders
Residue from yoke	0.00	0.00	50-75 gm	Landfill areas
Plastic without silica (from all sources)	45	15-18	2000-2500 gm	Recyclers
Plastic with silica	2.50	1	2000-2500 gm	Kline
PVC wire	10(approx)	60-70	Not known	Recyclers
Lead from circuit board	NA	100	15 gm/kg of the circuit plate	Traders from Sadar Bazaar
Reusable IC chip, CPU, recovered from mother board	100(approx)	2-50	Not known	Nehru Place
Laminated gold polished plate from circuit board	45	1500	25-30 gm/ computer unit	Meeruth
Gold polished pin from circuit board	600	2500	250 gm/ computer set	
Desoldered circuit Boards from all part, along with defective IC, CPU and capacitors	Not known	20	1500 gm approx from a single computer set	Mandoli, Mustafabad, Mayapuri and Chennai

Component	Price	Price/kg/pc	Weight	Market of recycled product
Dismantling of SNPS	70			
Fan		35	Not known	Nehru Place
Iron cover		10	Not known	Nehru Place
Condenser		10	Not known	Nehru Place
Copper from transformer and other part of SNPS		14	200 gm	Recyclers
Dismantling of floppy drive (1.22)	60			
Motor scrap		16	Not known	Recyclers
Aluminum		50	300 gm	Recyclers
Bearing		2	3 Pc	Nehru Place
Iron		3	Not known	Recyclers
Dismantling of hard disc	30			
Aluminum		50	200 gm	Recyclers
Bearing		2	4 Pc	Nehru Place
Magnet		6	500 gm	Unknown
Cartridge	25	Rs 25 each	Not known	Nehru Place

Thus, every component of a PC is disposed off through recycling. The things left for landfills are ashes and plastic residues from charred IC chips, condensers, etc. Unlike China, nothing is dumped in open fields, riverbanks or ponds. Though not dumped, the hazards involved in product recycling cause environmental damage to an unredeemable extent. The huge profit margin in the whole process of trade, recycling and marketing of these products is prompting new entrepreneurs to take up this business. A local trader buys a single PCs with colour monitor at Rs 500-700 per piece and get around Rs 2000-2400 by selling the disassembled parts to different recyclers or reusers. (Refer to the table above for the price of different recycled or reused products).

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In between electronic scrap dealers and recyclers, there are people like Sabir who purchase old PCs and its various component and reassemble it to make a new computer. But their number is very insignificant. During the survey period we came across only this one person.

Sabir started his career as a worker in a TV repair shop in Mumbai. During his stay, he came into contact with computer scrap dealers. There he developed the technique of using obsolete component to remanufacture fresh computer items. First of all he worked on converting obsolete printers into workable ones. With the passage of time he became adept at assembling an entire computer by using obsolete computer components. Now he has shifted to Delhi and devotes his energy to giving new vigour and life to old computer equipment.

Unwittingly, Sabir is giving a new meaning and direction to computer scrap, starting from casing to motherboards which otherwise would have met the same end of life, dismantling and roasting in the name of material recovery. Although he knows about different sources of computer waste scrap, he prefers to buy from small scale scrap dealers, individuals and corporate houses. He admitted that 60 per cent of components/parts are used from discarded computers; he buys only 40 per cent new parts.



Work as usual amongst the waste

SECTION 3

ECONOMICS IN THE TRADE OF E-WASTE

Though the electronic waste trade and recycling happens in the informal sector, it reflects the attributes of an organised economy in terms of the procurement of computers, the hierarchy in the recycling chain, and its linkages with the formal sector of manufacturing and marketing. Despite formality in structure of the trade, the overall e-waste market has been showing a picture of great complexity because of the existence of a dual market of recycling as well as resale. The nature and pattern of electronic trade in India can be understood from the market mechanism of recycling and resale of old PCs and various other factors like demand and supply of the waste, cost difference in case of upgradation and dismantling of computers, etc.

A decade ago, trade in computer waste was not very common. What was common at that time were some computer repair shops and a few specialised dealers who sold old computers and peripheral parts. There were some electrical waste dealers and as such no specialised dealer of scrap computers. The amount handled by these groups was insignificant. The contemporary period has witnessed a sudden surge in the supply of computers as a new form of waste to the scrap market. Surprisingly, within this brief period, it has transformed into a highly specialised sub-category of the scrap market. This has created new entrepreneurs to undertake new opportunities in the e-waste scrap market and also proved lucrative for old traders in waste, who have shifted to this new sub-sector.

Though 10 to 15 years are not enough for any trade to take an organised shape, yet trade in e-waste has assumed an organised structure in this short duration. Although the growth pattern of the trade imitates the features of the natural growth of any other trade, it followed a forced and misdirected entry to the scrap market.

Any economy, must have constant pull, first from demand side and then from the supply end. However, in case of trade in e-waste, there was an astonishing increase in the supply of material prior to sufficient demand for it. This sudden supply was stimulated by huge influxes of imported computers and 'home scrap' from Indian households and public and private sectors. The secondary market of electronic goods was capable of handling computer waste generated from households and public and private sectors. However, it was not well equipped to find markets for the imported waste. This inability of the secondary market to absorb computer waste created a space for scrap dealers.

Low initial investment enables a small entrepreneur to undertake this business. In fact, the majority of electrical scrap dealers switched over to electronic waste business. In due course of time, these scrap dealers helped in the growth of well knit markets for material recovery and also in establishing linkages with other sectors such as backyard manufacturing of colour and black and white televisions.

Market mechanism of old personal computers

As mentioned earlier, old PCs from imports and other indigenous sources are in both working and non-working conditions. PCs in working condition, from Indian business houses, are sent to recyclers as in most cases they are 486s or lower versions. Those computers, which have no demand in the secondary market of resale also go to the recyclers.

Imported computers are both in functional as well as in junk form. In functional category, PI, PII, and PIII PCs, laptops and peripheral parts have a good market in India. In the junk group, there are mostly monitors of different sizes and circuit boards, cables, other broken parts, etc. The offered price for a working computer depends upon the product model, configuration and place of manufacture (refer Table 1).

Price offered by exporters for working/non-working computers

System	Price	Configuration
PI 133	\$35	HDD 1G 32M RAM VGAI-2 M CDROM 4-8 sound card FDD 3.5
PI 166	\$40	
PII 266	\$88	HDD 3-6G 64M RAM VGA 8M CDROM 24-40X sound card FDD 3.5
PII 350	\$120	
PII 400	\$130	
14-inch monitor	\$12	Analogue control
15-inch monitor	\$23	Digital control
17-inch monitor	\$40	Digital control
Hard disk drive	\$27 for 20 PCs	1.6 GB
17-inch monitor	\$9	Non-working
15-inch monitor	\$6	Non-working
14-inch monitor	\$4	Non-working

Note: Price includes individual box packing and power cable and signal cable. This price list shows the price offered by the exporter, not the final price.

Imported computers in working condition

The primary buyers from importers are traders spread over different States. Working computers bought by them enter the gray market for resale. The profit margin they are being traded at between different traders and the retailer is not known. The price of an old computer meant for consumers depends upon quality, model, and year of manufacture.

On the basis of information given by players in the secondary market, the price list of old PCs purchased by consumers from retailers are:

Configuration	Price of each (Rs)
286 and 386	500-1000
486	1000-1500
PI	5000-8000
PII	8000-12000
PIII	15000

The 286, 386 and 486 processors and BGA monitor do not have any market for resale. These technologies ultimately go to scrap dealers for material recovery.

