

*Facilitating Partnerships for
Environmentally Sound Management of e-Waste in India*

Submitted to



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Submitted by



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Final Report

PREFACE

In view of the growing concerns of e-waste management across the globe, in particular the developing countries of Asia, the Secretariat of Basel Convention, under the project on Environmentally Sound Management of e-Waste in Asia Pacific, supported 10 Asian countries. India, a signatory to the Basel Convention, has initiated several programs on e-waste management. However, there is a need for rationalising the inventorisation process, increased awareness on e-waste management among stakeholders and analysis of possible partnership models to promote environmentally sound management (ESM) of e-waste.

In this context, Society for Development Alternatives, India (DA) is being supported for the first phase of the NGO project titled Facilitating Partnerships for Environmentally Sound Management of e-Waste in India. The project intends to reduce the environmental and health impacts from unscientific e-waste management in computer and mobile phone industry sector while demonstrating benefits and ensuring multistakeholder participation.

This report developed by DA is aimed at serving as a tool for devising models of multistakeholder partnership to ensure environmentally sound management of e-waste in India.

Objectives

This report has been developed as a NGO project as part of the Basel Convention Partnership Programme and under the Pilot Project for the Environmentally Sound Management of Electrical and Electronic Waste in Asia and the Pacific which was launched in November 2005.

The key objectives are:

- To identify and document existing sources of e-waste streams along the life cycle including product assembly, pre and post usage, management and disposal and identify improved practices based on the 3R principles.
- To generate awareness on e-waste management among various stakeholders in the selected industry sector

Major Recommendations of the study

- Regulating e-waste - India should formulate e-waste legislation with immediate effect so as to make mismanagement of e-waste by companies punishable under the law.
- Extended Producer Responsibility - The producer should be directed to take back a product at the end of its useful life either directly or through a third party.
- Environmentally sound recycling – The government must promote environmentally sound recycling in the country.
- e-Waste collection centres for small consumers - Collection centres must be set up in different parts of the country to encourage collection from small generators.
- Awareness – Awareness raising activities should be taken with not only the consumers and small business establishments, but also the public sector undertakings and government organisations.
- Advance Recovery Fee (ARF) At present as India is collecting service tax and educational cess on all products, an additional charge can be imposed on the consumer at the time of purchase.
- Green products – The producers should place emphasis on research and development of products that use less hazardous materials and / can be recycled in a safer manner. Design of products that last longer would help reduce the quantities of e-waste.

ACKNOWLEDGEMENT

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Further the team extends its sincere thanks to other contributing persons like Mr. J. P. Singh and his team of Vision RI Connexion Services Private Limited, New Delhi; Ms. Wilma Rodrigue of Saahas, Bangalore and Dr S Jose of St. Josephs Engineering College, Chennai.

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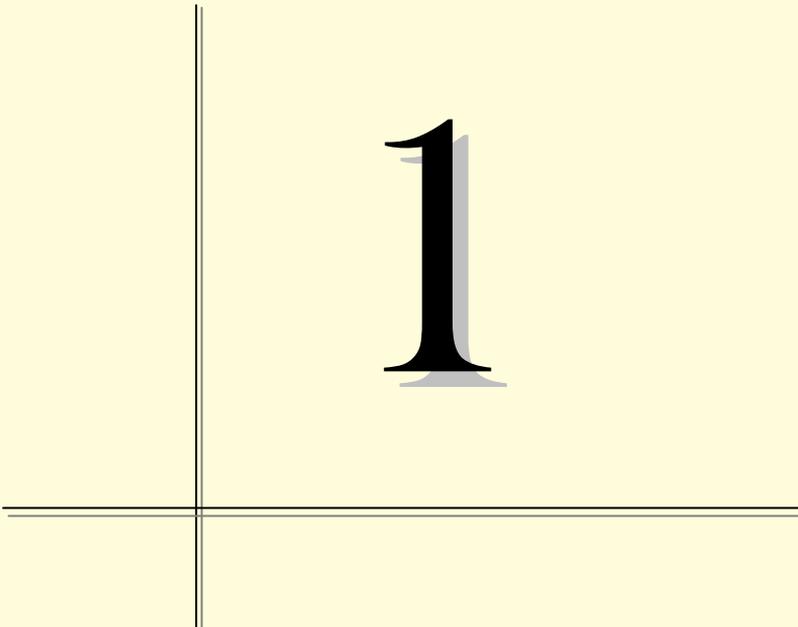
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ABBREVIATIONS USED

ASEM	–	Advisory Services in Environment Management
BAN	–	Basel Action Network
BBMP	–	Bruhat Bengaluru Mahanagar Pallike ()
BCRC	–	Basel Convention Regional Centre
COP	–	Conference of Parties
CPCB	–	Central Pollution Control Board, Government of India
CRT	–	Cathode Ray Tube
DA	–	Development Alternatives, India
DGFT	–	Directorate General for Foreign Trade, Government of India
EEE	–	Electrical & Electronic Equipment
EMPA	–	Swiss Federal Laboratories for Materials Testing and Research
EMS	–	Environment Management System
EPR	–	Extended Producer Responsibility
ESM	–	Environmentally Sound Management
EU	–	European Union
EWA	–	e-waste Agency
EXIM	–	Export & Import
Gol	–	Government of India
GTZ	–	German Technical Cooperation
ICT	–	Information Communication Technology
IFC	–	International Finance Corporation
IT	–	Information Technology
KSPCB	–	Karnataka State Pollution Control Board
PCBs	–	Printed Circuit Boards
PCs	–	Personal Computers
PIC	–	Prior Informed Consent
PRF	–	Prepaid Recycling Fee
MoEF	–	Ministry of Environment & Forests, Government of India
MPCB	–	Maharastra State Pollution Control Board, Government of India
MPPI	–	Mobile Phone Partnership Initiative
NASSCOM	–	National Association of Software & Services Companies, India
NGOs	–	Non-governmental Organizations
RoHS	–	Directive on Restriction of the use of certain Hazardous Substances
SAARC	–	South Asian Association for Regional Cooperation
SACEP	–	South Asian Cooperative Environment Programme

SBC	–	Secretariat for Basel Convention
SCOPE	–	Society for Conversation & Protection of the Environment, Pakistan
seco	–	Swiss State Secretariat for Economic Affairs
SEPD	–	Sub-regional Environmental Policy Dialogue
SPCBs	–	State Pollution Control Boards, Government of India
SteP	–	Solving the e-waste Problem project
SVTC	–	Silicon Valley Toxics Coalition
T/month	–	Tons per month
TNSPCB	–	Tamil Nadu state Pollution Control Board, India
TVs	–	Televisions
UNEP	–	United Nations Environment Programme
US	–	United States
US\$	–	US Dollars
OECD	–	Organization for Economic Cooperation & Development
WEEE	–	Waste Electrical & Electronic Equipment
WTO	–	World Trade Organization



1

1.0 INTRODUCTION

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1.1 Background of the Study

The Secretariat of Basel Convention (SBC) adopted the Work Programme on Partnership for 2005-06 in COP7 which included e-waste as a priority. This 4-Year program will be carried out through concrete and well-targeted national and regional efforts by SBC and other partners (governments, IGOs, UNEP, NGOs and industry) based on needs. Amongst the 10 Asian countries supported by the Secretariat of Basel Convention under the project on Environmentally Sound Management of e-waste for Asia Pacific, Development Alternatives (DA) is being supported for the first phase of the NGO project titled **Facilitating Partnerships for Environmentally Sound Management of e-Waste in India**¹.

The project intends to reduce the environmental and health impacts from unscientific e-waste management in computer and mobile phone industry sector while demonstrating benefits and ensuring multistakeholder participation. The project primarily targets the major stakeholders in the aforesaid industry sectors.

1.2 Need of the Study

The project is complementary to the on-going initiatives for management of e-waste in India and the following are the key elements of the project in this regard:

- Rationalisation of the inventorisation process
- Awareness on e-waste management among stakeholders
- Analyse possible partnership models to promote environmentally sound management (ESM) of e-waste

The project includes preparation of an inventory of sources of e-waste from selected industry i.e. computers and mobile phones, which is being conducted through secondary literature review of on-going initiatives and field surveys to bridge the identified gaps. The project also includes preparation of customised awareness materials, mobilize and engage stakeholders in order to establish multi-stakeholder partnerships at the community and city level, including organizing a national awareness-raising workshop. The progress so far is depicted in the following sections.

1.3 Objectives & Scope of the Study

The main objectives of the project are:

- To identify and document existing sources of e-waste streams along the life cycle including product assembly, pre and post usage, management and disposal and identify improved practices based on the 3R principles.
- To generate awareness on e-waste management among various stakeholders in the selected industry sector

¹ www.unon.org/confss/doc/unep/chw/chw_08/chw_8_09/K0653396.doc

The two fast growing industry sectors of computers and mobile phones in India are the focus of the project.

1.4 Overall Approach

Development Alternatives, with its partner NGOs and key stakeholders have taken the lead in the implementation of the project. The overall approach adopted for the implementation of the project is described below.

Available secondary literature on the past inventorisation studies were reviewed and separate source inventorisation studies were commissioned in the selected cities of the country to identify and document the existing sources of e-waste from computers and mobile phones. Awareness on various aspects on e-waste management was generated through networking and consultations with the key stakeholders. Capacity building exercises were carried out for the informal e-waste recycling sectors in Delhi and Bangalore.

Structured interviews were carried out with key government and industry personnel coupled with research on the existing good practices for e-waste management in India to were identified possible partnership models to promote ESM of e-waste in India.



2

2.0 SOURCES OF e-WASTE – A REVIEW STUDY

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2.1 Review of past inventoriastion studies

Secondary literature review has been undertaken to:

2.1.1 Overview of past initiatives in India

IRG South Asia Private Limited made an attempt to establish an approach and a methodology to quantify electronic waste (e-waste) in India in 2005 and has carried out assessment of the quantum of e-waste at the national level with support from GTZ and CPCB. The study adopted the market supply method to estimate the e-waste generated from 3 categories of electronic and electrical equipments viz. Information technology – computer and its peripherals, White Goods – washing machines and refrigerators and Brown Goods – televisions. e-waste was estimated to reach 2 million units from the domestic market by 2010.

Toxics Link conducted a pioneering study in and around Delhi in February 2003. The study highlighted areas where e-waste is recycled and mechanism's of recovery of components and source of e-waste. It then conducted a similar study in Chennai from September 2003 to February 2004. This study was primarily focused on computer waste and identified areas of e-waste recycling and the imports of e-waste into the city from developed economies. This year a study was conducted in Kolkata to understand the generation of e-waste, this has revealed that the city is fast joining other metros in e-waste generation, and is also emerging as a major centre for hazardous e-waste recycling in its residential areas that is being imported from other parts of India and overseas.

2.1.2 Methodologies used for estimation of quantum of e-waste in India

The methodologies for estimation of the quantum of e-waste have been reviewed.

Numerous methods have been suggested and used to estimate possible global quantities of WEEE. In Lohse et al. (1998) three estimation methods are described:

- the **consumption and use method**, which takes the average equipment of a typical household with electrical and electronic appliances as the basis for a prediction of the potential amount of WEEE (used in the Netherlands to estimate the potential amount of WEEE);
- the **market supply method**, which uses data about production and sales figures in a given geographical region (used by the German Electrical and Electronic Industries Association to estimate WEEE) and
- the **Swiss Environmental Agency's estimates** based on the assumption that private households are already saturated and for each new appliance bought, an old one reaches its end-of-life.

In the first two methods, assumptions need to be made about the average life-time of EEE products as well as their average weight (from which to derive WEEE

generation in tons). Under the third method, however, the assumption of the average life-time of the appliances is irrelevant, as it assumes a completely saturated market.

Another method of estimation developed at Carnegie Mellon University by Matthews et al. (1997) is also based on sales data. Although it focuses only on computers, it includes the reuse and storage parameters for obsolete machines, which in reality delay their entry into the waste stream. However, the model is only for the US and cannot be universally applied. The model attempts to examine the consumer behaviour when disposing an end-of-life PC and defines the pathways of computers from purchase to end-of-life. At the point of disposal, the model considers that the owner of the computer has 4 options viz. reuse, storage, recycled and landfilled. The model considers that a new computer when purchased eventually becomes obsolete. This model takes into account the consumer behaviour, such as time to obsolescence and stockpiling.

The results of WEEE estimation studies vary widely and comparisons of the studies are difficult because both the methods used and basic assumptions made differ from one study to another.

In India, IRG South Asia Pvt Ltd (2004) prepared an e-waste inventory with an approach consisting of material flow methodology, which is based on the market size of items of electrical and electronic equipment (EEE) and confirmation by tracer analysis.

