E-WASTE IN INDIA: AN OVERVIEW

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ABSTRACT: This paper talks about the problem and hazard of the E-waste across India. The sale of electrical and electronic equipment has been growing up in the last two decades very drastically. The computers have become an integral part of everybody's life but this necessity is not being recycled properly and before it is dismantled, it leaves a lot of harmful effects on human beings and environment. Laws and regulations are there management practices which are being applied and recycling is being done only to a very low extent. Though if recycling and reuse are done properly it will reduce the hazard very well. But the private and illegal practices are not letting it happen in developing countries like India.

INTRODUCTION

Waste can be defined as the material, substance or by-product which has lost its value. As per Basel convention wastes are substances or objects which are disposed of or are intended to be disposed of by the provisions of national laws. There are so many types of wastes and e-waste is one of its types. Electronic waste or e-waste for short is a generic term embracing various forms of electric and electronic equipment that have ceased to be of any value to their owners. There is a debate for the standard definition of it as shown in Table1:

Table1: Definitions of E-waste in Different Conventions

Reference	**Definition**
EU WEEE Directive (EU, 2002a)	"Electrical or electronic equipment which is waste including all components, sub-assemblies & consumables, which are part of the product at the time of discarding." Directive 75/442/EEC, Article 1(a) defines "waste" as "any substance or object which the holder disposes of or is required to dispose of pursuant to the provisions of national law in force."
Basel Action Network (Puckett & Smith, 2002)	"E-waste encompasses a broad and growing range of electronic devices ranging from large household devices such as refrigerators, air-conditioners, cell phones, personal stereos, and consumer electronics to computers which have been discarded by their users."
OECD (2001)	"Any appliance using an electric power supply that has reached its end of life."
SINHA (2004)	"An electrically powered appliance that no longer satisfies the current owner for its original purpose."
StEP (2005)	E-waste refers to "the reverse supply chain which collects products no longer desired by a given consumer and refurbishes for other consumers, recycles or otherwise processes wastes."

Now a days the electronic industry is the world's largest and fastest growing manufacturing industry. During the last decade, it has assumed the role of providing a forceful leverage to the socio - economic and technological growth of a developing society. The consequence of its consumer oriented growth combined with rapid product obsolescence and technological advances are a new environmental challenge - the growing menace of "Electronic Waste" or "e-waste" that consists of obsolete electronic devices. It is an emerging problem as well as a business opportunity of increasing significance, given the volumes of e-waste being generated and the content of both toxic and valuable materials in them. (Kurian Joseph) E-wastes are considered dangerous, as certain components of some electronic products contain materials that are hazardous, depending on their condition and density. The hazardous content of these materials pose a threat to human health and environment. Discarded computers, televisions, VCRs, stereos, copiers, fax machines, electric lamps, cell phones, audio equipment and batteries if improperly disposed can leach lead and other substances into soil and groundwater. In 1994, it was estimated that approximately 20million PCs (about 7million tons) became obsolete. By 2004, this figure was to increase to over 100 million PCs. Cumulatively, about 500 million PCs reached the end of their service lives from 1994 to 2003. 500 million PCs contain approximately 2872000 tons of plastics, 718000 tons of lead, 1363 tons of cadmium and 287 tons of mercury (Puckett and Smith, 2002). This fast growing waste stream is accelerating because the global market for PCs is far from saturation and the average lifespan of a PC is decreasing rapidly for instance for CPUs from 4-6 years in 1997 to 2 years in 2005(Culver, 2005).