Imported non functional computers

The imported non-working computers, consisting mainly of monitors, are sold in bulk to big traders. After skimming out some valuable parts, like CPUs, they pass it to the small scrap dealers from where the real recycling process of personal computers begins. The price of monitors sold to small scrap dealers ranges between Rs 100 to Rs 750 depending upon the size and colour of monitor. The working PCs from Indian sources secured by small traders are clubbed together with other e-waste scrap. The tender amount of electronic goods secured from government as well as private business houses depends upon the quantity of goods placed for auction. For example, the minimum auction price set by the Power Finance Corporation, New Delhi, for 29 computers, 6 CTVs, 24 printers and a few other electronic goods was Rs 30, 000. The price offered by manufacturing companies and retailers of PCs is very insignificant in comparison with price offered by other sources. It is between Rs 20 to 50 per kg of scrap.

After getting e-waste from different sources, small traders dismantle each component of PCs and separate them according to type of waste (for example, CRTs, circuit boards, plastic casings, etc). Through channelling each component to different groups of recyclers they get between Rs 2000 to 2400 from colour monitors and CPUs, and Rs 400 to 600 from BGA monitors and CPUs.

Juxtaposed to the recycling market, there also exists a secondary market for resale of old computers. Here also there is a massive input of electronic waste from imported sources. Interestingly, instead of overshadowing each other, both sectors—recycling and the gray market of resale – show continuous growth. This sustainable and never-ending growth of trade shows that people have consciously taken up these businesses as a matter of choice. Had any of the sectors been transitory in nature, then one sector would have gradually started shrinking and not grown continuously over time. The huge profit margin in handling of old computers has increased the demand for it in the scrap as well as secondary market of resale. However, the ever-shrinking profit difference in case of direct resale and dismantling,

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easy availability of it as scrap and rebuff from consumers has blocked the secondary market for certain types of computers. Often, these models, for example, 286s, 386s and 486s find their way into the recycling chain. The very phenomenon of narrowing down of price difference acts as a factor in making these technologies obsolete for consumers or even for the gray market. It becomes easier for retailers to sell to the scrap dealer rather than find consumers for reuse.

The demand for CRT from the informal sector of television manufacturing is also increasing the supply of PCs into the scrap market. Once the CRT has been removed, the remaining parts are sent either for material recovery or resale in the secondary market.

Another disturbing development is that retailers in the secondary market give these imports prime shelf space because the retailers' profit margins on them are higher than on domestically produced goods. These imports pose a direct threat not only to the environment but also to the formal sector of manufacturing. Genuine manufacturers have to face competition from the secondary market of remodelling and resale. Not only imported second hand computers but also some PC components from the scrap market goes to retailers and re-assemblers.

SECTION 4 TRADE PRACTICES

Trade policy and trade in computers

As mentioned earlier, India has emerged as a major market for old and junked computers. It is not only a producer but also a destination for dumping. An increasing demand for PCs for material recovery and also from secondary markets of resale (often known as 'grey market') has been driving for the emergence of an organized trade route, both indigenous as well as imported.

Trade policy for PCs

Recognizing the electronics and information technology as a sunrise industry and an area of growth for the millennium, the Government of India has made new PCs and their various peripherals freely importable. Such items do not require any license under the export and import policy.

Though new PCs can be freely imported in India, complexities persist in the statutory provisions for the import of old and junk PCs and their various parts. The complexity arises from confusing provisions for the import of old computers in the Custom Tariff Act. Though there is a clear reference to the import of new computers in the Act, which is in fact common for export and import transactions the world over through the universal Harmonized Tariff System (HTS), a similar provision does not exist for old computers.

The non-existence of classified categories for old computers does not imply that their trade is not allowed in India. In fact the Indian government has come up with a policy to promote the import of old computers. As per the recommendation of the National Task Force on Information Technology and Software Development, the Government of India in its 2001-02 budget has made a clear stipulation for the import of old computers as donations. This is meant to increase the IT penetration to 20 million PCs by the year 2008 and also to realize the dream of low-cost PCs for various sectors of activities, especially education.

As per the recommendation of the National Task Force on IT, the tax incentives for donations to institutions such as educational ones and hospitals have been increased. The incentives include the zero custom duty, exemption from gift and income taxes for both donors and receivers of PCs up to Rs. 50,000.

Under the Foreign Trade (Development and Regulation) Act of 1992, the Central Government has also provided for donations of computers and peripherals from zones which have been set up primarily for export -EOU (Export Oriented Units), EPZ (Exports Processing Zones), STP (Software Technology Parks) and EHTP (Electronics Hardware Technology Parks)- at a zero custom duty (Customs Notification No. 47/98 dated 16 July 1998). Units in EOU / EPZ / STP / EHTP can donate computers and peripherals after two years of import and use, to recognized non-commercial educational institutions, registered charitable hospitals, public

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libraries, public funded research & development establishments, organizations of the Government of India, or Government of State or Union Territory.

Though the imported old PCs for the above-mentioned purposes are free from duty, it does not take place through the 'free' list. Import of old PCs requires a special license from the concerned authority, under an 'actual user condition'. Hence the receivers of old PCs are not to act as decanalising channel and traders. The 'actual user condition' clause of the Foreign Trade (Development and Regulation) Act 1992 debars such sales. It stipulates: "In case of imports under license/ certification/ permission, the actual user alone may import such goods unless the actual user condition is specifically dispensed with by the licensing authority". Till date, Directorate General of Foreign Trade (DGFT) has not dispensed such conditionality in any instance, as revealed by the Deputy DGFT.

Finally, under the International Basel Convention on the Transboundary Movement of Hazardous Wastes, to which India is a signatory, the Ministry of Environment and Forests has to give prior permission to any hazardous imports. This is as per the provisions of the Hazardous Waste Management and Handling Rules 1989 as amended in 2000 (under the Environment Protection Act, 1986), in Schedule -3, List A and List B. Computer waste falls under such categories, and according to the Ministry, no such permission has been granted to date.

In India, three 'categories' of computers are imported under different provisions and through various channels. These are:

- A. New computers
- B. Old computers for reuse (less than 10-year old)
- C. Junk computers

1. The first category is part of the free list.
2. The second category is allowed for reuse but only against a license and it comes under the same HTS code as the new products.
3. For the third category, though the international trade dictionary does not recognize any trade in "junk computers", they are being illegally imported as scrap for recycling. There is no fixed Exim Code for this product. Most of the time, it is traded either under the 74th or 85th chapter of the Indian Custom Tariff Act.

Since this trade is taking place, it is important to address the loopholes in the present legal set up, which allows for the import of junk and obsolete technology for recycling and resale.

As mentioned earlier, the computers imported must not be more than 10 year-old. When they are, they come under the category of junk computers and the Indian custom law does not recognize their trade. In fact, the term "junk computer" does not exist in the internationally accepted Harmonized Tariff System. Opportunities of such detections are minimal, as the Custom Authorities hardly ever check the whole of containers. The Directorate General of Foreign Trade is the prime certifying

authority in case of imports of second-hand goods.

To examine the loopholes in the system, we adopted a two-pronged approach. Firstly, we interviewed concerned authorities such as DGFT and custom officers. Secondly, we established direct contact with exporters and importers of old PCs, both in India and abroad.