2.2 Studies conducted by DA for – Mobile Phones & Computers

▪ Focus states in India

The results of the IRG study in 2004 study clearly indicated that the states of Delhi, Karnataka, Maharashtra and Tamil Nadu were amongst the top 10 states in India, which generates higher amounts of e-waste in the country. The cities of Delhi, Bengaluru, Mumbai and Chennai were identified as the points of focus to undertake surveys and to establish contacts with the relevant government and industry representatives to devise the partnership models.

Three broad assessments were carried out in the different identified cities including:

- Identify sources of e-waste along life cycle of mobile phones
- Examine sources of e-waste from computers and formal and informal establishments engaged in recycling operations
- Examine current system of tracking entry of e-waste imports

The current study is looking at the states of Delhi, Karnataka, Maharashtra and Tamil Nadu and assessing possibilities for developing partnerships. The cities of Delhi, Bangalore, Mumbai and Chennai have been identified as the points of focus to undertake the sample surveys and to establish contacts with the relevant government and industry representatives to devise the partnership models.

The following three separate field surveys have been carried out:

2.2.1 Identify sources of e-waste along life cycle of mobile phones

Field surveys and interviews were conducted to examine the current methods of

managing the end-of-life mobiles with a sample of 450 respondents (including individual consumers, junk dealers and mobile phone repair shops). Empirical estimations were also carried out regarding the quantum of e-waste generated from the current pattern of use of mobile phones in India.

According to new research by Gartner², mobile phone production in India is expected to grow from 31 million units in 2006 at a compound annual growth rate (CAGR) of 28.3 percent to reach 107 million units in 2011. Mobile phone production revenue is expected to reach US\$13.6 billion by 2011 from US\$ 4.9 billion in 2006, a CAGR of 26.6 percent.

The growth in production will be driven mainly by the expanding mobile subscriber base in India and favorable local government policies promoting local electronics manufacturing in India.

At present, mobile phone production in India is dominated by the top five global handset vendors; Nokia, Motorola, Samsung, Sony Ericsson and LG. There are very few local-brand mobile phone makers with low production volumes and are typically focused on low-end and mid-range handsets. However, Gartner expects new players--local as well as global--to enter the mobile phone manufacturing market in India, aided by the global electronics manufacturing services (EMS) providers' present in India.

Though domestic mobile phone production currently caters mainly to local demand, over the next five years Gartner expects as much as 30 percent of production to be exported to neighbouring regions that are also demanding low-cost handsets such as Africa, the Middle East and other parts of South Asia.

From Table 1, it is evident that there has been tremendous growth in the mobile subscriptions. Total number of mobile subscribers have increased more than 179 times from 1997(678460) to 2007 (121431166). In last ten years average annual growth of mobile subscribers was 75.9 percent and highest growth was seen in the telecom circles where services started a bit late, i.e. Himachal, Bihar, Orissa, Assam, North East and Jammu & Kashmir, though their share in total subscriber base is less than 10 percent in April 2007. According to latest TRAI (Telecom Regulatory Authority of India) report the number of mobile subscribers has crossed the number of landline phone users.

Table 1. Circle wise Total Number of Cellular Subscribers in India {As on December 2006}

Year	All India	Metros	Circle A	Circle B	Circle C
1997	678460	545987	9713	122743	22944
1998	1070603	499841	311040	231098	28624
1999	1536377	631176	488074	382038	35089
2000	3107449	1194992	982511	838413	91533
2001	5478932	2161114	1871736	1252765	193317
2002	10480430	4054434	3515333	2550223	360440
2003	21991743	6994327	8047660	6052692	897064
2004	3737880	10259709	13505380	11581285	2032433
2005	57016643	13768212	19704846	18976672	4566913
2006	105425183	20072482	37443488	37129750	10779463
2007	121431166	21958514	42680298	43542736	13249618

Source: Quarterly Statistics of Subscribers, COAI (Various Issues)

² www.gartner.com

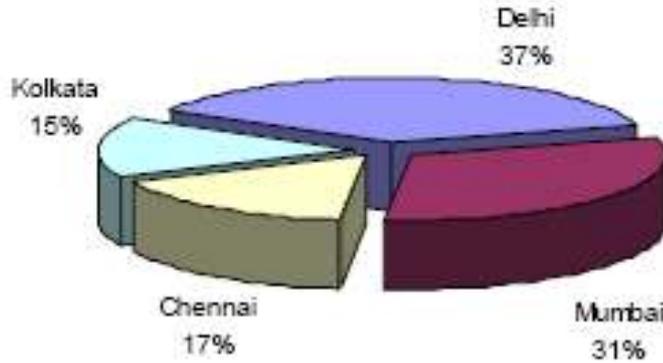


Fig 1. City-wise Mobile Subscribers in Metros December 1997

Table 2: Circle wise Annual Growth of Cellular Phone Users in India

Year	All India	Metros	Circle-A	Circle-B	Circle-C
1997-07	75.9	58.2	79.4	85.9	110.5
1997-02	79.2	71.9	85.8	82.0	96.8
2003-07	56.1	34.4	54.6	66.7	102.5

Source: TRAI Database

- **Manufacturing**

Major handset manufacturers like Nokia, Samsung, Motorola, Sony Ericsson, LG etc. are currently operating in Indian market for cellular handsets. However, their business mainly comprise of imports of readymade handsets or importing the components and reassembling and selling the same in India. However, initiatives to start manufacturing in the country itself are coming up. Nokia has already established a manufacturing plant of cellular handsets at Chennai, while rest of the companies like Motorola, Samsung, Sony Ericsson and LG will soon start making mobile handsets in India. It is expected that domestic manufacturing will ultimately replace imports and cellular handset industry will turn in to an export oriented industry. For example, Nokia has reached a shipment volume of 25 million handsets, as on December 2006, from its manufacturing unit in Chennai.

- **Importing**

In the initial period, the completely assembled handsets were imported to India from the international manufacturers and still the trend is going on. Till date, except Nokia's Chennai Manufacturing Plant, no other major mobile handset-manufacturing unit has been set up in India. The import figures of last ten years are given in the following table.

Table 3. Import of Mobile Handsets in India

Year	Number of Mobile Handsets
1997	37760
1998	195840
1999	207680
2000	116170
2001	311070
2002	317200

Year	Number of Mobile Handsets
2003	4164560
2004	15956150
2005	18881950
2006	45708790
2007	23767780

Source: DGFT Database (till September 2006)

During initial introductory phase of mobile telephony in the country, the quantum of cellular handsets imported was merely a few thousand. During the year 1997 only 37760 cellular handsets were imported. For years 1997 & 1998, the growth rate was phenomenal but sudden slack in the import for the year 2000 made the mobile handset business quiet calm. But there after, more than twofold growth in import was found during the year 2001-2002. From the year 2003, the growth in imports of cellular handsets was exponential. During the financial year 2006-07, the import figure for first six months till September was 23767780 and this is awesome if compared with the quantum of imports in initial years.

Cell phones, despite their relatively small size are experiencing an unprecedented rate of increased usage globally. That fact combined with the rapid obsolescence due either to malfunction or to rapid development of new, desired features, creates very significant volumes of wastes, posing a very serious global pollution concern both from the standpoint of disposal and recycling as well as from the possibility of transboundary movements of such wastes.

The data on the cellular subscriber base from 1995 to December 2006 was used for estimation of the number of cellular handsets discarded by the consumers. The average lifetime of a cellular handset, as validated by the empirical survey also, was assumed to be three years. The projections on subscriber base up to the year 2016 and corresponding quantum of cellular handsets likely to be discarded were calculated by using an assumed annual growth rate of 25% (Table 4).

Table 4: Number of Cellular Handsets discarded annually

Year	Cumulative Subscribers	Cumulative Discarded	Discarded Annually
1995	30000		
1996	220000		
1997	800000		
1998	1100000	30000	30000
1999	1600000	220000	190000
2000	3100000	800000	580000
2001	5500000	1100000	300000
2002	10500000	1600000	500000
2003	28000000	3100000	1500000
2004	48000000	5500000	2400000
2005	59250000	10500000	5000000
2006	74062500	28000000	17500000
2007	92578125	48000000	20000000
2008	115722656	59250000	11250000
2009	144653320	74062500	14812500
2010	180816650	92578125	18515625
2011	226020813	115722656	23144531
2012	282526016	144653320	28930664
2013	353157520	180816650	36163330
2014	441446900	226020813	45204163
2015	551808625	282526016	56505203
2016	689760782	353157520	70631504

Source: Estimates by the consultant

A sample survey of cellular phone users was done in New Delhi, which holds the largest number of mobile subscribers, refer Figure 1, to better understand the cellular

phone usage pattern. Structured discussions were also held with various stakeholders, the discussions are given below:

STRUCTURED DISCUSSIONS WITH VARIOUS STAKEHOLDERS

Manufacturers, Importers and Retailers

Relevant officials of cellular handset makers like Nokia and Samsung etc. were contacted and secondary literature was surveyed to find details about the companies. The following are some of the observations³:

- **Nokia** - Nokia has already eliminated PVC from new models of mobiles. Since the start of 2007, they have launched the first phones without any components containing brominated flame retardants (BFRs). However, Nokia failed to provide a timeline for the elimination of PVC and BFRs from its entire product portfolio – including network equipment. Nokia is good at its support for Individual Producer Responsibility (IPR)⁴.
- **Sony Ericsson** - Sony Ericsson states strong support for Individual Producer Responsibility. The company has now set a timeline of 1st January 2008 for eliminating the use of BFRs in two remaining applications, and the same timeline for substituting phthalates, beryllium and some uses of antimony compounds. All new models of mobile put on the market from 2006 are free of the worst chemicals. On the down side, Sony Ericsson needs to improve reporting on the amounts of discarded mobile phones it takes back and recycles.
- **Samsung** – In the past Samsung gained a dubious reputation of performing poorly at IPR. However, the company gained some reputation subsequently due to improving its performance on this account. The company has provided reasonable timelines for phasing out the worst substances and has improved the information to consumers on what to do with their discarded products. Although Samsung provides voluntary product take back of its electronic waste, this is only in a few countries and only for some product groups.
- **Motorola** - Motorola has clarified its understanding of the precautionary principle. Although Motorola provides information on products on the market that are free from brominated flame retardants (BFRs), the company has still to commit to timelines for eliminating all BFRs and PVC from their entire product portfolio. Motorola is good at Individual Producer Responsibility criteria. The company provides information to customers on recycling their old phones and runs voluntary take-back/recycling services in 80% of the countries where its products are sold. Motorola also reports on the amounts of discarded mobile phones it takes back and recycles.
- **LG Electronics** - LGE has been evaluated poorly for corporate double standards on Individual Producer Responsibility by Green Peace. While LGE's global website states that the company believes that the producer (not consumer) should be responsible for financing the waste management of its own brand products when they are discarded, in the US, LGE is part of a Coalition that has been opposing Producer Responsibility and lobbying for U.S. consumers to pay an Advanced Recycling Fee (ARF). On the positive side, LGE scores well for

³ Source: Guide to Greener Electronics by Green Peace, March 2007.

⁴ IPR means that each company must take care of the electronic waste from its own-branded discarded products)

launching mobile phone models that are free of brominated flame retardants (BFRs). LGE needs to improve on product take back and recycling.

Cellular Repair Shops

Discussions were held with the cellular repair shop owners in areas like Gaffar Market in Karol Bagh, Pitampura, Madhuban Chowk, Rohini etc. The summary findings of these structured discussions are given below.

There are two major categories of cellular handsets. One is GSM (Global System for Mobile Communications) and other is CDMA (Code Division Multiple Access). As far as repair is concerned, large numbers of cellular handsets which are brought to repair shops are based on GSM technology while numbers of CDMA handsets that come for repair are comparatively smaller. CDMA handsets have a very less chance of repairing as their spare parts are rarely available. The maximum numbers of handsets which come for repairing are of Nokia as its market share is substantially higher than other brands in market. Other reason is the availability of spare parts of Nokia handsets. Some common faults which are found in mobile phones are circuit board problems, low voice, signal problems, microphone problems, poor display or no display. Useful parts of the dead mobile phones can be used in other hand sets and repair shop owners make optimum use of working parts of useless/waste/dead mobile hand sets to repair the other handsets. As far as repair is concerned, the chances of massive e-waste generation are comparatively low. As handsets brought in by the consumers for repair are generally returned to the consumers whether repair is successful or not, the waste generation phenomenon shifts to consumers.

Mobile battery is one of the important components during functional life of mobile handset and accounts for one third weight of handset. It is found that average life of battery is 1.5 to 2 years as per the experiences and opinions of the repair shop owners. Nowadays Lithium-Ion battery is most widely used in most of the handsets. After completing its functional life, batteries become valueless even in scrap. Apart from this, there is not any replacement or change in batteries except the batteries within warranty period. There is no collective mechanism for dealing with old batteries and it is either discarded in dustbin or thrown away randomly anywhere.

From environmental awareness point of view, some of the mobile repair shop owners know about the content of batteries but not their hazardous nature. They are unaware about legislation, control activities relating to e-waste or dealing with e-waste. It is clear from the discussions that e-waste concept is new to these repair shop owners. But it is not surprising as the literate class also knows very little or none about e-waste and its environmental implications.