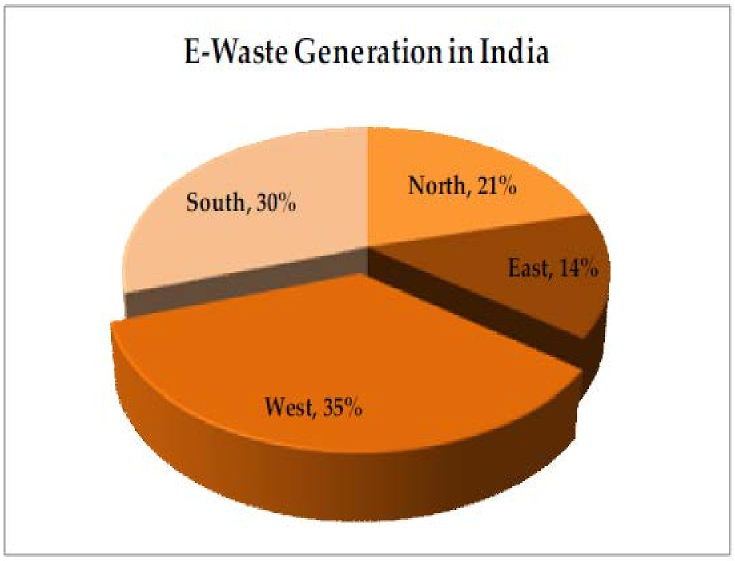
PCs comprise onlya fraction of all e-waste. It is estimated that in 2005approximately 130 million mobile phones will be retired. Similar quantities of electronic waste are expected for all kinds of portable electronic devices such as PDAs, MP3 players, computer games and peripherals (O'Connell,2002). Many of these products can be reused, refurbished, or recycled in an environmentally sound manner so that they are less harmful to the Ecosystem. India has a population of about 1210.2million. It has a large e-waste recycling industry, in and around the big cities, handling from collecting and dismantling to re-manufacturing obsolete appliances and material recovery. The entire business develops in the informal sector, i.e. within small units with low-skilled, mainly migrant labor. At national level, the programmer's activities are concentrating on supporting the National WEEE Strategy Group, while the project's implementation unit focuses on the 'Cyber City' Bangalore where it supports the establishment of a Clean e-Waste Channel, starting with safe and controlled recycling of corporate e-waste. We have to accept this fact that each of us, regularly contributing to pile up this type of non-biodegradable wastes. These facts combine to give an ever increasing stream of waste products with harmful environmental consequences. This paper talks about this ever-growing problem by mentioning the growing statistics, current waste type, management options and legal provisions.

Magnitude of the Problem

The magnitude can be best understood by the statistics of the generation of e-waste across the country. Table2: shows the same in all the states and union territories of the nation. The generation of e-waste is higher in those places which are either industrially prosperous or hub of the information technology. The major places are Bangalore, Hyderabad, Noida, Mumbai, Chennai, Chandigarh etc. The graph shown below suggests that the western region is the leading contributor because that region is industrially prosperous and commercial transactions done from there are greater as compared to other regions (Graph1)

Table2: State wise WEEE Generation

S.No.	State	WEEE (tons)	S.No.	State	WEEE (tons)
1.	Andaman Nicobar Islands	92.2	19.	Lakshadweep	7.4
2.	Andhra Pradesh	12780.3	20.	Madhya Pradesh	7800.6
3.	Arunachal Pradesh	131.7	21.	Maharashtra	20270.6
4.	Assam	2176.7	22.	Manipur	231.7
5.	Bihar	3055.6	23.	Meghalaya	211.6
6.	Chandigarh	359.7	24.	Mizoram	79.6
7.	Chhattisgarh	2149.9	25.	Nagaland	145.1
8.	Dadra & Nagar Haveli	29.4	26.	Orissa	2937.8
9.	Daman & Diu	40.8	27.	Pondicherry	284.2
10.	Delhi	9729.2	28.	Punjab	6958.5
11.	Goa	427.4	29.	Rajasthan	6326.9
12.	Gujarat	8994.3	30.	Sikkim	78.1
13.	Haryana	4506.9	31.	Tamil Nadu	13486.2
14.	Himachal Pradesh	1595.1	32.	Tripura	378.2
15.	Jammu & Kashmir	1521.5	33.	Uttar Pradesh	10378.1
16.	Jharkhand	2021.6	34.	Uttarakhand	1641.1
17.	Karnataka	9118.7	35.	West Bengal	10059.4
18.	Kerala	6171.8			



Graph1: Region wise WEEE Generation in India

Talking about the total waste generation in India it is difficult to give exact data and statistics. The figure shown below gives an idea that more than 332000 MT of e-waste is generated of which nearly 56000 tons is generated in the form of computers which is increasing very rapidly with every passing year. The major contributor is still the televisions and more than 144000 MT can be recycled but the processing of only 19000 MT could be done (Table3)