Loopholes in the current legal system

On the basis of the information disclosed, it was discovered that there is a substantial scope in the present legal set up for the import of junk computers.

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1. Flexible interpretations of the rules framed by the DGFT. This enables the Customs Authorities to take on-the-spot decisions and provide rules exemption.

In order to check and detect the illegal import of old PCs (import without license), Customs Authorities have been delegated power to take on-the-spot decisions, going from the confiscation of goods to the imposition of fines on such imports. However, after the imposition of a fine, importers are allowed to take possession of the goods.

Taking advantage of this, an importer can release goods by paying a fine to the Customs Department. The DGFT Authority also accepts at times that the Customs Authority allows importers to escape full penalty by an under-assessment of illegally imported goods.

2. There is no Exim code for trade in second-hand computers for donation purpose or for resale. For trade purposes, the computers are classified under the same Exim code as new computers. Both second-hand and new computers are classified under chapter 84 of the Indian Customs Tariff Act. Thus, trade data for new computers includes data for old computers. Taking advantage of this, exporters sometimes club old and junk computers along with new ones.
3. Taking advantage of the flexibility in the interpretation of rules, some Port Authorities also make a distinction between capital goods and non-capital goods in order to facilitate the import of told PCs. For them, old computers imported as a donation to educational or charitable institutions come under the 'capital goods' category. Being capital goods, they are then under the free list and access various tax benefits.
4. Other old computers (less than 10-year old) imported for the purpose of resale or recycling come under the 'non-capital goods' category and can only be imported against a license. In order to avoid the burden of high taxes, in case of import under non-capital goods category, importers indulge in price under-invoicing of goods.

The liberal position taken by the Customs Authority for keeping imported old PCs under capital goods in the free list (*Items which do not require any license under the export and import policy have been denoted as 'free' subject to licensing notes*) is in direct opposition to the position taken by the representatives of DGFT. For them, any old items should only be imported against a license and an arbitrary distinction between capital goods and non-capital goods should not be allowed.

Also, keeping his identity undisclosed, one of the Customs appraisers at the Chennai port revealed that some importers procure old computers in the name of a donation to a school. In order to get the benefit of tax concession and ease in import, they get registration of school under the Society Act 1968, without actually establishing such school.

5. A number of integrated HTPFs, EOUs, EPZs, etc. have been set up by the Government of India to meet specific requirements of a globally oriented

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electronics hardware sector. 100% Export Oriented Units can also be established outside these zones, anywhere in India, and all the incentives available to EPZs units and so on are also available to the EOUs.

Important amongst integrated single site technology park townships are the Hyderabad Hi-tech City, the Bangalore ITPL Park, the Chennai Tidel Park and the Technology Park at Thiruvanthapuram. Many more are coming up in other parts of the country such as Gujarat, Gurgaon, Mohali and Calcutta. An EHTP unit can be set up anywhere in India. Export Processing Zones (EPZs) have been set up in Bombay, Kandla, Falta (Calcutta), Chennai, Cochin, Noida (near Delhi) and Vizag. Of these, the Santa Cruz Electronics Export Processing Zone (SEEPZ) in Mumbai is primarily meant for electronics industry while the others are multi-products zones.

The production units set up inside these zones avail a flexible policy environment to ease business and provide incentives for exports. Some key incentives and facilities on offer are duty free imports of capital goods, raw materials, components and other inputs like the duty drawback scheme, duty exemption scheme, etc. Due to numerous tax concessions and a high possibility of escaping detection from Customs Authorities, some local traders have established links with EOUs for the import of obsolete technologies. Taking advantage of this, some units are reported to have indulged in the import of obsolete technologies.

The general restriction of DGFT regarding import of second-hand goods is not applicable to units set up as EOUs or in EPZs. Restricted items can be imported in 100% export oriented units and attract custom duty at approximately 55 % of their original price. In some cases, units set up in EOUs are allowed to import electronic scrap as revealed by the Customs Authority of Hyderabad. However, these imports are only allowed against mandatory export requirement, as per the rule set up by the Government of India. Instead of this, these imported items find their way through Indian recycling markets.

Recently, 30MT of imported old computers and electronic scrap have been confiscated at the Ahmedabad port. It consisted of printers, keyboards, monitors, CPUs, typewriters, projectors etc. The importer was a unit from 100% Export Oriented Unit and the exporter was from the U.S.A. The whole consignment was classified under chapter 85 of the Custom Tariff Act.

Other provisions for the import of electrical scraps

Beside this, there are written and clear provisions for the import of other types of e-waste, such as populated circuit boards, other electrical appliances, copper wire, etc. as a waste. Some of these items are mentioned in the free list and could be imported by anyone. The imported e-wastes are:

Exim Code	Articles/item/goods	Policy	Duty
854890 01	Unpopulated printed circuit board	Free	67.1
854890 09	Other machinery and appliances	Free	67.1
740400 01.20	Copper wire scrap covered by ISRI code word barely, etc.	Free	67.1
740400 01.90	Other- It includes 'Jelly filled telephone cable scraps	Free	67.1

Note: Restricted means import is permitted against a license and only for the purpose of processing or reuse.

Policy in international trade

Except for a few electrical scraps, there is no universally recognized international regulatory law or treaty in case of trade in obsolete technology. Even in the Harmonized Tariff System (HTS) which monitors the trade transactions of over 8 000 products, there is no reference to the trade in obsolete technology and junk computer. There are some categories in HTS for trade in electrical scraps, but it lacks any direct reference to old and junk computer. Whatever the regulation or policy, it finally depends on the commitment of individual countries.

Realizing the hazardous nature of e-waste, some countries have outlawed the e-waste trade. But such countries are few and the list of exporting countries is large indeed. At present, the major obsolete PC exporting countries to India are the USA, Korea, Singapore, Malaysia, Sweden, Canada, Australia and the UAE.

The lack of any institutionalised category for trade in second-hand electronic products in the HTS has widened the scope for trade in obsolete technology. HTS code no 8471, under which data-producing units like computers and their parts are being traded, does not attach any conditionality that traded computers should be new or old. The distinction between old and new technologies has been blissfully ignored. That distinction is generally supplemented by individual country's trade tariff regulation.

One importer of computers revealed that with constant improvements in the IT sector, Western computer manufacturing companies find it difficult to sell their older models on domestic markets. In order to dispose of old models, they are willing to sell them at lower price than the prevailing market rates. These models have a lower home demand and a well-developed demand in the developing world.

Major computer companies promote their latest models, and subsequently render older models obsolete. For example when the P III processor became outdated, companies sold their stocks below the market rates. P III computers can be bought for as low as Rs 15 000 per piece. These categories of computers come under second-hand category of import and have the same HTS code as the new ones.

However, the same Harmonized Tariff System makes a distinction between functional and non-functional products (junk products) by providing a separate chapter for trade in scraps. Though HTS recognizes trade in the electrical scrap, it is silent in any specifics on junk electronic products. Due to the absence of special categories of trade in junk electronic items, exporters and importers take recourse to the provision of Chapter 84 or 85, under HTS code 8471 and the consignment is booked not as scrap but as a reusable functional products along with new products.

Process of trade in old and junk PCs: Offshore trade

In order to understand the actual process of trade in obsolete PCs, we posted enquiries on the Internet. On the basis of the information disclosed by offshore as well as Indian traders, the trade process seems to involve the following:

1. Contact with Indian trader or importer is established.
2. Requirement and configuration of PCs is asked, price quotations are exchanged between both parties.
3. Supply orders are placed after finalization of mode of payment and terms and conditions of shipment.
4. Usually advance payment is taken before dispatching containers or vessels (T/T in advance or L/C at sight).