2.2.2 Sources of e-waste from computers, including storing, stockpiling and both formal and informal establishments engaged in recycling operations

Empirical estimations were carried out to determine estimates of the quantum of e-waste that is stored or stockpiled with bulk consumers (government establishments and business houses) and assesses capacities of existing informal and formal e-waste recycling units in the focus cities of Delhi, Mumbai, Bengaluru and Chennai.

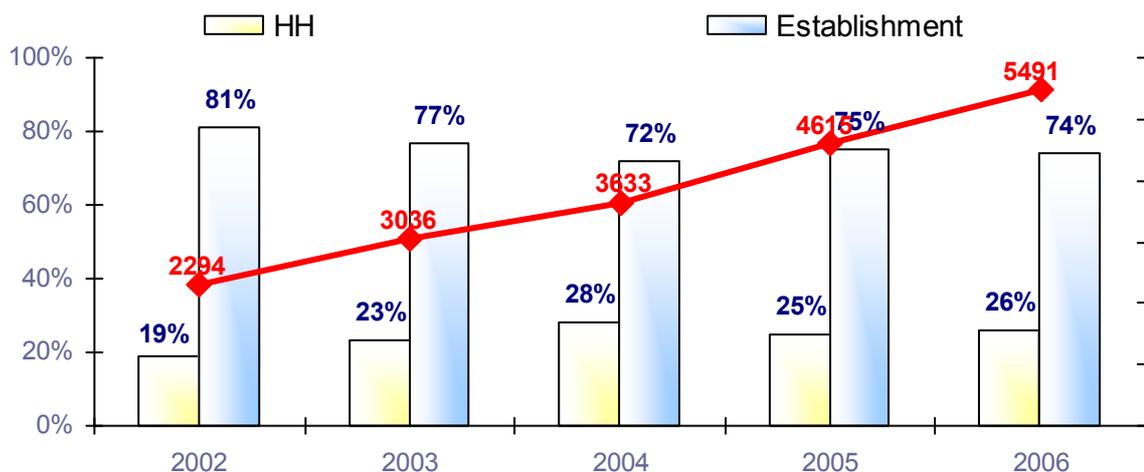


Fig: 2 PC Sales in Households & Establishments over years.
Source: MAIT 2007.

Figure 2 represents the sales of PC over the years and the distribution between the households and the establishments. It is evident from the figure that PC sales in the establishment sector is higher and considering the obsolescence rate of the PCs, the strategy to manage the e-waste generated from the computer industry should be targeted to the establishment sector.

BENGALURU (formally known as Bangalore)

Bengaluru, the undoubted centre of the IT industry, was the first city in India to have sent a WEEE wake-up call. Indo-German-Swiss Partnership initiated the issue related to electronic waste management in May 2004 for e-waste in association with several partners including Max Muller Bhavan, Agastya Foundation, Eco Watch and Saahas. The programme came under an umbrella called WEEE Care. At the time of initiation of the program there was limited understanding about e-waste, quantities generated how to proceed, and the possible solutions.

Subsequently several studies were initiated. In association with ASEM, GTZ and HAWA, Saahas conducted two studies to understand the scenario in Bengaluru.

- E-Waste, Bengaluru wakes up to a new threat and
- Understanding e-waste collection, flow and recycling

The studies revealed that Bengaluru was generating around 8,000 tonnes of e-waste (from computers and peripherals). This estimate was based on information received from recyclers in the informal sector in Bengaluru and from the fact that 30% of all equipment in the IT industry became obsolete every year and end up as e-waste. In 2003, there were no authorised recyclers and the only option available for disposal of e-waste was through the informal sector. This waste in fact was traded through auctions that were held regularly in the city. Two large auction companies namely Matex and the government Owned Metal Scrap Trading Corporation regularly advertised these auctions on their website. Large public sector companies like Bharat Electronics Ltd (BEL) engaged in the manufacture of electronic equipment used the services of Matex who were “registered/authorised” vendors from the KSPCB, to dispose their e-waste every three months with more than a tonne of e-waste being disposed every three months.

However it soon became apparent that these 'authorised vendors' only had licences to trade in metal scrap. e-Waste unfortunately was also being traded as metal scrap. Further probing has revealed that the authorised metal scrap dealers had links with the informal sector. In addition to the public sector, large private companies including the multinationals used the auctions to dispose their e-waste.

The information from these studies indicated the need for including e-waste in the category of hazardous waste and accordingly introducing mechanisms for its safe collection, recycling and disposal. Over the last couple of years various efforts have been made by different organizations to introduce e-waste management to the corporate sector who at first refused to accept responsibility for the management and proper disposal of e-waste. Gradually over the years due to constant motivation and awareness a gradual change in the attitude emerged and became visible at least among the large companies and multinationals.

This change in attitude coincided with the fact that Bengaluru and Chennai became the first cities in India to have authorised recyclers who were able to assure scientific and safe disposal of e-waste.

On the other hand the informal sector realized that they would soon have no access to large quantities of e-waste. This sector was made aware of the need for better management of e-waste through various programmes and after years of effort they are now looking at better processes and safe disposal.

Role & Status of Stakeholder Involvement

Bengaluru has emerged as a key city, which has identified the different stakeholders and is making demands to ensure that attention is given to e-waste and its proper management and disposal.

Currently three main stakeholders have been identified, namely

- A. **The Government**- agencies associated with e-waste that include Karnataka State Pollution Control Board (KSPCB), Bruhat Bengaluru Mahanagar Pallike (BBMP) Department of Information Technology, Government of Karnataka
- B. **The Generators** (mainly producers and consumers)
- C. **The Recyclers** (formal and informal)

A. Government agencies

A.1 Karnataka State Pollution Control Board (KSPCB)

The Karnataka State Pollution Control Board (KSPCB) has the responsibility for enforcement of the rules and legislation. Unfortunately there are no legal definitions for e-waste in India though the current legislation makes a distinction between the e-waste generated during production of electronic goods and waste that is generated through consumption of electronic goods (e.g. computers). The legislation that applies to an industry disposing of e-waste generated through consumption of electronic goods are the Water Act, its Rules and Cess Act (1974, 1975, 1977), the Air Act and its Rules (1981, 1983) and the Environment Protection Act (EPA, 1986) and its Rules (1986). This legislation only states that waste, which would include e-waste, that is generated, should not be dumped indiscriminately. The Hazardous Waste Rules and its Amendments apply only for the obsolete devices which are physically damaged or if generated by a manufacturer. This usually only takes place at the recycling and refurbishing level. Discussions with the department made it clear

that the hazardous waste rules are currently sufficient to address the safe disposal and recycling of e-waste.

The industries are bound to dispose of their e-waste to a proper recycler who is authorised by the KSPCB or to find a proper landfill. None of the legislations objects to sale of e-waste to authorised bodies but selling to scrap dealers or kabadiwalas that do not have an authorisation from the KSPCB is against the law. Experts estimate that if a company is caught selling e-waste to unauthorized bodies, a lawyer could still bail it out as there are no explicit rules for e-waste and e-waste is not defined. Bengaluru has 3 authorised e-waste recycling units. A tracking system is also in place whereby waste disposed through the authorised vendors is documented by filling in form 9 (under the Hazardous Waste (Management and handling) Rules) a copy of this form is then forwarded to the Karnataka State Pollution Control Board. KSPCB has also made it mandatory for all new establishments seeking Consent for Establishment (CFE) to comply with the e-waste regulations. All large companies are now well aware about the regulations regarding safe disposal of e-waste.

The department has recently looked into the use of auctions for profitable sale of e-waste. The department has asked MSTC to ensure that e-waste is auctioned only to authorized e-waste recyclers. They have also explained that authorized metal scrap dealers are not authorized to trade in e-waste. The respective websites of both Matex and MSTC confirms that the KSPCB action has shown results at least on paper. Both Matex and MSTC now mention that only authorised e-waste recyclers can participate in the auction of e-waste. Most measures taken to streamline the management and safe disposal of e-waste seem to have targeted the larger players.

The small and medium scale enterprises are of major concern as they do not take rules and legislation seriously. This fact is also confirmed by KSPCB although they have not yet looked at ways to address the problem. As a first step, KSPCB is in the process of issuing an advertisement in leading newspapers to reach out to other small and medium scale commercial establishments

A.2 Other government agencies

So far none of the other government agencies have taken much initiative with respect to e-waste management. Meeting with the top officials of the BBMP have revealed that there is little understanding of the basic categories of e-waste.

B. Generators

The corporate sector and government institutions contribute largely to e-waste in the form of IT equipment. In addition educational institutions and households are also significant contributors. Within the corporate sector the hardware companies have been looked at with special interest since they are required to take responsibility for the generation of e-waste.

Most large companies have introduced well-defined e-waste management systems. This includes:

- Identification of e-waste generated
- Ensuring proper segregation of this waste
- Disposal of the e-waste through authorised vendors.

B.1 Corporate sector

There is a vibrant hardware industry in Bengaluru. This industry is involved in the manufacturing of electronic equipment ranging from computer systems to

accessories, data communication products and electronic components. The hardware industry in the city is represented by the large multinationals, large Indian companies as also the small and medium scale enterprises. Collectively these companies are represented through MAIT (Manufacturer's Association for Information Technology). The association has been a part of various e-waste initiatives across the country including conducting an audit of recycling facilities in the country and informing their members to ensure that all waste is disposed safely through authorised channels. Currently all the large companies are involved more in R&D and assembly. Hence the e-waste generated from these companies is less. However the hardware manufacturers especially the multinationals have come under considerable pressure to introduce Extended Product Responsibility (EPR) in India

Discussions with Hewlett Packard (HP) revealed that they are unable to introduce such a system in India on account of the large market (estimated to be around 50%) for unbranded equipment in India. The introduction of an Advance Recycling Fee (ARF) would thus put them into a disadvantage with respect to their pricing.

Currently both HP as well as WIPRO has a take back programme for their equipment. However their experience in this programme has not been very good. Currently only a few of their large customers use the programme. The rest simply prefer to sell the equipment as scrap.

The programme offered by both Wipro and HP includes a free pick up of obsolete equipment from their customers. In the case of HP even printer cartridges are included in their take back. HP admits that safe recycling of their products is an area of concern for them. HP which is a part of EWA (The E-Waste Agency) in Bengaluru is considering supporting EWA in its attempt to introduce safe recycling for the informal sector. EWA has already initiated measures in key areas in Bengaluru to identify and support the informal sector. Two associations of the informal sector have been formed. One an association of dismantlers is called EWARD and the other an association of recyclers involved in retrieval of precious metal from PCBs called Eco Bird.

Some companies like Hewlett-Packard (HP) have now introduced a very good system to ensure that equipment, which is donated also, comes back into safe disposal. The company has a MOU with Rotary International, where the end of life equipment, which is mostly computers, is handed over to a specific department created in HP. All sensitive data is removed. The machines are then handed over to Rotary who in turn has an arrangement with Microsoft to refurbish and introduce software into the machine. Appropriate donors are identified and an agreement signed with them. These donors must return the equipment back to Rotary International after it has reached end of life. The reverse flow then takes place to HP.

Cisco Systems, Bengaluru maintains a waste reduction program based on reducing, reusing and recycling. They have a global policy for waste management including e-waste which states that only less than 10% has to be land filled. The e-waste is segregated, stored and sent to an authorized recycler recognized by KSPCB. As mentioned earlier the global programme of Cisco - Cisco Resource Exchange and Disposal Online (CREDO) is used by the offices in Bengaluru to help reduce the quantities of e-waste ending up in Landfills. Some of the products like computers are refurbished and donated to academic institutions, a certain set of instructions are given to the institutions on management of the e-waste generated at the end of life of the products. The company also encourages return on products at the end of life so that it can be recycled in an effective manner. The company encourages employees to bring in waste household electrical equipment including used batteries, CDs, Floppies etc. which is stored and disposed of at regular occasions.

Table 5. Corporate e-waste as categorised by some companies

Product category	Devices
IT Equipment	CPU's, servers, laptops, switching stations
	Monitors, CRT's
	Keyboards, mouses, harddrives, detachable drives, computer housings, printers, scanners, speakers, headsets
	CDs, floppies, Cartridges, tapes
Office Equipment	TV's LCD projectors, VCPs, CD players, Calculators, remote controls
	Shredders, laminators, binders
	Photocopiers, fax machines
Telecom Equipment	Phones, mobiles ,mobile charges
Electrical	Electrical spares, power supply boxes, cables, wires, swiches, fuses, UPS, batteries, cells
Lighting equipment	Fluorescent lamps

Source: ELCIA (Electronics City Association)

B.2 Public Sector:

There are large public sector organisations that are engaged in the manufacture of various electronic components and telecommunication equipment. Surprisingly these large public sector companies appear still reluctant to comply with the e-waste regulations especially with respect to disposal through authorised recyclers. Many public sector companies still use MSTC to auction their e-waste.