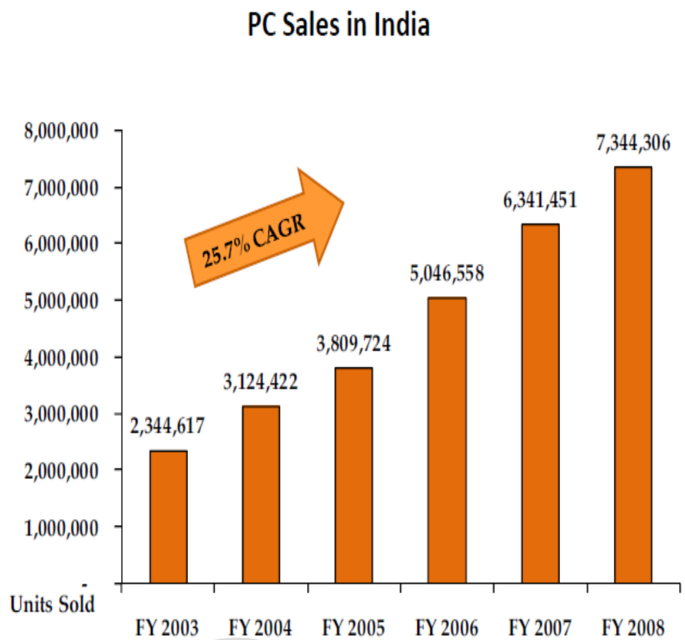
Table3: E-Waste Generation in India-Breakup

E-Waste Generation in India - Breakup

Components	Generated	Avail. for Recycling	Processed
Computers	56,324	24,000	12,000
Cellular Phones	1,655	143	7,000
Televisions	2,75,000	70,000	-
Imports	-	50,000	-
Total	3,32,979	1,44,143	19,000

All data in MT; Source: MAIT

Table 3 shown previously threw light on the contribution of the computers on the generation of e-waste. This component became more important later on which is suggested by Graph 2 shown below. It is also trying to suggest that the sales of computers in India was high sometime back when recession had not shown its effect on the economy of the country. Looking at these stats it can be easily predicted that a number of PCs were retiring for disposal and growing a steep rise to the production of e-waste.



Graph 2: PC Sales in India

Every technical person knowing about computers are aware of the fact that it is a assembly comprising of different components like keyboard, CPU, monitor etc. These components can be sold separately also. The Graph 3 shows that the individual component sale is also going up with the passing time.

Graph 3: Sale of Server, Printer, Monitor & Keyboard

All the computer monitors and TVs contain a very important component CRT. The volume of waste CRT generation in India is typified by the study by Kumar and Shrihari (2007). This study used market supply method to estimate that about 132000 kg. of waste TVs will be generated in Mangalore city alone (in India) between 2007 and 2008.

This will be expected to increase to 223704 kg by 2009-2010. Waste PC generation is also expected to follow the same trend-218742 for 2007/08; 275808 for 2008/2009 and 547346 kg for 2009/2010. These categories are the leading contributors to WEEE generated in the city; waste Tvs constituting 39% and waste PCs 55% (Kumar and Shrihari,2007).

There are some indirect factors which are responsible for the increase in the generation of e-waste the most important is the import of outdated equipments, set-ups and individual parts to be sold on a cheaper price or being donated for the development. An assessment of e-waste management in India indicated that about 720 tonnes of e-waste are imported daily in delhi alone (Dimitrakakis et al, 2006). The figure shown below suggests the same. It can clearly be seen that places like Mumbai, Ahmedabad, Madras are the major ports which receive this kind of substances and are on the world map (Figure 1)

Figure1: Export of WEEE in Asian Countries

Components of E-waste

The components can be divided into two parts. Table 4 shows the hazardous components of WEEE.

Table4: Hazardous Components of WEEE

Mercury	Thermostats, sensors, relays in switches and discharge lamps, batteries, LCD
Lead	Soldering of printed circuit boards, cathode ray tubes and light bulbs, batteries, LCD
Cadmium	Switches, springs, connectors, housings and printed circuit boards, batteries
Hexavalent Chromium	Metal coatings for corrosion protection and wear resistance
Polybrominated biphenyls (PBB) and polybrominated diphenylethers (PBDE)	Flame retardants in printed circuit boards, connectors and plastic covers
Americium	Radioactive source in smoke alarms
Sulphur	Batteries, heart damage, kidney damage, liver damage, eye irritation

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Some part of E-waste is non-hazardous and important components are listed below:

- Tin: solder, coatings on component leads.
- Copper: copper wire, printed circuit board tracks, component leads.
- Aluminium: nearly all electronic goods using more than a few watts of power (heatsinks), electrolytic capacitors.
- Iron: steel chassis, cases, and fixings.
- Germanium: 1950s–1960s transistorized electronics (bipolar junction transistors).
- Silicon: glass, transistors, ICs, printed circuit boards.
- Nickel: nickel-cadmium batteries.
- Lithium: lithium-ion batteries.
- Zinc: plating for steel parts.
- Gold: connector plating, primarily in computer equipment.