5. The shipment takes approximately one month to reach the port entry.
6. After reaching at the decided port, it is the importer's responsibility to get it cleared from the Customs Department. The method of getting it out of the Customs zone has already been mentioned.

One importer disclosed that Gulf countries serve as transit points where waste scraps of every kind come from the US, Europe and West Asian countries. There the waste is compacted, according to the nature of the scrap. Subsequently, a label coding of scraps takes place. For example, an air conditioner or a refrigerator's non-ferrous metal is exported under the label of TALK, motor parts as AL-CASTING, etc. India and China are waste scraps' major importers. Dubai-based exporters are well aware of the Indian scraps market and they keep scrap prices at pace with Indian market prices.

“Not junk, try to get it as working computer”

International traders are well aware of legal loopholes and routinely help bypass them to facilitate the trade in scrap computers.

We interacted with more than 5 off shore trading companies, one from the USA and others from Canada, Australia and Singapore. We were offered a wide range of obsolete computers along with guidance on ways to escape restriction and increase our profit margin while importing junk or old PCs. What was offered was a supply not only of junk and working PCs, but also of other electronic items like working mobile phones, projectors and so on.

In order to know more about the intricacy of trade, we presented them with the difficulty of importing junk computers, owing to recent (supposed) Indian government moves. We were provided with the following advice to overcome such restrictions:

1. Firstly, we would be supplied using labels of 'used working computers' as opposed to "junk" computers that are not working. That would be an effective way to get around the obstacles imposed by the government.
2. Secondly, under-invoice was suggested to both increase the profit margin as well as minimize the economic cost of penalty imposed by Customs Authority for illegal import.
3. 'Any' model, brand was available.
4. A Korea-based company offered to supply working PCs with different memory chips, and processors. They disclosed that there is no difference within the Harmonized System Code between new and second-hand products. The computer system HS code is 8471.41 and for monitors it is HS code is 8471.60. The HS code is universal and used in every country.

Indigenous trade

Most of the indigenous trade originates in an auction or a tender floated by various businesses or governmental users. There is subsequently a long chain of scrap dealers involved in the collection of e-waste from diverse sources and areas.

While embassies, private offices, computer-manufacturing units, big retailers prefer to sell through an auction, others -like small retailers- sell directly to nearby scrap dealers. In fact, some PCs scrap dealers send out their own representative to different electronic markets to secure e-waste. Sometime e-waste tenders are also floated by MSTC limited (a Government of India enterprise, trading metal scrap) on behalf of various public and private sectors.

Trade-related information from different sources is disseminated through specialized journals of scraps. The "Auction News Journal" a bi-weekly, is published from New Delhi and contains almost all scraps-related auction news.

Beside journals, newspapers also carry e-waste auction news. Interestingly, auction news is better carried in Hindi newspapers than in English newspapers. This is particularly true in the case of auction by embassies and small private sector offices. Examples of such auctions over one month are:

Date	Name of auctioneer	Tender No	Place	Items	Amount
02-05-02	Antariksh Bhavan, Bangalore	T 01	Bangalore	Computers, typewriter, other, electrical item	NS
16-05-02	Commissioner of Customs (preventive), Calcutta		Calcutta	Computer parts	NS
24-05-02 & 10-06-02	TELCO, Jamshedpur	EAAM/21/286	Jamshedpur & Calcutta	Computer, printer, spores & other electrical items	NS
24-05-02	Airport Authority of India, Air Cargo Complex, Calcutta	Auction	Calcutta	Computer, Telecommunications parts & other electronics equipment	
28-05-02	Punjab State Electricity Board	Auction	Verka	PVC Alum. Cable scrap	6 MT
29-05-02	MSTC on behalf of Bharat Electronics Limited, Bangalore	TCA-24	Bangalore	Wire scraps, other electronic items	
06-06-02	Hindustan Petroleum Limited, Chennai.	T-018	Chennai	Computer spares and electrical items	
11-06-02	Air India & Indian Airlines, Chennai	T-@@	Chennai.	Computer spares, cameras etc	
15-06-02	Power Finance Cooperation, Janpath, New Delhi	Auction	New Delhi	Computers, Printers, C.T.V. ETC	29 computer 24 printer, 6CTV
18-06-02	BSNL, Mehsana/ Vadodara/ Surat	T-40 (02)	Mehsana, Vadodara, Surat	Counters, Teleprinters, telex machines, A.C., other electrical instrument	
19-06-02	Depot Store keeper, Metro Railway, Calcutta	Auction	Calcutta	Computers	
21-06-02	HQ, BSF, Lodi Road, New Delhi	D14012/12	New Delhi	Computers, electronic Typewriter, AC, etc	
03-07-02	MSTC on behalf of commissioner of customs & central excise. Hyderabad	T-72	Vizag	Color TVs, Cell phones, computer parts	50 color TVs, 48 mobile phone
02-07-02	BSNL, Nanded, Jalgaon	T89, 90	Jintur, Nanded Jalgaon etc	Mother boards, cables, etc	

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Thus, the sporadic figure of import and the huge list of tender notices within a brief one-month period represent an ugly picture of e-waste trade.

In fact, in the present legal set up, the scope for imports of e-waste is huge. Unlike in the past, when importers were small operators who ordered a few PCs and sold the goods in key grey markets, there is now an organized set of importers who are directly tied up with international companies and use their own distribution networks.

These importers have high degrees of penetration in different States. Importers also have their own representatives in foreign countries to procure old PCs. Some important centres of imports, from where old or junk PCs move out for reuse or recycling are Delhi, Mumbai, Chennai, Pune, Ahmedabad, Calcutta, etc. The trade is invisible due to the diversified nature of the trade and the recycling of PCs.

The existence of an external as well as internal trade route reflects a picture of highly structured market of old electronic goods and scrap. PCs, working or junk, emanating from international as well as from Indian sources, have prepared a base for the emergence of specialized markets in e-waste.

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ELECTRONIC WASTE AND ENVIRONMENTAL LEGISLATION IN INDIA

Despite a wide range of environmental legislations in India there are no specific laws or guidelines for electronic waste or computer waste. Overall India has so far enacted around 14 laws for governing the country's environment, but none of these have any direct reference to electronic waste or refer to its handling as hazardous in nature. However several provisions of these laws apply to various aspects of electronic wastes.

VARIOUS LAWS AND THEIR RELEVANCE TO ELECTRONIC WASTES

The Hazardous Wastes Rules, 1989, amended 2000

The Hazardous Waste (Management and handling) Rule, 1989 and as amended in May 2000, defines hazardous waste as "any waste which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or likely to cause danger to health or environment, whether alone or when on contact with other wastes or substances, and shall include:

- Waste substances that are generated in the 47 processes indicated in column 2 of Schedule I and consist of wholly or partly of the waste substances referred to in column 3 of same schedule.
- Waste substances that consist wholly or partly of substances indicated in Schedule 2, unless the concentration of substances is less than the limit indicated in the same Schedule.
- Waste substances that are indicated in Part A of Schedule 3 unless they do not possess any of the hazardous characteristics in part B of the same Schedule."