Bharat Electronics Ltd., (BEL) set-up to meet the specialized electronic needs of the Indian defense services, has been the first public sector company to initiate e-waste management. Over the years, it has grown into a multi-product, multi-technology, multi-unit company. It is a bench mark company for other public sector as well as private companies for environmental management with very good initiatives in water conservation, solid waste management and energy to name a few. The company has recently initiated a segregation programme to manage e-waste. e-waste is segregated into 4 categories namely -

- Computer and Computer peripherals
- PCBs and electronic components
- Electrical wires/cables, cut wires
- All other electronic equipments

The segregated waste is then recycled at authorized e-waste recycling facilities in Bengaluru. As per government regulations, tenders are called for the sale of this e-waste. Earlier all authorised scrap dealers were invited to take part in the tender. In the present situation the tender is restricted to only authorised e-waste recyclers. Every 3 months around 1 tonne of e-waste is disposed.

BEL officials admit that there is a large gap between the price of the scrap offered earlier which was around Rs 250 /kg. In comparison the authorised dealers are able

to offer just about Rs 30/kg on an average. However, the BEL policy is committed to following the rules, which require them to hand over the waste to an authorised dealer.

The service industry is also a huge generator of e-waste. Take the case of the public sector banks. The top three in Bengaluru are Canara bank (132 branches), State Bank of Mysore (107 branches) and State Bank of India (100). Discussions with the management have ascertained that each bank has a central department that distributes and monitors all the electronic equipment in each branch. However each branch then disposes obsolete equipment individually. So far the mode of operation for each branch is either through direct sale to a scrap dealer or through an auction conducted once a year for different types of scrap. In an auction conducted in 2006, one of the leading banks disposed 500 monitors valued at Rs 1 lakh from the head office. These monitors had been accumulated over a period of 3 years. Most of the officers revealed that it would not be very difficult to comply with the new e-waste regulations including disposal to an authorised vendor. They are unaware about any proper disposal channels and would be willing to comply with the legislation. However, they would need instructions from the top management.

Currently the State Bank of India has two receptacles for safe disposal of dry cell batteries, CDs and floppies. Similarly the State Bank of Mysore also has 1 receptacle for one of its branches.

B.3 Small and medium scale enterprises

e-Waste is also generated from the small and medium scale enterprises that manufacture components. These SMEs also act as suppliers to the large multinationals. In Karnataka there are around 2,000 SMEs engaged in various different manufacturing activities including manufacture of components for the electrical and electronics industry. This includes the PCB board manufacturers and manufactures of other components. The hardware manufacturers especially the multinationals have come under considerable pressure to introduce EPR in India. It must also be noted that SMEs generate e-waste not just from manufacturing but also contribute through extensive use of electronic equipment. If the service sector is included then the potential for generation of e-waste is huge.

Typically most SMEs outsource the management of their electronic equipment to small vendors. These vendors are supposed to supply equipment to these companies and also repair and refurbish old computers. The same vendor is contacted to take back and replace obsolete equipment. Discussions with a vendor revealed that they no longer spend much time in repair. Only basic parts, which need repair, are replaced. Otherwise the equipment is discarded as e-waste. These vendors in turn look for the best rate of return and would therefore sell the equipment to regular scrap dealers. The rate of obsolescence of these SMEs is tagged at 10% which is considerably lower than the larger corporate.

C. Recyclers

In Bengaluru over the last three years and as a result of efforts from the different stakeholders, management of e-waste has slowly become a little more organized and scientific. Thus the city now has three formal e-waste processing units (recyclers) whose processes now conform to safe environment and health standards namely, E-Parisara Pvt. Ltd, Ash Recyclers and the new facility Nishant Technologies. The KSPCB has also authorized these recyclers. Over the last two years extensive work has been done with both the formal and informal sector by NGOs and donors.

However recent studies conducted under the Indo-German Swiss Partnership on e-waste have indicated that the recovery rates for precious metals even by the formal sector in Bengaluru is much below that of smelters in Europe where recovery is done in large industrial integrated smelters and refineries with systems for environmentally safe handling of the critical substances (Refer Box 1). The results provide an estimate of the environmental impacts generated by the current Indian e-waste recycling system and help to identify the processes which are most harmful. They also provide preliminary figures allowing for proposing new business models to divert certain fractions from the informal sector to dedicated industrial smelters, increasing the profitability of all stakeholders. Such an international division of labour could successfully create job opportunities and conserve resources in India, while at the same time utilize economies of scale and state-of-the-art technology to minimize environmental impact and boost metal recoveries.

C.1 e-waste recycling in the formal sector

- **E-Parisara Pvt. Ltd,**

It is an enterprise solution to e-waste recycling technology has pioneered e-waste recycling technology in the country and was the first authorised e-waste recycler in Bengaluru. In the current situation in the city, E-Parisara has made considerable inroads and is now a credible e-waste recycler with many big names as its customers. This includes HP, IBM, GE, Intel, Motorola and Honeywell. Each of these companies has done elaborate audits to ensure that e-waste is managed safely while

BOX 1. Efficiency of e-waste Recycling Operations

The Indo-German Swiss Partnership on e-waste has recently studied the processes carried out in the informal sector of Bengaluru and has compared them with two other scenarios: one of the newly established formal recycling companies in India and a refinery in Europe. The objective of the study was to describe the processes using Material Flow Analysis, to assess the environmental impact and to compare the Gold recovery efficiencies of the 3 scenarios. The results show that the informal sector generates a high environmental impact, as a relatively large amount of chemicals are used for the extraction and are subsequently emitted to the environment without any treatment. The formal sector using different wet chemical processes handled by professionals has a limited impact, which is monitored by local environmental authorities. If both processes may have an advantage on the European smelting process regarding investments and infrastructure requirements, they are largely disadvantageous as for the amounts of toxics involved.

The comparison in the efficiency of the 3 gold-recovery scenarios shows that both Indian recyclers, formal or informal, achieve similar recovery rates between 8 – 18 % of the gold contained in the initial material. The Umicore Precious Metals Refinery in Belgium recovers more than 95% of the gold but also the other precious metals and most non-ferrous metals contained in the PWB, which are lost by the current recycling practices, found in India.

The Material Flow Analysis showed that half of the loss occurs during the manual segregation, during which PCBs are screened for 'apparent' gold and the rest is disposed untreated. The remaining losses are due to the inefficiency of the chemical processes and are disposed of with the residues in the streets or effluents in the inadequate sewage system.

Source: http://e-wasteguide.info/system/files/Keller_2006_ETH-Empa.pdf

also ensuring confidentiality to the company. The facility has initiated occupational health and safety measures for all its employees. E-Parisara now has an annual turnover of 550 tonnes. 50% of this waste is from the IT sector, 30% of this is accounted for by the telecom industry, 10% from R&D and BPO segments and 10%

are miscellaneous. E-Parisara has been working on a B2B (Business to Business) model. It entered into a contract with various companies and purchases the waste directly from them @ Rs 8-10/kg. E-Parisara is now pursuing C2B models (Consumer to Business). As a start waste from households and schools which is collected by Saahas (NGO) is given to E-Parisara directly.

Earlier this year E-Parisara also acquired an export license and recently for the first time sent a consignment of e-waste to Umicore Precious Metals Refining in Belgium. Umicore operates as one of the world's largest precious metals recycling facility. The company offers eco-efficient recycling and refining services for precious metal bearing materials such as by-products from other non-ferrous industries (e.g. drosses, mattes, speiss, anode slimes), consumer and industrial recyclable products (e.g. electronic scrap, spent auto catalysts, spent industrial catalysts, sweeps & bullions).



Photo1. Operations in E-Parisara, Bangalore

Actual economic benefits will only be seen after the material has been examined and evaluated by Umicore. However from the above reports and studies it is clear that the best economic benefit would come if recovery of the precious metal is done in high tech smelters such as that offered by Umicore. There is however the question of logistics in terms of transport of the material which has to be taken into consideration. It is in this context that the informal sector could play a significant role whereby they could use their network to source raw material, dismantle the same upto a point and then sell it to a vendor who could perhaps offer a better price for the same.

▪ **Ash Recyclers**

Ash Recyclers is a Bangalore based environmentally conscious electronic waste recycling organization, which received authorization from the KSPCB at around the same time as E-Parisara in 2005. Its solutions consist of creating a mix of reuse and recycling of electronic waste to have a zero environmental impact and maximize value from the process of e-waste disposal. It is known to encourage second hand sale through retrieval of working components and refurbishing of old equipment through manual sorting of reusable components and dismantling of e-waste to recover useful raw materials. In the Indian context, this aspect also plays an important role since traditionally Indians are all known to try and stretch the life of products and reuse to the maximum level possible.



Photo 2. Operations of Ash Recyclers, Bangalore

▪ **Nishant Technologies**

Recently (May 2007) a third recycler, Nishant Technologies has been given authorisation to operate in Bangalore by the KSPCB. They are yet to start operations.

C.2 e-waste recycling in the informal sector

The informal sector has traditionally been engaged in retrieving material and recycling different waste streams. When e-waste emerged as a new waste stream it was also accepted into the fold of general waste recycling. Previous studies have also shown that most persons working with e-waste recycling are uneducated. They however possess remarkable skills, which include the ability to recognize different types of raw materials. They are also meticulous in their recovery of this material from even small components. The informal units usually operate without a license in residential areas and pose a threat to the surrounding environment and communities.

The **dismantlers** receive large quantities of material, which is always assorted. This material would have been purchased directly through an auction or purchased from a larger scrap dealer. The material includes larger appliances (electrical or electronic) or components like PCB, wires, key boards etc. The procedure followed by dismantlers is the same for all units in Bangalore. Dismantlers work in very tiny units, which are not more than 100 sq feet in area. The material is generally heaped up into one corner of the unit. Workers are then expected to wade through this pile and sort out small portions of the material. After sorting smaller portions each appliance/component is worked upon. Raw materials like plastic, MS, aluminium are removed and kept in different piles. Very often the workers even sit on top of a pile of waste on account of poor planning of the units



Photo 3. Informal e-waste recyclers in Bangalore

A unit engaged in **recovery of precious metal** is also involved in activities, which are similar to the ones carried out by the dismantlers. This includes sorting and segregation of waste. However, here the emphasis is on retrieval of components, which have precious metals like gold, silver, palladium and platinum embedded in its components. Thus the raw material, which they work with, is mostly PCB and other smaller components. Currently these units have a small storage area where waste is sorted and components retrieved. This same area also has chemicals and other materials like mercury used for leaching. The same space also has a furnace for leaching the gold and other precious metals. Most often the containers are not labelled and even kept in the open without proper provisions for an overhead shelter.

No personal protection equipments are used by the workers in the informal units neither is any regard given to safety. There are several incidences of workplace accidents.

Several initiatives have been taken by different stakeholders to work with the informal sector including training programmes on occupational safety measures and emission control. Two associations have been formed a groups of informal recyclers in the city namely - ECO-BIRD and EWARD. This will help them work together and benefit from the combined efforts and funds to upgrade their units.

Conclusion

All in all e-waste management in Bengaluru has moved forward in many ways and

can now serve as a model for other cities and state in the country. The fact that there are possibilities for the informal and formal sector to work together for mutual benefit is especially encouraging. In addition the fact that big multinationals are finally moving towards accepting responsibility for their waste and introducing systems whereby donations are included in the thinking. So far only a few select companies and households have participated so the actual challenge would be to ensure that e-waste management and safe disposal encompasses a broader section of both the corporate world and the general masses.

CHENNAI

The problem of e-waste is increasing in Chennai with the growth in the IT sector in the city. The presence of a major port is another important factor. The city thus generates domestic e-waste and the port of Chennai receives e-waste from other countries.

Toxics Link first conducted a study in Chennai from September 2003 to February 2004, with a primary focus on computer waste because of the massive amounts of dumping of this waste from developed countries. The study identified sources and e-waste recycling hotspots in the city.

The results of a field survey conducted in the Chennai in 2006, to assess the average usage and life of the personal computers (PCs), television (TV) and mobile phone undertaken by Shobhana Ramesh and Kurian Joseph, Anna university showed that the average household usage of the PC ranges from 0.39 to 1.70 depending on the income class and for mobile phones it varied from 0.88 to 1.70.

Considerable quantities of e-waste are reported to be imported⁵. However, no confirmed figures available as most of such trade in e-waste is camouflaged and conducted under the pretext of obtaining 'reusable' equipment or 'donations' from developed nations. The government trade data does not distinguish between imports of new and old computers and peripheral parts and so it is difficult to track what share of imports are used electronic goods.

Recently an extensive study on electronic waste generation and management in Chennai as part of a thesis work at the Anna University has been completed by Shobhana Ramesh which is the first e-waste management study by an academic in the country. Her study followed personal computers, television sets, mobile phones that had outlived their use. On a smaller scale, she also studied the role played by discarded electrical units in creating a hazardous environment.