Environmental Impact Assessment of WEEE

We all know that heavy metals like mercury and lead are very poisonous and its absence is generally required in potable water. The graphs above have shown its high presence already and it is estimated that in the time to come the sale of the computers and its components will increase and someday when it reaches the level of 500 million then the components like plastic, mercury, lead, cadmium and chromium will reach to a level which can create disaster. These components have yet not found any appropriate process for complete and foolproof recycling and reduction. The Table 5 suggests the same.

Table5: Projection of Waste Material

Component	Contribution in weight (pounds)
Plastic	6.32 billion
Lead	1.58 billion
Cadmium	3.0 million
Chromium	1.9 million
Mercury	632000

The processes of dismantling and disposing of electronic waste in the third world countries like India lead to a number of environmental impacts as illustrated in the graph. Liquid and atmospheric releases end up in bodies of water, groundwater, soil and air and therefore in land and sea animals – both domesticated and wild, in crops eaten by both animals and human, and in drinking water. Studies suggest that one type of airborne dioxins is found at 100 times levels previously measured. Levels of carcinogens in duck ponds and rice paddies exceeded international standards for agricultural areas and cadmium, copper, nickel, and lead levels in rice paddies were above international standards. Heavy metals found in road dust lead over 300 times that of a control village's road dust and copper over 100 times. Table 6 shows the summary of the potential environmental hazard of different components:

Table6: Effects of Different Components

E-Waste Component	Process Used	Potential Environmental Hazard
Cathode ray tubes (used in TVs, computer monitors, ATM, video cameras, and more)	Breaking and removal of yoke, then dumping	Lead, barium and other heavy metals leaching into the ground water and release of toxic phosphor
Printed circuit board (image behind table - a thin plate on which chips and other electronic components are placed)	De –soldering and removal of computer chips; open burning and acid baths to remove final metals after chips are removed.	Air emissions as well as discharge into rivers of glass dust, tin, lead, brominated dioxin, beryllium cadmium, and mercury
Chips and other gold plated components	Chemical stripping using nitric and hydrochloric acid and burning of chips	Hydrocarbons, heavy metals, brominated substances discharged directly into rives acidifying fish and flora. Tin and lead contamination of surface and groundwater. Air emissions of brominated dioxins, heavy metals and hydrocarbons

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Plastics from printers, keyboards, monitors, etc.	Shredding and low temp melting to be reused	Emissions of brominated dioxins, heavy metals and hydrocarbons
Computer wires	Open burning and stripping to remove copper	Hydrocarbon ashes released into air, water and soil.

The major constituents and sources have been listed in Table 7 showing major and potentially hazardous substances like lead, cadmium, mercury etc.

Table 7: Sources, Constituents and Effects

Source of e-wastes	**Constituent**	**Health effects**
Solder in printed circuit boards, glass panels and gaskets in computer monitors	Lead (PB)	• Damage to central and peripheral nervous systems, blood systems and kidney damage. • Affects brain development of children.
Chip resistors and semiconductors	Cadmium (CD)	• Toxic irreversible effects on human health. • Accumulates in kidney and liver. • Causes neural damage. • Teratogenic.
Relays and switches, printed circuit boards	Mercury (Hg)	• Chronic damage to the brain. • Respiratory and skin disorders due to bioaccumulation in fishes.
Corrosion protection of untreated and galvanized steel plates, decorator or hardener for steel housings	Hexavalent chromium (Cr) VI	• Asthmatic bronchitis. • DNA damage.
Cabling and computer Housing	Plastics including PVC	Burning produces dioxin. It causes • Reproductive and developmental problems; • Immune system damage; • Interfere with regulatory hormones.
Plastic housing of electronic equipment's and circuit boards.	Brominated flame retardants (BFR)	• Disrupts endocrine system functions
Front panel of CRTs	Barium (Ba)	Short term exposure causes: • Muscle weakness; • Damage to heart, liver and spleen.
Motherboard	Beryllium (Be)	• Carcinogenic (lung cancer) • Inhalation of fumes and dust causes chronic beryllium disease or beryllicosis. • Skin diseases such as warts.