Schedule 1

Although, there is no direct reference of electronic waste in any column of Schedule 1 (which defines hazardous waste generated through different industrial processes) the manufacturing as well as disposal process of computer could be characterized as hazardous processes on the basis of use of carcinogenic substances used in chip production. These include arsenic, benzene, cadmium, lead etc.

In fact, Schedule I has listed some industrial process that generate hazardous waste in production as well as disposal process. Similar process and waste are also being used and generated in computer manufacturing and disposal. These are:

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Process	Waste
1. Production or use of lead	Lead ashes, lead slags, and lead-containing filter material.
2. Production or use of cadmium	Lead containing filter material.
3. Metalworking	Beryllium containing metal waste. Mercury containing metal waste.
4. Industrial printing and copying with liquid toner.	Printing ink residue, Silkscreen printing ink residue, Liquid toner residue.
5. Production or use of materials made with silicones excluding cement	Silicon containing residues
6. Production or use of plastics or raw materials for them	Halogen free residue of additives plastics (e.g. Dyestuffs or flame retardants)

The above-mentioned toxic substances are used in almost every electronic goods. Lead is used in circuit boards, in monitor screens and glass. Disposal of these parts either through burning or in landfill release toxic substances. Mercury used in switches, circuit boards, in flat panel displays is released into the environment when burned or smelted. Similarly, beryllium used in every electronics assemblies and is released into the environment through dust emissions and during crushing, cutting or burning operations. Also circuit board and plastics casing that are impregnated with brominated flame retardants to prevent flammability are source of release of dioxins and furans.

As per the May 2002 draft amendment of the India hazardous waste rules, once a waste product is classified as hazardous according to industrial process listed in Schedule 1, it is exempted from the concentration limit requirement set by Schedule 2 of Act, and is considered hazardous irrespective of its concentrations.

Schedule 2

The Schedule 2 of the Hazardous Waste Management and Handling Rules, 1989, lists waste substances which should be considered hazardous unless their concentration is less than the limit indicated in the said Schedule. Even going by this computer waste can be considered hazardous in nature.

The various classes of substances listed in this Schedule are:

Class A: If 1 kg of any substances contains 50 mg of listed items than it shall be called hazardous waste (See class A list). Following are the toxic substances present in desktop computer and which are also listed in schedule 2.

	Element	Weight (lbs)
A1	Antimony & antimony compound	<0.1
A2	Arsenic and arsenic compound	<0.1
A3	Beryllium and cadmium compound	<0.1
A4	Cadmium and beryllium compound	<0.2
A5	Chromium (VI) compound	<0.1
A6	Mercury and mercury compound	<0.1
A17	Halogenated aromatic compounds (Found in casing which weigh 13.8 lbs)	yet to established.
A7	Selenium and selenium compound	<0.00096

Class B: If 1 kg of any substances contains 5000 mg of listed items, than it shall be called as Hazardous waste (See class B list). Following are the Toxic substances present in Desktop Computer and also being listed in schedule 2 of Hazardous waste manual.

	Element	Weight (lbs)
B2	Cobalt compound	<0.1
B3	Copper	<4.2
B4	Lead	<3.8
B6	Nickel compound	<0.51
B7	Tin compound	<0.6
B8	Vanadium	<0.1
B10	Silver compound	<0.1
B11	Organic halogen compound (found in plastic casing)	
B30	manganese-silicon	<0.1

(Note: Class C and class D are not applicable in case of the computer waste scraps as the listed items are not present in computer or information technology waste, and are not included in this discussion.)

The above-mentioned substances (in Schedule 2) are present in desktop computers. If the concentration of the above mention substances exceeds 50 mg and 500mg as prescribed in the limit of class A and B of schedule 2 respectively, then computer waste weighing around 30 kg can be categorized as hazardous waste.

The import and export of hazardous waste is dealt with in Schedule 3 of the Rules.

Schedule 3

List of Hazardous Waste to be applicable only for imports and exports are mentioned in schedule 3 of the manual. It define hazardous waste as

“Wastes listed in lists ‘A’ and ‘B’ of part A of schedule 3 applicable only in case(s) of export/import of hazardous wastes in accordance with rule 12,13,and 14 only if they possess any of the hazardous characteristics in part B of said schedule”.

This clause defines hazardous waste for the purpose of import and export. It has divided hazardous waste into two parts, A and B. Part A of the schedule deals with two lists of waste to be applicable only for imports and exports purpose.

Export and import of items listed in List A and B of part A are permitted only as raw materials for recycling or reuse. It is the opinion of legal experts that the trade of wastes mentioned in list A which possess characteristic of hazardous wastes are regulated by law.

Electronic waste and related items listed in part A, list A and B – Schedule 3

Following are the electronic items being mentioned in list A:

A1180 “Electrical and electronic assemblies or scraps containing components such as accumulators and other batteries included on list B, mercury-switches, glass from cathode ray tubes and other activated glass and PCB-capacitors, or contaminated with schedule 2 constituents (e.g. cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they exhibit hazard characteristics indicated in part B of this schedule. (See B1110)”.

A1090 Ashes from the incineration of insulated copper wire.

A1150 Precious metal ash from incineration of printed circuit boards not included on list ‘B’

A2010 Glass waste from cathode ray tubes and other activated glass.

A3180 Wastes, substances and articles containing, consisting of or contaminated with polychlorinated biphenyls (PCB) and including any other polybrominated analogues of these compounds, at a concentration level of 50 mg/kg or more.

Comments: Electronic items like glass from cathode ray tubes and PCB-capacitors exhibit hazardous characteristic in so far they are being mentioned in list A, part A of schedule. Their trade in the ‘mentioned form’ requires special permission from the concerned authority. The rules deal with components but not with whole computers as waste scrap. Taking advantage of this loophole, toxic substances are being dumped in name export and import of 2nd hand computers or peripheral part.

Following are electronic items placed on list B

B1110:

1. Electronic assemblies consisting only of metals of alloys
2. Electrical and electronic assemblies (including printed circuit board, electronic components and wires) not valid for direct reuse but for recycling.

Comments: Trade of electronic items made out of metal is permitted both for reuse and recycling. However, PCB and PVC coated wire could be imported only for recycling and not for reuse. This provision is in direct opposition to Basel Convention and its Ban Amendment provision, which permits import and export only for reuse and not for recycling. This provision also overlooks crude and rudimentary methods of recycling which is highly polluting.

List of Hazardous characteristics mentioned in Part B of List A – Schedule 3

This list contains 14 sub clauses for categorizing handling/trade/recycling of any substance as hazardous. Each sub-clause may be interpreted in a much wider context to cover any substance, their handling and recycling as hazardous if listed characteristics may be applicable in categorizing trade and recycling of computer waste as hazardous and beyond the regenerative capacity of environment:-

H6.1 Poisonous (Acute): Substances or wastes liable either to cause death or serious injury or to harm health if swallowed or inhaled or by skin contact.

H8 Corrosives: Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissues, or, in the case of leakage, will materially damage or even destroy, other goods or the means of transport; they may also cause other hazards.

H10 Liberation of toxic gases in contact with air or water: Substances or wastes, which, by interaction with air or water, are liable to give off toxic gases in dangerous quantities.

H11 Toxic (delayed or Chronic): Substances or wastes which if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.

H12 Ecotoxic: Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.

H13 Capable, by any means after disposal, of yielding another material, e.g., leachate which possesses any of the characteristics listed above.