The information gathered during the examination of the current status of e-waste management among a sample of the generators in Chennai city are enumerated below.

Role & Status of Stakeholder Involvement

Currently the following stakeholders have been identified in Chennai as generators of waste:

1. Manufacturers
2. Assemblers
3. Corporate users
4. Educational institutions

⁵ Agarwal, 1998; Toxics Link, 2004

5. Government organizations
6. Banks
7. Individual consumers
8. Importers of electronic waste

Discussions with the **corporate sector** in the city has revealed that only a few software companies like WIPRO, INTEL, CTS, TCS and COVANSYS have tie up with formal recyclers, others do not have any e-waste policy such as Elnet Software City, which houses few branch offices of software companies and government sponsored software industry developing computer languages in local language and Igp Metal Gaskets Pvt Ltd, a multi crore industrial unit exporting its products to 48 countries including USA. The production is clean and hygienic. But the e waste generated in this company is supplied to a scrap dealer. At present this industry has decided to go for a buy back policy with respect to the computers.

Almost all of the public sector companies are not aware of the dangers of the e waste and do not have a clear policy to handle it.

Educational institutions such as the Government Polytechnic College, Chennai has junk electrical and electronics in their premises, which is currently stored. This is normally auctioned and no one is aware of the fate of the e-waste or the credentials of the scrap dealers.

Discussions with a few banks in the city show some the same system being followed of auctioning e-waste to scrap dealers. Indian Overseas Bank which has a tie up with the computer manufacturers (HCL, WIPRO) by which they replace new computers for the old ones and the manufacturers deliver the old computers as a junk to the scrap dealers for a minimal amount. State Bank of India normally gives the old computers to their own employees for a minimal rate while Bank of Baroda normally give their electrical and electronic wastes to scrap dealers through auction, and have any idea about what the dealers do with these wastes

The **Tamil Nadu Pollution Control Board (TNPCB)**, commissioned the Centre for Environmental Sciences, Anna University, to do an inventory of all facilities generating, importing, storing and recycling e-waste in 2005 (The Hindu, June 11, 2005). The Board observes that the major sources of e-waste in Tamil Nadu are – the software companies, the government, public and corporate sector; PC retailers and manufacturers; secondary market of old PCs; dumping from developed countries and individual households. TNPCB have constituted a five member committee during 2005 to take into account issues related to e-waste management in the state. Periodical stakeholder meetings are organised and the Board has issued Consent to Establish and Consent to Operate to five e-waste recycling facilities in Tiruvallur and Kancheepurm districts of Tamil Nadu. The Board has also stressed the proposed IT Parks promoters to have their own common or individual disposal facility for e-waste. The Board has also put up a request to the State IT Department to included provisions for e-waste management in the State' IT Policy – software companies with ground floor area more than one crore to obtain consent and authorisation for management of e-waste and software companies to ensure that the e-waste generated is disposed to the authorized recyclers as approved by the Board.

Recycling of e-waste

Operations of the informal Recycling Sectors In Chennai

The informal recycling units in Chennai do the business of half processing and recovering of metals including repair, recovery and salvage of metals & precious metals in unhealthy and unhygienic conditions contribute damage to their health and

environment. They do not have valid license for recycling. They use strong acids to retrieve precious metals such as gold. Working in poorly ventilated enclosed areas without masks and technical expertise results in exposure to dangerous and slow poisoning chemicals. The trade in e-waste is camouflaged and is a thriving business in Chennai, which is conducted under the pretext of obtaining reusable equipment by importing and from IT sectors. Recyclers, many of them women and children, melt computer parts with acids, releasing a smoky stream of lead, dioxin and other toxins.

There are many informal recyclers in and around Chennai. These units are located in different parts of the city namely:

1. Rangarajapuram - (residential area)
2. Perungudi - IT high way
3. Thiruvanmiyur - (Residential area)
4. Allandur - (residential and industrial area)
5. Guindy - (Full of industries)
6. Royapettah - (Schools, colleges and hospitals)
7. Saidapet - (residential and commercial area)
8. Triplicane - (residential area, hostels and colleges)
9. Richistreet - (commercial area)
10. Moore market - (commercial area)
11. Paadi - (industrial area)
12. Ambattur - (industrial area)

Note:

- Richie Street – electronics market goods - sold, repaired, refurbished and resold
- Royapuram and Thiruvotriyur – Areas of recycling activities.
- New Moore Market, Chintadaripet, Pudupet –scrap or second-hand goods market of Chennai.

The main areas where the informal recycling units are concentrated are

1. Guind industrial area,
2. Richi street (scrap market)and
3. Thiruvanmiyur situated in the East Coast Road

Observation of these areas has revealed that around 3 – 4 people are employed in each informal unit and they normally receive around 2-3 PC's per day. Discussions with a dealer in Richi Street who has been operating for the past 10 years have revealed that he gets a profit of Rs 15000 to 20000 per month and he has provided nose mask and hand gloves to his employees. The main source of e-waste is software companies through auctions and tenders and there are several loopholes in the tender process, which helps the informal sector.

Economics of e-Waste Recycling

The economics revolves around three main stakeholders in the e-waste recycling business. They are:

1. The importers who have their own e-waste recycling unit, and make the highest profits.
2. The scrap dealers who make profits in the range of Rs 10,000 - 20,000 per month.
3. The workers who work for daily wages ranging from Rs 100 - 150.

Transportation of e-waste

e-Waste is being transported in all possible ways including open trucks, fish carts, and other public transport vehicles. The wholesale scrap dealers either take these materials which are auctioned or collect from illegal agents and send them to small informal recyclers.

Operations of the Formal Recyclers In Chennai

TNPCB has given the recycling license to five of e-waste recyclers in the city namely

1. Trishyiraya Recycling (India) Pvt Ltd
2. INAA Enterprises
3. AER world wide (India) private Ltd;
4. Ultra solution (I) Pvt. Ltd.
5. TESAMM Recyclers (I) Pvt. Ltd.

For a city like Chennai where voluminous quantity of e waste is imported and handled having only four authorized E waste handlers is insufficient.

The e-waste processed by the formal unit include computers, fax machines, printers, refridgerators, microwave ovens, telephones, scanners, TV and washing machines. About 1000 tons of e-waste is processed every year by a formal recycling centre. The waste is obtained from software companies and is segregated by type. The average composition of two truckloads consists of 61% of iron scrap, 26% plastic scrap, 6%shredded pieces, 4% glass and 1.1% of cartons by weight. The circuit boards from all electronic items are categorized into four types:

- **Type A** - Boards with gold-coated pin connectors - Motherboard, circuit boards in hard disk, RAM, VGA, mobile phones.
- **Type B** - Boards with 80%Integrated circuits, (IC's) - Fax machines, printers, and EPBX boards.
- **Type C** - Boards with 50% IC's – Monitor, mouse, keyboard, phone boards.
- **Type D** – Board With 20% IC's-Circuit boards in televisions, power supply unit boards. The, plastic scrap, shredded pieces copper and the aluminium were exported for better returns. Iron scrap is sold to the iron smelters, and the glass to the CRT manufacturers. Rubber and phosphorus are accumulated at site due to lack of disposal methods.

At present only one formal recycling centre of recycling capacity of 1000 tonnes per year is in operation in Chennai. An authorized recycling centre revealed that the required recycling capacity for profitable recycling is 5000 tonnes per year. Fourteen recycling centres with a recycling capacity of 20,000 tonnes per year are required to manage the wastes for the next ten years.

TRISHYIRAYA Recycling (India) Private Limited

They are in operation for the last seven years (Pre-Processing). They are recycling all electronic and some electrical devices. The Govt. of India, Ministry of Commerce, has approved Trishyiraya as 100% export oriented unit. Their production has increased from 200 T/year in the year 2004 to 1000 T/year in the year 2007 with an annual turnover of 5 – 6 crores.

They are collecting the e-waste from all major multi national companies. Foreign MNC'S give e-waste free of cost but some Indian MNC'S charge them for collecting their company's e-waste. Some of the clients are CTS, INTEL, DELL, TCS, and COVANSYS etc. They are getting scrap from Chennai Port Trust and Customs department as well. They have received all relevant certificates, licenses and clearance from the Ministry of Commerce, TNPCB, CPCB and MOEF. They are heading towards ISO 14001:2004.



Photo 4. Operations of Trishi Raya, Chennai

The facility has its recycling unit in Chennai (MEPZ) and collection units at Pondicherry, Madurai, Bangalore, Mumbai and Jodhpur. Their future plan is to start a recycling unit in Rajasthan and in Gujarat. They are exporting their products to Europe satisfying all the Government norms. In Europe (Belgium) their clients, collect the product and send it to their recovery unit where they recover copper, silver, gold and aluminium and treat the slag in an eco-friendly manner. It costs around Rs. 80 crores to start this type of recovery unit in India.

They have provided all safety measures for their employees, such as the sensors, which sense any leak of hazardous gases, the noise level and frequently update the quality of air in their shop floor. They have insured for all their employees and have got all relevant license, certificates and approvals.

ULTrust Solutions (I) Pvt. Ltd.

Started in June 2002, they are engaged in the collection, recycling and safe disposal of electrical/ electronics scrap. It is equipped with state of the art technology to effectively dismantle and dispose computer and other electronic scrap in a safe and environment friendly manner. The various computers and electronic scrap are collected, segregated into corresponding groups and destroyed according to strict safety regulations.

It provides following services

- One-Stop Solution for Complete Electronic Waste Management
- Collection of electronic waste from anywhere in India.

They have a yearly turnover of about Rs. 1.5– 3 Crore. Some of their major clients are TCS, and COVANSYS.

AER World Wide (India) Private Ltd

Started in 2001 in India, they have been in the business for the last six years. They recycle all electronic devices and electrical devices, by collecting the e-waste from all

major multi national companies. They have 15 employees in their recycling unit. They have got all the relevant certificates, licenses and clearance from Ministry of Commerce, TNPCB, CPCB and MOEF. They have a production capacity of 200 T's/year (2007) from 50 T's/ year (2003). The yearly turnover is Rs. 1-2 crores. Their major clients are HCL, TCS and IOB.

Conclusion

As many IT giants and electronic goods manufacturers have set-up their production facility in Chennai, the Government should make them responsible in treating their waste in a Environmentally Sound manner. E waste is being imported into the city through both the official route and also the unofficial route. The people of Chennai, especially the students and the IT professionals must be made aware of the dangers of these E wastes and separate E waste Collection Centre should be provided for consumers. Formal recyclers must work with the regulatory authorities and improve their recycling process. It may not be possible to eradicate the informal recyclers immediately; instead an informal sector inclusive model must be initiated.

DELHI

Delhi, the capital city of India, is the hub for e-waste recycling activities. There being no authorized formal recycler in Delhi, dismantling and recovery of precious materials from e-waste is carried out by the informal sector. IRG in 2004 observes that in Delhi a five step value cycle is followed covering aspects such as:

1. Generation and Stockpiling. Different economic actors purchase, use and then stockpile or discard electronic waste. These range from manufacturers such as MNCs to large and small businesses, households, institutions and non-profit organizations.
2. Collection. This is carried out by the informal sector, as well as by the IT companies themselves.
3. Handling and Brokering
4. Processing
5. Production

The study estimates that the total number of PCs dismantled in Delhi's market are 1274 and 941, considering 5 and 7 years of obsolescence respectively, with the assumption that the weight of each PC is 27.21 kg.

There are no formal e-waste recyclers in Delhi. Majority of the work is done by the informal sector. A snapshot of the major locations in Delhi where e-waste dismantling and recycling is carried out is enumerated below.

Scrap Market

1. Turkman Gate

Turkman Gate is one of the biggest scrap markets in Delhi known for E-Waste. Turkman Gate is the area where e-waste comes in large quantity especially computer waste. There are some formal and informal collection systems for e-waste in the scrap trading mechanism at Turkman Gate. The Response for structured discussions was not encouraging in this grey market for e-waste. A few respondents shared some information while others were hesitant to respond. Most of the

discussions were held at a place slightly away from scrap shops. These scrap dealers collect e-waste from closed factories, running factories, government and private offices. Mode of conveyance is either tempo or three wheeler or six wheeler i.e. Truck. It depends on quantity of scrap available. Frequency of E-Waste collection for big deals varies from 1-3 months. Three wheeler delivery vans are also quite frequently used. From informal sources, it was learnt that scrap dealers collect e-waste informally/illegitimately through these delivery vans. These three wheeled delivery vans carry 600-700 kg each approximately.

Disassembling processes are being carried out in this area but not in open. Cellular e-waste is not visible in this scrap market.