In 2002, Greenpeace studied environmental contamination from the storage of waste CRTs, prior to recycling in Kantinagar and Brijgang areas, New Delhi, India. Significantly high levels of Ni (0.4%), Pb (1.5%), Zn (2.1%), Ba (0.3%), and Cd (310mg/kg) were obtained in dust and soil samples from within the waste CRT storage sites (as shown in following table) (Greenpeace, 2005b). the soil samples contained Pb at concentrations of 1580 mg/kg, more than 50 times the background soil concentration which is typically 30 mg/kg. Table 8 shows the presence of different components from the samples taken.

Table 8: Sample Analysis of E-waste

	Powder in CRT*(mg/kg)	Soil**(mg/kg)	Dust! (mg/kg)	Dust/soil!! (mg/kg)
Ag	52	<2	10	155
Ba	3850	277	2610	193
Cd	16800	54.5	310	16.4
Cr	11	20	86	21
Cu	74	61	439	82
Pb	494	1580	14600	1370
Ni	121	47	3900	157
Zn	273000	964	21100	506
Yt	<1	171	10500	67

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The metropolis are facing rapidly growing e-waste quantities, for instance, in the 'Cyber City' of Bangalore. Low risk processes, such as the manual dismantling of WEEE, offer good job opportunities for low and medium skilled labor if given proper training and access to the necessary and affordable technologies. However, some of the processes are extremely harmful and neee to be transferred to formal industries.in other urban areas purely business driven e-waste recycling systems have come about without any government intervention. Any further development in these e-waste sectors will have to be built on the existing set-up. Other than that in many places a complex e-waste handling infrastructure based on and execited by a very entrepreneurial informal sector hasdevelpoed, reflecting a long tradition in waste recycling. Rag pickers and waste dealers easily adapted to the new waste stream and a large number of other bussinesses were created in reusing components or extracting secondary raw materials.

Recycling Options

In India e-waste is becoming an important waste stream in terms of both quantity and toxicity. During the past two decades the Indian economy has experienced significant changes, as is typical of any economy in transition. The Indian electronics industry has emerged as a quickly growing sector in terms of production, internal consumption and export. The growth of PC ownership per capita between 1993 and 2000 was 604%, whereas the world average increase was 181% during the same period (Dwivedy and Mittal, 2010a, 2010b). Domestic WEEE is significant in addition to illegal imports. The country has been one of the main destinations for UEEE and WEEE from OECD (Organization for Economic Co-operation and Development) countries, with an estimated 50000 tons of WEEE imported every year. India has a lucrative market for reusable products through repair, reconditioning and component reuse, and refurbishing shops are common. Although some of the used products are reused through well-established charity organizations, the majority of imports are destined for the backyard recycling sector. The institutions authorized to recycle e-waste in India collect only 3% of the e-waste produced. The remaining portion is processed through informal recycling processes in large cities such as Delhi, Mumbai and Bangalore (Ongondo et al, 2011). The lack of control and regulation of the WEEE recycling industry has led the poorest members of the population to find an economic benefit in recovering valuable parts from WEEE while discarding the waste components. These activities are performed in an unprofessional manner with very high health and environmental risks. There are only three hazardous waste sites in the entire country and a large amount of solid waste containing heavy metals and hazardous substances are landfilled. (Ongondo et al.,2011) E-waste is recycled in Delhi and several states around Delhi, Chennai, Bangalore, Pune and Kolkata, with Delhi acting as the center of e-waste recycling in the country. In the Mandoli industrial area in Delhi, Muslim residents engage in illegal recycling of PCBs using acid bath processes to recover copper and gold (Shinkuma and Managi, 2010). The recovery rate for precious metals from circuit boards is approximately 20% which is sufficient to make informal recovery of these metals profitable (Sander and Schilling, 2010). Recently huge numbers of second hand motherboards have been illegally imported from China. Some of these are sold in used goods markets, and the others are recycled in Mandoli Industrial Area in Delhi (Shinkuma and Managi, 2010). There are also cases in which pre-treatment is conducted in India prior to export of the material to other Asian country. Only primary products of the Indian market are actually repaired or reused in appreciable quantities; non-functional imports serve only for recycling. In recent years, partly due to an Indian-German-Swiss partnership, two processing plants were opened in which UEEE/WEEE processing can be monitored and processed according to certain guidelines. These plants are E-Parisaraa Ltd. In Bangalore and Trishyiarya Recycling India Private Limited in Chennai. A third plant with a capacity of 12000 tons per annum is currently being built in Haridwar near Delhi (Sander and Schilling, 2010). In India, collectors generally pay customers for their old cell phones, which are in demand by a strong recycling network. This case shows that depending on the market, many old appliances may still have value, making the adoption of any transportation or collection fees unnecessary, although recycling fees might be necessary to enforce safe recycling procedures to protect the environment and the health of workers and other individuals (Silveira and Chang, 2010). Figure 2 shows the formal recycling system for the E-waste across the country.