Comments: Ambit of these sub clauses is so comprehensive that it will cover each steps of computer recycling from pre heating to final roasting of motherboard to recover mercury and other material from it. However each step of recycling involves

occupational health risk to workers, people residing in surrounding area and environmental degradation in general. Open burning of the PVC coated wire and motherboard of computer for material recovery emits many toxic gases like Dioxin and Furan. Coming into direct or indirect contact of these gases causes various forms of cancer in human being.

Analysis of schedules 2 and 3 of the Hazardous Wastes Rules, 1989 categorized some part of computer scraps as hazardous waste. However, the act is vague in dealing with import of whole junk computer sets. The rules do not clearly mention that it can be applied for import and export of e-wastes in form of junk desktop computers. In fact, whole of part A of the schedule 3 mentions at length items that could be traded irrespective of being of hazardous nature. The only provision is the ban on dumping.

Any import or export must be carried out with prior permission of concerned authority. The new Schedule 6 added in May 2002, which prohibits trade of 28 listed items does not have any reference of junk computer or its parts. The sole purpose of act seems to be of regulatory nature and that too only to control indiscriminate and illegal tariff of hazardous waste.

Part B of schedule 3 mentions lists of hazardous characteristic. The law prohibits trade of any substances having or showing resemblance to the hazardous characteristics as mentions in list. Import and export of hazardous waste/substances listed in part A of schedule 3 shall be prohibited if any of items have resemblance with items listed in Part B of same schedule.

Basel Convention and its application to e-waste

The Basel Convention defines waste by disposal destination or recovery processes. These various processes are listed in Annex IV of the Convention. For example, virtually any material that will be recycled or processed in order to reclaim a metal, or to reclaim an organic or inorganic substance for further use, is deemed a waste. Electronic components that are used without further processing are likely to not be defined as a waste.¹

The convention has provided for two lists. List A found in Annex VIII is presumed to be hazardous and thus covered by the Basel convention; and list B, found in Annex IX, is presumed to be non-hazardous and thus not subject to 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 Basel Annex VIII hazardous waste lists the following applicable entries to e-waste:

A1010 Metal wastes and waste consisting of alloys of any of the following: antimony, arsenic, beryllium, cadmium, mercury, selenium, tellurium, thallium.

¹ From exporting harm: The high tech trashing of Asia.

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- A1020** Waste having as constituents or contaminants, excluding metal waste in massive form, any of the following: antimony compounds, beryllium, beryllium compounds, cadmium, cadmium compound, lead, lead compounds, selenium, selenium compounds, tellurium, tellurium compound.
- A1030** Wastes having as constituents or contaminants any of the following: arsenic, Arsenic compounds, mercury, mercury compound, thallium, thallium compounds.
- A1160** Waste lead-acid batteries, whole or crushed.
- A1170** Unsorted waste batteries excluding mixtures of only list B batteries. Waste batteries not specified on list B containing Annex I constituents to an extent to render them hazardous. [Note: List B batteries include: waste batteries conforming to a specification, excluding those made with lead, cadmium or mercury]
- A1180** Waste electrical and electronic assemblies or scraps containing components such as accumulators and other batteries included on list A, mercury-switches, glass from cathode ray tubes and other activated glass and PCB-capacitors, or contaminated with Annex 1 constituents (e.g. cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they exhibit hazard characteristics contain in Annex III.
- A2010** Glass waste from cathode ray tubes and other activated glass destined for direct reuse and not for recycling or final disposal.

It is also important to note that the Basel convention's list B includes:

- B1110** Electrical and electronic assemblies (including printed circuit board, electronic components and wires) destined for direct reuse and not for recycling or final disposal.

From the above we can conclude that at the very least, circuit board, 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 Basel convention. Likewise, whole, used, discarded computers, printers, and monitors that contain such circuit boards or CRTs that are not to be reused directly are to be considered as hazardous waste and subject to the Basel convention.

Basel Convention and the Indian Rules:

The Annex VII of Basel convention includes almost same entries applicable to E-waste as it is in schedule 3 of Indian hazardous waste manual. However, there are some provisions, which stands in direct opposition to what has been in the Basel convention.

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One of such conflicting provision is grant of trade in electronic assemblies like printed circuit board, electronic components and wires for recycling and not for direct reuse. (List B No 1110). This provision is contradictory with similar provision for BASEL charter, which allow trade only for reuse and not for recycling. There is another confusing provision in entry No A1150 on trade of precious metal ash from the incineration of printed circuit boards. There no such analogous provision in Basel convention. These imply that ash containing many carcinogens could be imported for reuse or recycling against a license from concerned authority.

The Indian rules provide a detailed procedures to be followed for import and export of listed waste. All trade in listed in part A of schedule 3 shall be illegal if there is any laxity in compliance of the procedures mention in the rule 12,13, and14 of Basel. Though hazardous in nature, waste placed in list B do not required any permission for import and export under H-waste rules. This provision is analogous of Annex 9 of Basel. However import and export of substance mentioned in this list require adherence to concentration limits prescribed in Annex III of Basel Convention.

Both the Basel convention and Indian Hazardous Waste Rules define wastes as substances that need to be controlled in their movement, disposal, recovery or reclamation and recycling operation. However these rules, including the Basel Convention fails to specify any sound method of disposal and does not mention the transfer of environmentally sound technology for recycling or reclamation. The present Indian law ensures safe disposal of all hazardous waste, produced within the country. It does not impose a complete ban on the movement of hazardous waste, and is more in nature of insuring control movement so that there could be safe disposal facility.

However, safe disposal facility could be possible only when there is option of sound technology of disposal. To our best knowledge India do not have any technology for e-waste disposal.

RECOMMENDATIONS

1. Given the nature of hazardous composition of e-waste and also due to absence of technology of proper recycling there should be complete ban on trade of junk computers and its peripheral parts in any form.
2. The listed items in Schedule 3, having resemblance with electronic waste in all forms, should be brought into schedule 6 so that their trade will not only be restricted but prohibited.
3. The trade policy framed by the Director General of Foreign Trade needs to be revised so as to stop the import of obsolete technology. For control of trade in obsolete technologies, a correct declaration and proper labeling according to the legal requirement should be followed. The delegated power of custom authority to impose penalty on import of 'notified goods' (good which are prohibited to be imported without license) and allow importers to obtain back confiscated goods should be changed in case of imported junk computers and peripheral parts.
4. The double standard for import of e-waste by units situated in export oriented units or export promotion zones should be abandoned. The exemption of EOU make no scientific sense as most waste imported are useless and can not be reused for re-export purpose. Unless gaps in policy and legislation are not plugged, India will not have any respite from being dumped with obsolete technology.
5. In fact, the present centralized environmental protection regime is inadequate to manage the problem associated with high tech sector growth. The phenomenon of electronic waste, its management, trade, recycling, and disposal cannot be dealt with in a piece meal approach. An integrated Information Technology Waste Management Policy' which seeks to address all issues ranging from production and trade to final disposal, including technology transfers for the recycling of electronic waste is needed.