2. *Mayapuri*

Mayapuri scrap market is known for e-waste and scrap of automobile sector. This is the only legal scrap market where scrap trading is done through official process like tender or auctions. Discussions were open and responses were constructive. The e-waste comprise of electrical components like heaters, geysers, electrical motors, compressors, fridge, air conditioners, etc and electronic components like computers, printers, electronic typewriters, tape recorders, fax machines, telephones, television sets etc.

They do not have any conceptual separation for the scrap material as they treat all scrap as a unified one. The frequency of e-waste collection is random. It varies from days to weeks and weeks to months. Collection frequency depends on the quantity of scrap available in the market through tenders or auctions and also depends on the financial position of the scarp dealers at a particular point of time. If the scrap dealers ran out of money for bidding tenders then as per the tendered value dealers come together and bid collectively so that everyone will get the business. Depending on the quantity of the scrap, collection of the e-waste is done through truck or tempo only.

These scrap dealers have been operating from last 15-25 years in the e-waste area. Their shift to handle various type of scrap is natural as per the latest trends in technology which brings new electronic and electrical items. The response regarding cellular e-waste is not encouraging at all. The scrap dealers hardly get any quantity of it. Presently, they prefer computer waste than mobile phone waste as they get better profit margin and with good recoverable items from computer waste. They are not in position to tell about mobile phone related e-waste due to fluctuating flow and lesser quantities of cellular e-waste.

3. *Old Seelampur*

Old Seelampur is one of the biggest retail markets of electronic and electrical scrap trading. Old Seelampur market is operates informally. During visit for structured discussions there was a taut resistance from the scrap dealers. Due to this reason, discussions remained incomplete during the two visits. During the third visit, efforts to gain the confidence of some respondents paid off. Even these respondents were slightly hesitant to share all the information. During discussions it was felt that they were trying to conceal the information and had some fear in their minds. After assuring that this study is not going to affect their business, the discussions started in a comparatively amicable situation.

They collect all type of scrap especially computers, printers, or their components like hard disk, CD Rom, monitor, mother board, other circuit boards, SMPS, etc. Collection of e-waste is done through all possible sources like repair shops, service centers etc. through their own scrap collectors or daily scrap hawkers. The other sources of e-waste collection are the different states in India through the scrap

traders' known sources (agents). They go to these states for their personal work simultaneously they purchase e-waste and send the same through transport to Delhi. Whenever companies want their scrap material to be cleared off, they just call these scrap dealers and the deal is fixed after inspecting the scrap. This e-waste is transported through trucks or tempos depending on the quantity.

After collecting e-waste, they either simply sell it with some profit margin or the parts, which fetch them a good profit, are separated and sold with higher margin. Regarding separation facilities, they tried to cut short information and tried to mislead. These scrap dealers get the mobile phone waste occasionally. However it is known that some of these scrap dealers collect circuit boards of mobile phones from repair shops and sell on per kg or per piece basis. Contrary some of the mobile or computer repair shop mechanics used to visit these scrap dealers to check whether they get any useful circuit board or any other parts. The price of mobile phone circuit boards is based on bargain.

They are sold on per kg basis or per piece basis. The price range for circuit boards varies from Rs. 50 – 200 per piece or Rs. 200-400 per kg. These scrap dealers have been working in this area from last 10-20 years. They are in this business right from the initial setup of the business. Previously they used to deal with e-waste of electrical and electronic equipments as per the market trend of these items at that time. The scrap business shifted from electrical items to black and white televisions, and later changed to color televisions and other electronic equipments. Presently, they deal with computers and in future they may switch over to mobile waste as per the market demand. These scrap dealers get good business in dealing with e-waste related items. Since they have been continuing this business for a long time, they do not want to switch to other scrap trading business.

These scrap dealers / junk dealers do not carry any concern about environment and safe handling of e-waste. Besides trade in scrap, they also dismantle the e-waste in concealed locations. Although they deal with e-waste, computers in general, they hardly get any cellular e-waste now-a-days except very small quantities a few times in the year.

They expect to get cellular e-waste in the future; still they prefer computer waste which is better in scrap trading due to its size and large amount of recoverable materials like metal, electronic components, plastic, etc. compared to cellular phones. One respondent revealed that there are some places like Nalah where copper is extracted from open wire burning. These activities are being carried out during night only.

The main reason behind reluctance to discuss is the fear that their business may get affected or in worst situation it may get closed down. Previous studies by various groups regarding e-waste, which revealed the practices of scrap dealers very critically, have made them skeptical and it is really hard to get the requisite information from them amicably. They revealed that some photographs and video shootings were taken by previous groups showing the mishandling of e-waste by them which with adverse environmental consequences and health hazard to workers engaged in these activities.

Exposure of their practices through media and other green advocacy groups made their life difficult and worrisome. Another fear that haunts them is the sealing drive by Municipal Corporation of Delhi (MCD). These fears made them more sensitive and less responsive to the queries by study team.

4. Shastri Park

Shastri Park is known for trading and disassembling of e-waste especially computers.

Generally, e-waste/scrap material like computers and other equipments come from Old Seelampur for dismantling and further processing. The response from Shastri Park is almost similar to Old Seelampur. There are some concealed trade links between Shastri Park and Old Seelampur in e-waste business. During disassembling process, breaking and separation of each and every part of computer and its accessories like mother board, monitor, printer, hard disk, floppy disk, CD ROM, SMPS, etc. is carried out. The sellable carried out in Muradabad and Loni in Uttar Pradesh as this process is legally prohibited in Delhi due to Pollution Control Norms. It was revealed that extraction processes are being carried out informally within the closed house premises during night only.

As far as cellular e-waste is concerned, a very few shops in Shastri Park deal in circuit boards of mobile phones. Generally, most of the customers include repair shop mechanics. During discussions, dealers were not ready to talk regarding the source of circuit boards of mobile phones but it is expected that they may be getting such scrap from cellular repair shops.

Recyclers

There is not authorized recycling facility for e-waste in Delhi and its vicinity. Recycling or, to be precise, dismantling of e-waste is carried out illegally in Delhi due to pollution control norms set by the statutory authorities. These activities are mainly carried out informally in the places like Shastri Park, Old Seelampur etc. However, major activities are carried out in Uttar Pradesh. The areas like Loni, Muradabad, Mustafabad, Meerut etc. are the places where most of the recycling/dismantling processes are carried out illegally and mostly during night time. Photographic evidence could not be furnished as recyclers/dismantlers did not allow getting inside the recycling/dismantling premises. The resistance from these recyclers/dismantlers made the structured discussions difficult.

However, some indicative information was gathered. There is no provision of protective measures for workers in the recycling/dismantling areas. All the work is done by bare hands and only with the help of traditional equipments like screw drivers, hammers etc. The dangerous chemicals like Sulphuric Acid and other similar acids are being used for extraction of the metals. The metals like copper and gold are being extracted especially from the mother boards of computers in very unsafe manner. There was no indication of any recycling/dismantling of cellular e-waste. Recycling/dismantling operations are either carried out by old men, children or women. Mostly women and children are involved in these operations.

MUMBAI

Mumbai is the business and financial capital of India and is also a large port city. Mumbai's attraction for banks, investors and financial institutions and a large population make it a major consumer and disposer of electronic products. The Greater Mumbai Region is one of the most industrialized pockets in the country with a large number of electronic and electrical good manufacturers as well as their ancillaries located in the industrial areas in and around Mumbai.

Table 6. e-Waste from PCs in Mumbai using Market Supply and Marker Supply Method

Year	Weight (in Tonnes)		
	Market Supply Method	Market Supply Method A	Average
2007-08	12,606	10,729	11,668
2008-09	7,597	10,941	9,269
2009-10	12,296	10,863	11,580
2010-11	16,599	11,018	13,809

Source: Toxics Link (2007)

Major Sources of e-waste in Mumbai are

- Banking and financial services sector
- Government Offices
- Manufacturing units
- Service Centres and repair shops
- Imports

2.2.3 Current system of tracking entry of e-waste imports

Field surveys and interaction with the Traffic Managers at the major ports of Mumbai and Chennai were conducted. Discussions with relevant officials of the Director General of Foreign Trade were carried out.

Import of e-waste is legally prohibited in India. There are reports of e-waste imports in India e.g. Toxics Link report: Scrapping the Hi-tech Myth: Computer waste in India, Feb 2003. The Ministry of Environment & Forests admits that a 100% control of the borders is not possible. Therefore there are possibilities of import of e-waste.

As per the amended Hazardous Waste Rules 2003, the state Pollution Control Boards will examine applications for import from importers and forward such applications with its recommendations and requisite stipulations for safe transport, storage, processing and disposal to the MoEF. The earlier existing gap has been filled and the approvals will follow a sequence from SPCB to MoEF, then to the Directorate General of Foreign (DGFT) and Customs. The following two tables are excerpts from the minutes of EXIM Facilitation Committee meeting where imports of e-waste have been denied by DGFT.

Table 7. Decision of DGFT to restrict import of e-waste

Name of Firm	Item of import	Decision of EFC NO.3/AM07- 04/10/2006
Reliance Communications Infrastructure Ltd., Mumbai. 1/53/8/134/R-17/AM07	Second hand handsets- 10000 Nos.	The Committee rejected the case since import of such items will result in dumping of e-waste into the country.
Ezeemobile, Mumbai. 01/53/8/186/E-19/AM07/ILS	1500 units of CDMA Mobiles refurbished Cellular Phones	Committee rejected the case since allowing such import may lead to e-waste dumping

Source: Minutes of EFC Meeting held on 4 October 2006. Website of Director General of Foreign Trade⁶.

⁶ http://dgftcom.nic.in/exim/2000/committee/meet_rilc_0107.htm

Table 8. Decision of DGFT to restrict import of e-waste

Name of Firm	Item of import	Decision of EFC No. 1/ AM07 dated 25.04.2006
M/s. Sri Viswaroopa Electronics, Madurai. 01/53/162/1570/S-78/AM06/ILS	Second hand/used Monitors – CIF value Rs. 6,00,000	Committee decided to reject the case on the basis of recommendation of Dept. of IT that the import of these items will have adverse impact upon domestic industry and concern of e-waste dumping.
M/s. Sri Viswaroopa Electronics, Madurai. 01/53/162/1569/S-79/AM06/ILS	Used T.V. sets. 266 – CIF Value Rs. 2,16,080	Committee decided to reject the case on the basis of recommendation of Dept. of IT that the import of these items will have adverse impact upon domestic industry and because of concerns related to e-waste dumping.

Source: Minutes of EFC Meeting held on 25 March 2006. Website of Director General of Foreign Trade⁷.

Chennai Port Trust

Following are the procedures that have been followed for importing **scrap i.e; electrical & electronic wastes (in the name of scrap)**.

Even though it has been stated that we can't import computer parts in India by showing it as Scrap, people are importing not only computer wastes but also all types of e-wastes. Though import of e-waste is banned into India, it still comes in along with mixed metal scrap. The port trust official seems to be un-aware of the entire issue. They also do not have any control over what happens to the mixed metal scrap after it lands in the port. There seems to be no proper records of total metal scrap being imported and the constituents of the same.

No medical check ups are carried out for the labourers handling these mixed medical scraps. Also the labourers themselves are not very open to medical tests as they are worried about losing their job. Though there exists a provision for compensation for the labourers from the government in case they are detected with any diseases, they are not aware about the same.

Table 9. Quantum of Waste imported in India

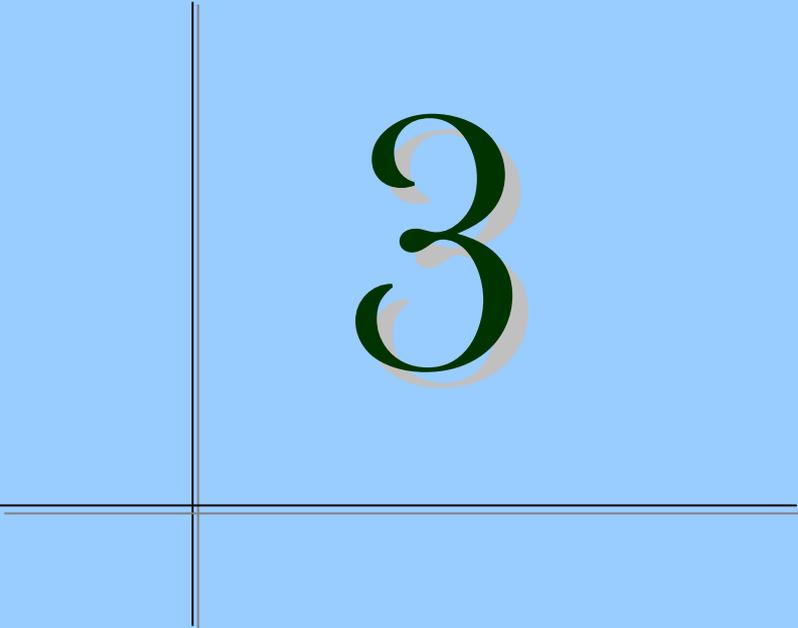
Sl.No	Period	Quantity (Lakhs)
1	2003 – 04	2.18
2	2004 – 05	2.75
3	2005 – 06	4.92
4	2006 – 07	1.44

Source: Indian Ports Association

⁷ http://dgftcom.nic.in/exim/2000/committee/meet_rilc_0307.htm

The data obtained from the Indian Ports Association clearly shows that approximately 11244'000 Tonnes of unnamed components have been imported through other Cargo in Chennai Port. (Traffic April – March 2007) Thus, from the above table we can deduce that the quantity imported for the year 06 – 07 is not true. Either the data given by the higher official is incorrect or the cargo that carries the metal scrap is illegally imported.