Sales of electronic products in India and many other countries are predicted to rise sharply in the next 10 years. Unless action is taken to properly collect and recycle materials. Many developing countries will have large amounts of hazardous e-waste, resulting in serious consequences for environment and public health (UNEP, 2010).

The report "Recycling- from E-Waste to Resources" (Schluep et al., 2009) predicted that e-waste production from old computers will increase by 200-400% from 2007b to 2020 in South Africa and China and by 500% in India. By 2010 the amount of e-waste from discarded mobile phones reached approximately 7 times greater than 2007 levels in China and 18 times higher in India. By 2020 e-waste from televisions will be 1.5-2 times higher in China and India, whereas in India, e-waste from discarded refrigerators will be double or triple (UNEP, 2010).

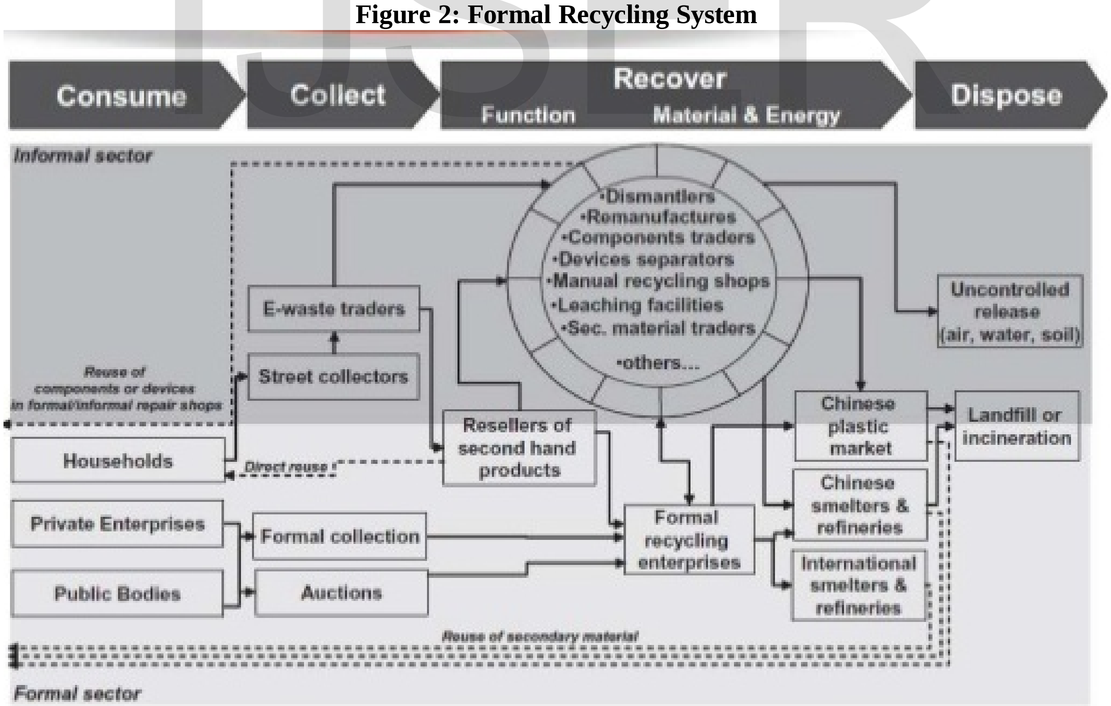
WEEE material composition (ETC on Resource and Waste Management) clearly suggests that the toatl metal content forms more than 50% of the total weight of e-waste.(Table 9)