ANNEX I TOXICS IN COMPUTERS

Hazards In E-Waste

(Source: Exporting Harm Basel Action Network, Feb 2002)

Annex I				
Composition of a Personal Desktop Computer				
<i>based on a typical desktop computer, weighing ~70lbs</i>				
Name	Content (% of total weight)	Recycling Efficiency (current recyclability)	Weight of Material (lbs.)	Use/Location
Plastics	22.9907	20%	13.8	Includes organics, oxides other than silica
Lead	6.2988	5%	3.8	Metal joining, radiation shield/CRT,PWB
Aluminum	14.1723	80%	8.5	Structural, conductivity/housing, CRT, PWB, connectors
Germanium	0.0016	0%	<0.1	Semiconductor/PWB
Gallium	0.0013	0%	<0.1	Semiconductor/PWB
Iron	20.4712	80%	12.3	Structural, magnetivity/(steel) housing, CRT, PWB
Tin	1.0078	70%	0.6	Metal joining/PWB, CRT
Copper	6.9287	90%	4.2	Conductivity/CRT, PWB, connectors
Barium	0.0315	0%	<0.1	Vacuum tube/CRT
Nickel	0.8803	80%	0.51	Structural, magnetivity/(steel) housing, CRT, PWB
Zinc	2.2046	60%	1.32	Battery, phosphor emitter/PWB, CRT
Tantalum	0.0157	0%	<0.1	Capacitors/PWB, power supply
Indium	0.0016	60%	<0.1	Transistor, rectifiers/PWB
Vanadium	0.0002	0%	<0.1	Red phosphor emitter/CRT
Terbium	< 0	0%	<0	Green phosphor activator, dopant/CRT, PWB
Beryllium	0.0157	0%	<0.1	Thermal conductivity/PWB, connectors
Gold	0.0016	99%	<0.1	Connectivity, conductivity/PWB, connectors
Europium	0.0002	0%	<0.1	Phosphor activator/PWB
Titanium	0.0157	0%	<0.1	Pigment, alloying agent/(aluminum) housing
Ruthenium	0.0016	80%	<0.1	Resistive circuit/PWB
Cobalt	0.0157	85%	<0.1	Structural, magnetivity/(steel) housing, CRT, PWB
Palladium	0.0003	95%	<0.1	Connectivity, conductivity/PWB, connectors
Manganese	0.0315	0%	<0.1	Structural, magnetivity/(steel) housing, CRT, PWB
Silver	0.0189	98%	<0.1	Conductivity/PWB, connectors
Antimony	0.0094	0%	<0.1	Diodes/housing, PWB, CRT
Bismuth	0.0063	0%	<0.1	Wetting agent in thick film/PWB
Chromium	0.0063	0%	<0.1	Decorative, hardener/(steel) housing
Cadmium	0.0094	0%	<0.1	Battery, blue-green phosphor emitter/housing, PWB, CRT
Selenium	0.0016	70%	0.0096	Rectifiers/PWB
Niobium	0.0002	0%	<0.1	Welding alloy/housing
Yttrium	0.0002	0%	<0.1	Red phosphor emitter/CRT
Rhodium	< 0	50%	<0.	Thick film conductor/PWB
Platinum	< 0	95%	<0.1	Thick film conductor/PWB
Mercury	0.0022	0%	<0.1	Batteries, switches/housing, PWB
Arsenic	0.0013	0%	<0.1	Doping agents in transistors/PWB
Silica	24.8803	0%	15	Glass, solid state devices/CRT, PWB

*Source: Handy and Harman Electronic Materials Corp.
72 Elm Street
North Attleboro, MA 02760
www.handyharman.com*

Although it is hardly well known, E-waste contains a witches' brew of toxic substances such as lead and cadmium in circuit boards; lead oxide and cadmium in monitor cathode ray tubes (CRTs); mercury in switches and flat screen monitors; cadmium in computer batteries; polychlorinated biphenyls (PCBs) in older capacitors

and transformers; and brominated flame retardants on printed circuit boards, plastic casings, cables and polyvinyl chloride (PVC) cable insulation that release highly toxic dioxins and furans when burned to retrieve copper from the wires.

Due to the hazards involved, disposing and recycling Ewaste has serious legal and environmental implications.

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

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

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

Mercury — Mercury can cause damage to various organs including the brain and kidneys, as well as the fetus. Most importantly, the developing fetus is highly susceptible through maternal exposure to mercury. When inorganic mercury spreads out in the water, it is transformed to methylated mercury in the bottom sediments. Methylated mercury easily accumulates in living organisms and concentrates through the food chain, particularly via fish. It is estimated that 22 % of the yearly world consumption of mercury is used in electrical and electronic equipment. It is used in thermostats, sensors, relays, switches (e.g. on printed circuit boards and in measuring equipment), medical equipment, lamps, mobile phones and in batteries. Mercury, used in flat panel displays, will likely increase as their use replaces cathode ray tubes.²⁸

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

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

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

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

Beryllium — Beryllium is a steel-grey metal that is extremely lightweight, hard, a good conductor of electricity and heat, and is non-magnetic. These properties make beryllium suitable for many industrial uses, including, electronic applications such as computers. In computers, beryllium is commonly found on beryllium alloy used to strengthen the tensile strength of connectors and tinyplugs while maintaining electrical conductivity. Beryllium has recently been classified as a human carcinogen as exposure to it can cause lung cancer.³² The primary health concern is inhalation of beryllium dust, fume or mist. Workers who are constantly exposed to beryllium, even in small amounts, and who become sensitized to it can develop what is known as Chronic Beryllium Disease (berylliosis), a disease which primarily affects the lungs.³³ Exposure to beryllium also causes a form of skin disease that is characterized by poor wound healing and wart-like bumps.³⁴ Studies have shown that people can still develop beryllium disease even many years following the last exposure.

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

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

ANNEX II EUROPEAN DIRECTIVES

DIRECTIVE 2002/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 27TH JANUARY 2003

On the restriction of the use of certain hazardous substances in electrical and electronic equipments

Summary

The main objective of this directive was to approximate the laws of the Member States on the restrictions of the use of hazardous substances in electrical and electronic equipments and to contribute to the protection of human health and to the environmental-sound recovery and disposal of waste electrical and electronic equipment.

The Article 4 states that from 1st July 2006, new electrical and electronic equipments put on to the market should not contain lead, mercury, cadmium, hexavalent chromium, poly-brominated biphenyls (PBB) or polybrominated diphenyls ethers (PBDE).

A community action programme would be carried out to on the prohibition of other hazardous substances and their substitution thereof by more environment-friendly alternatives, which ensure at least the same level of protection to consumers.

All the Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive before 13 August 2004.

DIRECTIVE 2002/96/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 27TH JANUARY 2003

On Waste Electrical and Electronic Equipments (WEEE)

Summary

The objective of the community environment policy is specifically to protect and improve the quality of the environment, protect human health and prudently and rationally utilise natural resources. The policy is based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should be rectified at source and that the polluter should pay.

The Union felt that WEEE generation is growing rapidly and the content of hazardous components in electrical and electronic equipments is a major concern during the waste management phase. Also, the recycling of WEEE is not undertaken to a sufficient extent.

The waste management strategy states that, where the generation of waste cannot be avoided, it should be reused or recovered for its material or energy.

Thus this directive's first priority is the prevention of waste electrical and electronics equipment (WEEE), and in addition, the reuse, recycling and other forms of recovery of such wastes so as to reduce such waste disposal. It also seeks to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment, e.g. producers, distributors and consumers and in particular those operators directly involved in the treatment of waste electrical and electronic equipment.

The Member States shall encourage the design and production of electrical and electronic equipment, which take into account and facilitate dismantling and recovery, in particular the reuse and recycling of WEEE, their components and materials. In this context, Member States shall take appropriate measures so that producers do not prevent, through specific design features or manufacturing processes, WEEE from being reused, unless such specific design features or manufacturing process present overriding advantages, for example with regard to the protection of the environment and safety requirements.