It should be noted that there are neither norms nor regulations for importing this e-waste because it is not imported in the name of e-waste. It cannot be restricted unless a separate scanning process for this e-waste is in place.



3

3.0 e-WASTE MANAGEMENT INITIATIVES

3.1 Understanding the key Stakeholders for e-waste management in India

Regulatory Bodies

In India organizations or bodies have been constituted under different acts and regulatory/legislative support to safeguard the environmental and as regulators for various trades which directly or indirectly effects the environment and general health.

These bodies are:

1. Ministry of Environment and Forest (MoEF)
2. Central Pollution Control Board and state Pollution Control Boards

Industry Associations

NASSCOM

The National Association of Software and Services Companies (NASSCOM) is India's premier trade body and the chamber of commerce of the IT software and services industry in India. NASSCOM is a truly global trade body with around 850 members, of which nearly 150 are global companies from the US, UK, EU, Japan and China. NASSCOM's member companies are in the business of software development, software services, and IT-enabled/BPO services. NASSCOM was set up to facilitate business and trade in software and services and to encourage advancement of research in software technology. It is a not-for-profit organization, (funded entirely by its members) registered under the Societies Act, 1896. NASSCOM has been the strongest proponent of global free trade in India. NASSCOM is committed to work proactively to encourage its members to adopt world class management practices, build and uphold highest quality standards and become globally competitive. In India and around the world, NASSCOM members are participants in the new global economy and are reputed for their cutting-edge business practices and social initiatives.

MAIT & OTHER ASSOCIATIONS/AGENCIES

Manufacturers' Association for Information Technology (MAIT) was set up in 1982 for purposes of scientific, educational and IT industry promotion and it is emerged as an effective, influential and dynamic organization. Representing actively Hardware, Training, Design/R&D and the associated services sectors of the Indian IT Industry, MAIT's charter is to develop a globally competitive Indian IT Industry, promote the usage of IT in India, strengthen the role of IT in national economic development and promote business through international alliances. The organization's special focus is on domestic market development and attracting foreign investment in the Indian IT Industry. MAIT is represented on all concerned Government of India forums and works in close association with the Department of IT, Ministry of Communications & IT, Ministry of Commerce & Industry, DGFT, Ministry of Finance, NCAER, BIS, ESC, NIC, STQC, CII, TEMA, ELCINA, CETMA, etc. for the advancement of the IT Industry in India.

Non-Governmental Organizations

NGOs like Toxics Link, Saahas etc. are working in a major way on e-waste management initiatives in different parts of the country in association with donor agencies and IT companies and industry associations.

Consumer

Consumers sector contributes to the major share of e-waste comprises of the following categories as mentioned below.

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.

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 a sizable amount of total installed PCs. Hence they are the major producers of obsolete 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.

Manufacturers and Retailers

Manufacturer 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.

Imports

Among the highest 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. Existence of international as well local trade network and mushrooming of importers of old computers in far flung areas indicate the huge import of obsolete technology in India.

Traders / Scrap dealers / Dissemblers

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 electronic items. Immediately after securing computers from various sources, scrap dealers face the dilemma of deciding which item 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 item components find their way to the storehouses for dismantling. Sometimes, even an item meant for direct reuse may ultimately end up in the storehouse as dealers cannot wait long for a prospective buyer.

Recyclers

The e-waste recycling market is not concentrated in a single place, but spread over different areas, each handling a different aspect of recycling. In spite of the absence of proper technology, each component is disassembled and recycled or reused. The general practices observed in India 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.

3.2 City Initiatives

▪ Bengaluru

e-Waste initiatives in Bengaluru are supported by the Indo-German-Swiss Partnership for e-waste along with cooperation from the Government, Industries and recyclers. The programme includes dissemination of knowledge, seminars for awareness creation, and study on the existing situation in Bengaluru, establishing cooperation from NGOs and Government in e-waste management. It also looks into bringing in technical support for recyclers for the uplifting of informal recyclers.

▪ Mumbai

Mumbai, the financial nerve-centre of India, is also India's largest port city and manufacturing hub of the country. As a result, Mumbai is not only the port of import for new and used electronics but also home to large user and manufacturer generating large volumes of e-waste.

Toxics Link, UNEP and MPCB jointly conducted a four-month period awareness campaign in schools & colleges in Mumbai in 2006. The campaign aimed to create awareness on the hazards of e-waste, the importance of safe and environmentally friendly management. It highlighted the critical role of different stakeholders, especially household consumers as well as stimulates greater efforts of the government in environmentally friendly e-waste management. In addition, a stakeholder workshop that brought together consumers, producers, governments and NGOs to chart a way forward.

▪ Delhi

Municipal Corporation of Delhi (MCD) in collaboration with Confederation of Indian Industries (CII) conducted a workshop on the development for an institutional framework for handling of electronic waste. The workshop was organised to evolve a system of disposal, and manufacturer's responsibility for recycling of the waste on the 23rd of November 2004. (Delhi news line Nov 2004).

3.3 Major Initiatives in India

▪ Indo-German-Swiss Partnership for e-waste

The Indo-German-Swiss Partnership for e-waste, has been working with the informal recycling sector to improve their techniques and processes and prepare them for a more formalised role in the future. Several training and workshops have been organized to develop interest among informal recyclers and share experiences with their counterparts and improve the network.

The overall vision of the project is to reduce environmental degradation and to extend income generation opportunities through improved e-waste management. The project's purpose is to provide improved technologies and skills for e-waste recycling systems in India and improve working and living environment of urban dwellers working in the (informal) e-waste recycling sector through identifying and presenting sustainable alternatives to “backyard” e-waste recycling while strengthening links between partners globally to exchange best practices, policies and technologies. The initiative was to establish suitable collection, recycling and disposal systems, substitution or minimization of toxic substances in production and product design, development and enforcement of adequate policies and regulatory systems to make environmentally and socially responsible e-waste recycling viable.

An online e-waste guide has been developed under this programme to serve as a current and definitive information resource on the issues, problems and opportunities created by e-waste, focusing on the present scenario in India. The guide also serves as a common collaborative work platform for various e-waste initiatives underway across India, with linkages to similar initiatives around the world.

Under the aegis of the Indo-German-Swiss partnership initiative an e-Waste Agency (EWA) was formed to bring together industry, government and NGO to work on a sustainable e-waste management strategy for Bengaluru⁸. However, the agency hopes to function as a role model for the setting up of similar associations in other parts of India. The main activity was to develop a ‘Clean e-waste Channel’, which included developing of training modules for several stakeholders, uplifting the informal recyclers, drafting guidelines for the handling of e-waste and increasing awareness in the field of e-waste. EWA has already put forward a proposal before the MOEF to enact legislation on e-waste.

A profitable environmental management-training programme (PREMA) was carried out with a small group of informal recyclers in Bengaluru who have formed an association called ECO-BIRD.

- **FICCI**

A report by FICCI in 2004-2005 explains that e-waste management in India is quite a task since there are no accurate estimates of the quantity of e-waste generated and recycled and no national level policy to manage it. The FICCI reports say that Delhi alone generates 9729.15 tonne of e-waste annually⁹. Constituents of e-waste products like circuit boards, cables and computers can have several adverse effects on health like damage to the central nervous system, liver and kidney damage and muscle weakness.

- **Toxics Link** along with GTZ and EMPA has devised a workable e-waste recycling model through another consultative process. The model recommends a very important role for the manufacturers and producers of electronic goods. Refer Section 6.3 for more details on the models.

- **The Energy Resource Institute (TERI)** with support from the European Union had undertaken studies on the health impacts of e-waste recycling activities in partnership with various non-governmental organizations, independent bodies and governmental bodies - including the Indian Ministry of Environment and Forests (MOEF) and the Central Pollution Control Board (CPCB).

⁸ www.ewa.co.in

⁹ www.ficci.com

The main objective of the program was to make recycling of computers more efficient, ensuring that no part of the computer is wasted and ensure standards that are environmentally friendly. An additional factor was to ensure protection of workers exposed to the various radioactive fumes emitting from the e-waste they handled. The project began in December 2005; TERI has since brought in experts from Europe to begin training Indian institutions in efficient recycling practices. The project has also partnered with advisers from the University of Dresden in Germany and the University of Crete in Greece.

- **Saahas**, a NGO based in Bengaluru, is working on various models to enable participation of the industry representatives in the e-waste management. The organisation is also coordinating the collection of used dry cell batteries, CDs and floppies in Bengaluru from schools, corporate offices and public areas and transporting them to e-Parisara, a registered recycler, for disposal. Saahas has also undertaken a study in Bengaluru to assess the e-waste situation.
- **Manufacturers Association for Information technology (MAIT)** together with GTZ, the German Technical Cooperation agency has undertaken a e-waste assessment study, conducted by the e-Technology group of India's leading market research firm IMRB International this year. This is a survey of over two hundred corporate houses and close to four hundred households to map their e-waste management practices. The study identifies stakeholders in the e-waste value chain including the profile and practices of the formal and informal recycling facilities in the country with focus on Delhi (NCR), where the largest proportion of e-waste is recycled/processed.
- **WIPRO:** is the first Indian computer maker to offer products that are RoHS compliant. It has introduced new PCs that are RoHS compliant. The RoHS directive, adopted in 2003 by the European Union, went into effect in July 2006. This directive restricts the use of six hazardous materials in the manufacture of various types of electronic and electrical equipment. Wipro's entire PC line will be RoHS compliant by the end of the year 2007. The company has promised to phase out the use of some hazardous chemicals still used in its products by 2009, including a brominated flame retardant and polyvinyl chloride. These chemicals are not covered under the RoHS directive. In September 2006, the company announced an e-waste disposal program for its customers¹⁰. The service allows any customer to return old PC to Wipro for recycling on payment of applicable freight charge. The company has tie-ups with three authorised recyclers—Ash Recyclers and e-Parisaraa in Bengaluru and Trishyraya in Chennai.
- **Acer:** This Company has launched an e-waste management initiative. Customers can put in a request online with the serial number of the old Acer machine they want to send back, and the rest is taken care of by the company. The company charges a recycling fee of Rs 1,000 per PC. The company has tied up with eParisaraa, which recycles customer take-backs while Trishyraya manages the manufacturing rejects from Acer's Pondicherry plant¹¹.
- **HCL:** HCL Infosystems Limited, India's largest PC manufacturer, announced the unification of its various environment protection initiatives under the comprehensive 'HCL eSafe' program during October 2007. The pronouncement of HCL eSafe program was marked by launch of a new line-up of 'HCL eSafe' desktop PCs that are compliant with RoHS directive. HCL is also the pioneering company in India to have

¹⁰ June 14, 2007 — IDG News Service

¹¹ Indian Express Newspapers (Mumbai) Ltd 2006

set-up a comprehensive e-waste management program for its manufactured products through a tie-up with an authorized recycler.

The HCL eSafe program will include several new public awareness initiatives targeted at informing various stakeholders about the impact of e-waste and their responsibility in its mitigation. One such direct initiative is targeted at increasing awareness among school children — the future generation of PC users — about the environmental impact of e-waste. The program directed at schools engages & educates the children with the help of specially designed and created literature on the importance of protection of environment and how they play a very significant role in protecting it. Another campaign aims to build customer awareness through HCL's channel partners and its retail outlets.

HCL eSafe will complement the company's long-running 'HCL Best Assured' campaign, which seeks to raise awareness about the unauthorized imports of old and counterfeit PC components into the country. HCL is also engaging with various stakeholders including industry associations, government bodies, partners and suppliers in support of a suitable legislation or framework for environment protection in the country¹².

- **WeP Peripherals:** has a cartridge range called Green that is made from recycled cartridges. The company collects dead DMP cartridges and use them for manufacturing the Green range of products. The company also has a reward programme for customers buying green products, where customers get 20 percent discount on a new cartridge for returning the old one. To create awareness among end-users, WeP has set up 60 e-waste collection centres in Bengaluru at housing societies, commercial buildings and shopping malls. These centres even collect non-WeP products like CDs, floppies and batteries and send them to an authorized recycler like E-parisara.
- **Hewlett-Packard:** The HP Planet Partners Hardware Return and Recycling Program offers to take back end-of-life HP computer and printing hardware products. This initiative offers customers an option to dispose and recycle of used computing equipment in a socially and environmentally responsible manner.
- **Cisco:** Cisco Resource Exchange and Disposal Online (CREDO) is an in-house virtual electronic equipment exchange where Cisco staff from all over the world can purchase equipment they need internally, and post equipment that's no longer in use and help in scrap management. The ultimate goal is to prevent any Cisco equipment or parts from ending up in landfills.