Table 9: WEEE Material Composition

Component	Weight (%)
Iron & steel	47.9
Non-flame retarded plastic	15.3
Copper	7
Glass	5.4
Flame retarded plastic	5.3
Aluminium	4.7
Printed circuit boards	3.1
Other	4.6
Wood and plywood	2.6
Concret and ceramics	2
Other metals (non-ferrous)	1
Rubber	0.9

Computer scraps including CRTs are managed through various low-end management alternatives such as reuse, open burning, backyard recycling and disposal in open dumps (Ahluwalia and Nema, 2006). Informal remanufacturing of EoL CRTs is also a common practice in India. The activities of remanufacturing CRTs are being undertaken by two different stakeholders: CRT dismantlers and CRT re-gunners, with about 320-350 retuned CRTs per day in Delhi alone (Streicher-Porte et al, 2005). The retuned CRTs are used in the production of unbranded (or locally branded) PC monitors and TVs. The other recovered components resulting from the dismantling process such as integrated circuits (ICs), and capacitors are reused in the production of unbranded monitors and televisions. Un-reusable CRTs are recycled and the glass fed into a secondary glass market (Streicher-Porte et al, 2005). Other materials extracted from the dismantled monitors and TVs (e.g. Copper) are usually sold to recyclers located in the industrial areas of Delhi (Dimitrakakis et al, 2006). This is however not without environmental consequences. The study of Greenpeace International at the sites used in the storage of CRTs in India revealed high levels of contaminatiobn of soils and dust(Greenpeace, 2005b).

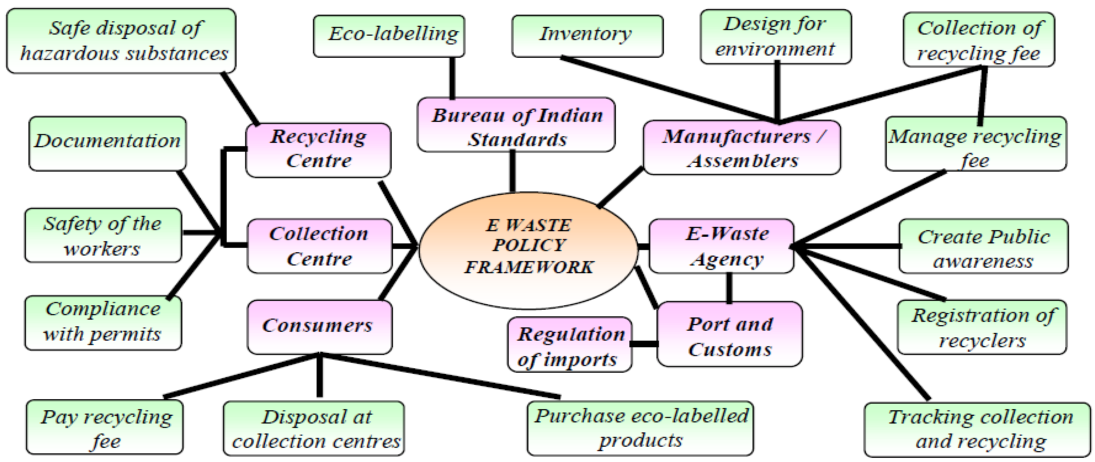
Figure 2: Formal Recycling System



Management Alternatives and Initiatives

Current system of management has been shown in figure 3 below

Figure 3: Elements of E-Waste management System for India



Some important initiatives have been taken all over the world for the management of E-waste. Table 10 describes these initiatives which are applicable for indian context also.

Table 10: initiatives for E-Waste Management

Initiatives	Description
Basel Convention and Basel Ban	A global agreement regulating movements of hazardous wastes, including WEEE, between countries, in force since 1992. However, an Amendment to the Convention, commonly known as the Basel Ban, which calls for prohibiting the export of hazardous waste from OECD to non-OECD countries, is still to come into force.
StEP initiative (solving the e-waste problem)	A UN-led initiative started in 2004 at the 'Electronic Goes Green' Conference in Berlin to build an international platform to exchange and develop knowledge on WEEE systems among countries to enhance and coordinate various efforts around the world on the reverse supply chain (StEP 2005).
Basel Action Network (BAN), Silicon Valley Toxics Coalition (SVTC) and computer take back campaign	network of non-governmental organizations (NGOs) in the US working together on WEEE issues, including international advocacy for the Basel Ban, domestic collection and recycling events as well as investigative research to promote national solutions for hazardous waste management.
WEEE Forum	Founded in 2002, the WEEE Forum is a group of representatives of voluntary collective WEEE take-back systems in Europe, taking care of individual producers' responsibility in Europe.
National Electronics Product Stewardship Initiative (NEPSI)	A multi-stakeholder dialogue to develop the framework of a national WEEE management system in the USA. The NEPSI dialogue includes representatives from electronics manufacturers, retailers, state and local governments, recyclers, environmental groups, and others.
Electronics Product Stewardship Canada (EPS Canada)	EPS Canada was created to work with both industry and government to develop a flexible, workable Canadian solution. An industry-led organization, the founding