The Member States are also to set up systems to provide for the treatment of WEEE using best available treatment, recovery and recycling techniques, and ensuring at least the same level of protection of human health and environment in all countries. For the purposes of environmental protection, Member States are to set up minimum quality standards for the treatment of collected WEEE.

Member States are required to ensure that producers or third parties acting on their behalf set up systems either on an individual or on a collective basis, to provide for the recovery of WEEE collected separately, giving priority to the reuse of whole appliances. The Member States are to ensure that by 31 December 2006, producers will meet the different recovery targets set up by the EU.

The Member States are to encourage the development of new recovery, recycling and treatment technologies. And the consumers of different electrical and electronic equipment in private households are given the necessary information about: disposal, return and collection systems, their role in reuse and recycling, effects on environment and health.

The Member States shall bring into force the laws, regulations and administrative provisions by 13th Aug 2004.

ANNEX III

INTERNATIONAL NETWORKS

Silicon Valley Toxics Coalition (SVTC) is a diverse grassroots coalition that engages in research, advocacy, and is organised around the environmental and human health problems caused by the rapid growth of high-tech electronics industry.

SVTC was formed in 1982 in response to the discovery of substantial groundwater contamination throughout Silicon Valley that was caused by toxic chemicals that leaked out of underground storage tanks from high-tech companies (at the time referred to as the “clean industry!”)

Their programs address a wide variety of sustainability issues associated with the high-tech electronics revolution. And their program efforts spring from a philosophical commitment and a long track record supporting community involvement and environmental and economic justice.

No other organization has done more than the Silicon Valley Toxics Coalition to call attention to and improve the environmental health and safety practices of the global electronics industry.

The Coalition has built a united campaign of allies including community residents, consumers, electronics and technology workers, and government policy makers to raise the environmental consciousness and performance of the high-tech sector.

Their activism expanded the awareness of the toxic legacy of high-tech development and moved the industry to eliminate some of the most toxic chemicals and to begin to adopt more sustainable practices.

SVTC is located in San Jose, Santa Clara County, California that suffers from some of the environmental and occupational health problems created by high-tech development. SVTC works to develop models that can be replicated locally and globally. As our network and outreach have grown, our initial efforts have matured to sustain regional, national, and international impact.

The **Basel Action Network (BAN)** is a global network of toxics and development activist organizations that share a vision of international environmental justice. The network seeks to prevent all forms of “toxic trade” — in toxic wastes, toxic products and toxic technologies. BAN members work nationally, regionally and globally to accomplish the following mission:

“The Basel Action Network (BAN) works to prevent the globalisation of the toxic chemical crisis. In particular, we seek to ensure that the Basel Convention and its ban (Decisions II/12 and III/1) on the export of hazardous wastes from OECD to non-OECD countries will not be weakened, but rather ratified and implemented at the earliest possible date. We also seek to ensure that the Basel Convention and other instruments and efforts, serve to prevent the trade and growth of the world’s most hazardous, and often obsolete industries, particularly with respect to developing or newly industrializing countries.”

BAN functions by sharing information and strategic ideas deemed useful in accomplishing the above mission. BAN members then implement these ideas on the ground, in their respective countries. BAN also endeavours to bring global representatives to each of the meetings of the Conference of Parties of the Basel Convention and other important Basel Convention meetings. BAN is administered by the Secretariat services of the Asia-Pacific Environmental Exchange (APEX) based in Seattle, Washington, USA. APEX is an activity of the Tides Centre.

BAN is a new international network and is currently seeking active members. The Basel Action Network (BAN) works to prevent the globalisation of the toxic chemical crisis. We work in opposition to *toxic trade* in toxic wastes, toxic products and toxic technologies, that are exported from rich to poorer countries. Alternatively, we work to ensure national self-sufficiency in waste management through *clean production* and *toxics use reductions* and in support of the principle of *global environmental justice* where no peoples or environments are disproportionately poisoned and polluted due to the dictates of unbridled market forces and trade.

	United States	European Union	India	China
Policy	<p>Doesn't consider e-waste as hazardous, and prefers to recycle it.</p> <p>Thus exporting it to developing countries without 'prior informed consent'</p> <p>Never signed either the Basel Convention on the Transboundary Movement of Hazardous Wastes or its Ban Amendment</p>	<p>Considers e-waste as hazardous, thus tightly controls their use and disposal. It recognises the problem and already proposed an ambitious system of "Extended Producer Responsibility" (EPR).</p> <p>Strong proponent of the Basel Convention and its Ban Amendment.</p>	<p>There is no policy on e-waste, though some parts of computers could be considered as hazardous waste.</p> <p>Is a party to the Basel Convention, but has not ratified the Ban Amendment. Earlier strong proponent of the Ban on imports of all hazardous materials, but of late supporting imports for recycling even if hazardous.</p> <p>PIL in the High Court of Delhi (April 1996) and Supreme Court of India (May 1997) led to bans on the import of hazardous wastes in the country. The Court appointed the MGK Menon Committee to overview the situation.</p>	<p>China was one of the first global proponents for an international ban on the export of toxics waste from developed to developing countries.</p>
Legislations	<p>In the US, it is legal to export e-waste. The Resource Conservation and Recovery Act (RCRA) has been amended and controlled over time to encourage its export, by exempting it from any export controls.</p> <p>Households, small and large producers come under different provisions for exemptions, but exports for 'recycling' allowed.</p>	<p>On 27 Jan 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 (<i>Waste from Electrical and Electronic Equipment-WEEE</i>).</p> <p>On 27 Jan 2003, A second Directive (<i>Restriction on the use of Certain Hazardous substances-ROHS</i>) in electrical and electronic equipments has been passed that will require manufacturers to phase out the use of hazardous materials.</p>	<p>The Hazardous Waste (Management & Handling) Rules, 1989, as amended in 2000, issued under the Environment Protection Act, 1986.</p> <p>The Rules have been amended in 2000, and another set of amendment is ready for 2002.</p> <p>The Foreign Trade (Development and Regulation) Act, 1992, under which second hand computers can be imported under license for actual users. Unclear laws have led to proliferation of trade in used and junk computers. Customs not aware of e-waste as 'hazardous.'</p>	<p>In 1996, China passed the Law on the 'Prevention and Control of Solid Waste Pollution to the Environment', which</p> <ol style="list-style-type: none"> Prohibits the import of solid waste, unusable to recycle Strictly regulates the import of solid waste to be used as raw material.

ANNEX IV
COMPARATIVE STUDY OF HOW VARIOUS
COUNTRIES HANDLE E-WASTE

	United States	European Union	India	China
Practices	Trade of e-waste is not controlled, with large volumes going to overseas smelters or backyard recyclers. Over 50 to 80% exported. Rest landfilled or incinerated.	Trade of e-waste is controlled legally, but doubts about its enforcement. However e-waste still emerging and exported.	Essentially imports are not controlled, e-waste is imported freely and recycling is carried out in a hazardous manner. Mostly backyard recycling in Delhi, Chennai, Mumbai etc. Imported e-waste obtained through international route of traders who use legal loopholes to import such waste and auction it to smaller traders etc. Over 1 million poor people involved in the manual recycling operations.	Import is controlled in case of shredded circuit boards, PVC coated flame-retardants and banned for whole circuit boards, CRTs, monitors. However documentation have shown widespread backyard and hazardous recycling of e-waste.