	members are 16 leading electronics manufacturers.
ERP (European Recycling Platform)	Set up at the end of 2002 by Hewlett Packard, Sony, Braun and Electrolux to enable the producers to comply with the WEEE directive. It aims to evaluate, plan and operate a pan-European platform for recycling and waste management services.
Seco/Empa e-waste programme	A project set up in 2003 by seco(Swiss State Secretariat for Economic Affairs) and implemented by Empa (Swiss Federal Laboratories for Materials Testing and Research) in cooperation with a number of local partners and authorities, to assess and improve WEEE recycling systems in different parts of the world by analyzing the systems and by exchanging knowledge on recycling techniques and frameworks.

Ahluwalia and Nema (2006) proposed a framework for the management of waste computers and identified regunning of CRTs for use in the manufacture of TVs of local brands and screens for video games as a preferred option.

India and South Africa have set up WEEE Strategy Groups to develop a comprehensive WEEE management system. These strategy groups consist of delegates from varies key stakeholders i.e. government agencies, EEE producers and importers associations, recyclers and NGOs. The groups have set up committees which look into specific issues such as the formulation of policies and legislation, the creation of a national WEEE baseline, the restructuring of the WEEE recycling sector, the implementation of producer responsibility(EPR) and the creation of public awareness. EPR is a good approach and illustration has been shown in Table 11.

Table 11: EPR Approach

Type of EPR approach	**Example**
Product take-back programs	• Mandatory takeback • Voluntary or negotiated takeback programs
Regulatory approaches	• Minimum product standards • Prohibitions of certain hazardous materials or products • Disposal bans • Mandated recycling
Voluntary industry practices	• Voluntary codes of practice • Public/private partnerships • Leasing and servicing • Labelling
Economic instruments	• Deposit-refund schemes • Advance recycling fees • Fees on disposal • Material taxes and subsidies

Existing Laws And Regulations

- **Factories Act 1948 (amended till 1987):**

There are several contaminants arising out from manufacturing or recycling of electronic components and are listed in this Act.

- **Environmental Protection Rules 1986 (amended till 2004):**

There is no direct standard, which can address pollutants from an electronics manufacturing or recycling industries. However certain PCB units fall in electroplating category and are therefore required to be abide by the effluent disposal norms as given in schedule 1 of this rules.

- **Hazardous waste (management and Handling) rules 1989, amended in 2003:**
  - Schedule 2 of this act can be applied for the disposal of e-waste.

- Schedule 3 entry at SI. No. A1180: Waste electrical and electronic assemblies (For EXIM i. e. Export Import)
- Schedule 3 entry at SI. No. B1110: Electrical and electronic assemblies not valid for direct reuse but for recycling (For EXIM)

- **Hazardous Waste (management, Handling and Transboundary movement) rules 08:**
- Part A of Schedule III (Basal No. 1180) consists of list of e-waste applicable for import with prior informed consent.
- Part B of schedule III (Basal No. 1110) deals with list of e-waste applicable for import and export not requiring prior informed consent**.**

- **Basal Convention:**
- The Basal convention on the control of trans boundary movements of hazardous wastes and their disposal, adopted by a conference in Basal (Switzerland) in 1989, was developed under UNEP.

CONCLUSIONS

- E-waste is a rapidly growing hazard. It is contaminating the soil, water and environment around us.
- E-waste has many hazardous components not being recycled at all. The recycling plants are also very less in number.
- There is no proper disposal method for e-waste so recycling is the only available alternative to counter it for the time being.
- The private awkward systems are more active for recycling than the government itself.
- The EPR approach can be very well applied to make effective recycling possible.

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