3.4 Gaps in Existing Initiatives

Despite several initiatives taken by different stakeholders there has been a slow start of Environmentally Sound Management of e-waste in India. There are several reasons for this including:

☞ **Government Apathy**

Despite pressures from NGOs and demand from industries for legislation on e-waste, the government has not shown any intent. Now due to the building pressures, both from internal and external agencies, the CPCB has come out with the draft guidelines

¹² www.hclinfosystems.in/news92.html General Press Release October 2007

for Environmentally Sound Management e-waste for the entire country¹³. In this regard, consultations with various stakeholders are underway.

☞ **Lack of authorised e-waste Recyclers**

There are only 4-5 formal recyclers operating around the country today. The rest are all in the informal sector. This has severely constrained IT companies and agencies in formulating and executing their own e-waste recycling policies.

☞ **Lack of awareness**

Lack of awareness both at the user end and the manufacturing sector has resulted in ineffective implementation e-waste management. Interestingly even IT channels are unaware about the hazards of e-waste. Only a few companies have heard about the concept of e-waste, and still fewer have some idea of their vendors' initiatives.

☞ **Inadequate implementation initiative**

The IT sector is taking small steps towards dismantling e-waste through the organised sector. IT companies are bypassing the proper procedures to deal with their obsolete hardware products through donations and the unorganised sector.

There is no doubt that e-waste is a clear and present danger and the industry as a whole needs to join hands in tackling the issue. The associations need to raise the pitch for policy on the matter; vendors need to show more commitment in executing their initiatives by proactively educating customers and channels by establishing a network between the vendor and customers that will play an important role in spreading the message against e-waste.

3.5 Capacity Building & Awareness Initiatives of DA

Action on ground involving youth especially the school children has been taken up to raise awareness. As part of DA's on-going programme called the **Community Led Environment Action Network (CLEAN-India)**, DA and Saahas, a NGO based in Bangalore, have initiative a e-waste collection system from selected schools and shopping malls around the city. The collected batteries, CDs and floppies are been transported to e-Parisara, a registered recycler, for disposal. In association with WeP Peripherals, a company that provides IT peripheral products and solutions and printing services, these e-waste collection bins have been placed at various public places and schools around the city of Bangalore. Also refer section 6.2.

A poster on e-waste hazards and management has been prepared for creating awareness to the general public (Refer *Annex I, separate enclosure*). Flyers on e-waste management are being finalized (Refer *Annex II, separate enclosure*). A public awareness animation film on e-waste management has also been prepared.

3.5.1 Training of Informal Recyclers

DA is collaborating with the Indo-German-Swiss Partnership for e-Waste to facilitate restructuring of the informal recycling units in Delhi and Bangalore.

DA has been working with HAWA, GTZ and EMPA to build capacities of the informal recyclers in Bangalore. The main objective of this programme is to implement improved dismantling and recycling methodologies and to assist the informal sector in acquiring authorization of their recycling units. In this regard, a draft manual for

¹³ <http://www.cpcb.nic.in/docs/e-waste.html>

trainers on good house-keeping measures and use of personal protective equipments is currently being prepared. For this DA is collaborating with Saahas, a NGO based in Bangalore. A draft manual for trainers on good housekeeping measures in Small Scale e-waste Recycling Units is also being prepared. On the other hand, in Delhi DA, in association with GTZ-ASEM, is facilitating implementation of an informal sector inclusive model for e-waste management with groups of informal recyclers engaged in dismantling and cable stripping activities.

Regular training and awareness workshops on the importance of personal protection equipment (PPEs) and their use are being organized to encourage the recyclers to adopt safer measures.



Photo 5. Training of Informal e-waste recyclers

3.5.2 South Asia Cooperation

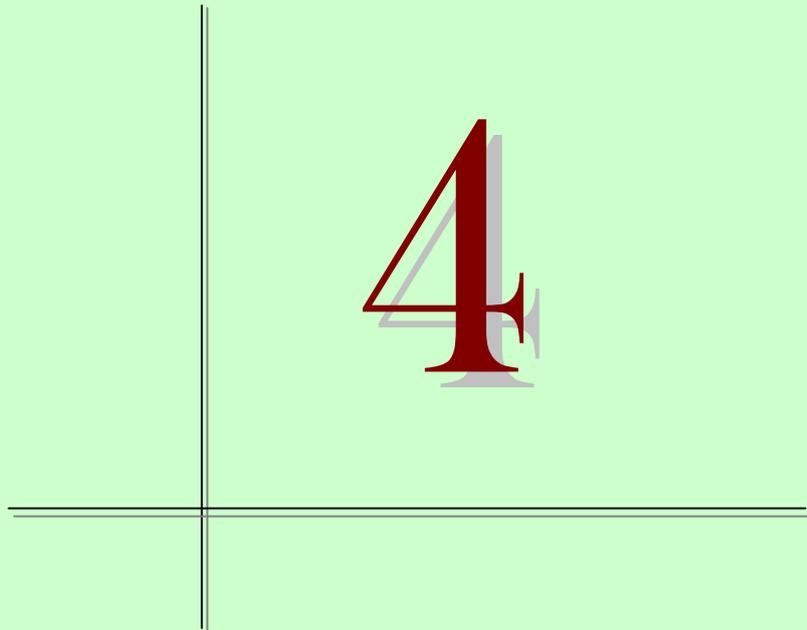


Photo 6. Participants for Scoping Exercise Workshop on e-waste in South Asia

Through networking with South Asia Cooperative Environment Program (SACEP), DA is promoting adoption of the principles of ESM of e-waste in the South Asian countries.

In this regard, a **South Asia position paper on e-waste management** (*Refer Annex III SACEP Position Paper*) was prepared and a scoping exercise to determine priorities and actions for the sub-region (*Refer Annex IV for Agenda and Annex V for list of participants, as separate enclosures*) was conducted on 21 September 2007 in New Delhi. Representatives from the government, academia and non-governmental organizations from South Asian countries participated in the workshop.

It was agreed during the workshop that a Task Force will be constituted at the South Asia region to devise measures to ensure sound management of e-waste in the region. The Task Force would comprise representatives from NGOs, industries, academia, research organisations and governments representing all South Asian countries. DA and SACEP will facilitate constitution of the Task Force.



4.1 Awareness Initiatives

- **The Asia-Pacific Regional Scoping Workshop**

The Asia-Pacific Regional Scoping Workshop on the Environmentally Sound Management of Electronic Wastes in November 2002 was the first intergovernmental meeting to be held on the “e-waste” problem in Asia. The Basel Convention Regional Centre in Beijing and the Secretariat of Basel Convention, Geneva organized the workshop. A variety of potential solutions were discussed at the meeting like safe dismantling process, change of design, extended manufacture responsibilities and strengthening of National capacities and legislative frameworks for monitoring and controlling transboundary movements of hazardous waste.

- **National workshop on e-waste management**

In March 2004 a national workshop on e-waste was organised in Delhi by **Ministry of Environment and Forests, Government of India (MoEF)** and **Central Pollution Control Board (CPCB)** in association with GTZ-ASEM with participation from Toxics Link, other NGOs cooperation with MAIT, several IT companies and other associations. The workshop looked at formation of a national level working group on e-waste, policy level interventions, planning for a national level study and rapid assessments in major e-waste producing regions or cities of the country.

- **WEEE Care!**

Two workshops aptly titled 'WEEE Care!' were organized in Bengaluru (formally known as Bangalore) hosted by the Goethe Institute/Max Mueller Bhavan in collaboration with the Karnataka State Pollution Control Board (KSPCB) and the **Indo-German-Swiss Partnership for e-waste**, brought the issue to the fore and forced all stakeholders to collaborate to find solutions to a looming problem. The WEEE Care! Campaign was launched in August 2004. The workshop, attended by the corporate, government and NGO representatives, was the first to put a spotlight on the issue of e-waste in Bengaluru. Since the e-waste spectrum is broad it was decided to limit the programme to obsolete products from the IT industry hence computers and its peripherals came under the focus. The encouraging response received from all the stakeholders led to the follow-up workshop in May 2005, which culminated with the formation of a nodal body mandated (E-Waste Agency – EWA) to develop a strategy for setting up an electronic waste management system for the city.

- **e-Waste management for Asia and the Pacific**

Government, academicians, civil society organisations from India attended an expert meeting on Regional Strategy for Asia and the Pacific on e-waste management held in, June 2004 at the **United Nations Environment Programme (UNEP)** Regional Office in Bangkok, Thailand. The meeting led to the collaboration of various groups to promote e-waste management in the

Asia Pacific region by initiating a regional level activity for knowledge sharing. The meeting also identified e-waste as an emerging environmental issue for the region.

- **National-level workshop on draft e-waste legislation**

The **MoEF** organized a National-level workshop on May 3rd and 4th 2006 in Bengaluru to discuss draft legislation on the management of e-waste in the country. Chairmen and member secretaries of State Pollution Control Boards and the representatives of Central Pollution Control Boards, Ministry of Environment and Forests and different IT industrial associations attended the workshop. The workshop discussed the draft legislation focussing on extending responsibility of generators of waste under the legislation. The draft also proposed constituting four agencies like EWA in Kolkata, Mumbai and Delhi with Bengaluru set up as the model¹⁴.

- **Effective e-waste Management, Asia Pro Eco programme**

The **Energy Research Institute (TERI)** organised a workshop, 'Effective e-waste Management' as a part of the European Union's Asia Pro Eco programme. The workshop was conducted in both Bengaluru and Delhi during May 2006. These workshops were to sensitize the participants to the technological and social benefits of adopting best practices ensuring efficient e-waste disposal and management¹⁵.

- **India Round Table on Sustainable Consumption and Production**

The India Round Table on Sustainable Consumption and Production was held in Mumbai on 29th September 2006 officially hosted by **MoEF and UNEP**. The roundtable was organised pursuant to the Marrakech Process, a global framework of initiatives for promoting sustainable consumption and production patterns, which called for national and regional consultations on Sustainable Consumption & Production and the formulation of action plans leading towards these. Participants from various organizations comprising equal numbers from Government bodies (Central, State and Municipal), Public Sector Undertakings and Autonomous Government Bodies, like Industry, Academic Institutions, and NGOs, took part in the conference to discuss the issues of e-waste in India. It was concluded that for the successful management of urban waste, it was essential that greater financial resources be given to Municipal bodies and improved technology be coupled with greater community participation. For the handling of e-waste, a stronger legislative framework coupled with more effective implementation of existing laws was needed. A successful e-waste management model would necessarily integrate the informal sector in some of the tasks, e.g. collection and segregation. The few successful e-waste management schemes had to be scaled up and replicated on a national basis¹⁶.

- **3R South Asia Expert Workshop, Nepal September 2006**

The 3R workshop in Katmandu dealt with the issue of e-waste management and its relevance in South Asia. The workshop with experts from across Asia pointed out the needs for South Asia – technology transfer and adaptation, 3R

¹⁴ <http://www.e-wasteproject.org/docs/blr4jurgen.pdf>

¹⁵ www.teri.org

¹⁶ http://www.unepie.org/pc/sustain/reports/events/India_Meeting_Report_2006.pdf

to be used in e-waste management in applying EMS and ISO 14000 and an environmental fee-based financial model.

- **7th UNEP Asia Pacific Roundtable on Sustainable Consumption & Production (APRSCP) Conference, April 2007, Hanoi**

The 7th UNEP APRSCP Conference was held in April 2007 in Hanoi. It involved knowledge exchange of current e-waste management practices and legislation around the world and providing a platform for discussion on the need for and role of the regional network to promote sustainable e waste management in the region.

- **Workshop on 'Clean e-Waste Channel'**

As a first step towards setting up the 'Clean e-Waste Channel', **Electronics City Industries Association (ELCIA)** organized a workshop and collection event on the 20th & 21st of September at the Electronics City Campus. The Indo-German Swiss e-Waste Initiative and Saahas supported the event. ELCIA is the umbrella organization representing all the companies operating in Electronics City, home to several of the biggest electronic products brands as well as large users, with over 150 member companies having around 60,000 staff. The workshop was hosted by Infosys and held at the Infosys campus at Electronics City and was attended by facility managers from several companies in Electronics City, as well as Central Pollution Control Board (CPCB) and KSPCB officials. One of the major outcomes of the event was the decision by ELCIA members to formulate a "Code of Conduct" for the companies in Electronics City, which would define their commitment towards proper e-waste management. Another important issue discussed was donation of old computers for developmental and educational purposes, led by Anchorage, an NGO active in this domain.

- **International conference on e-waste management, The Indian Institute of Chemical Engineers (IChE)**

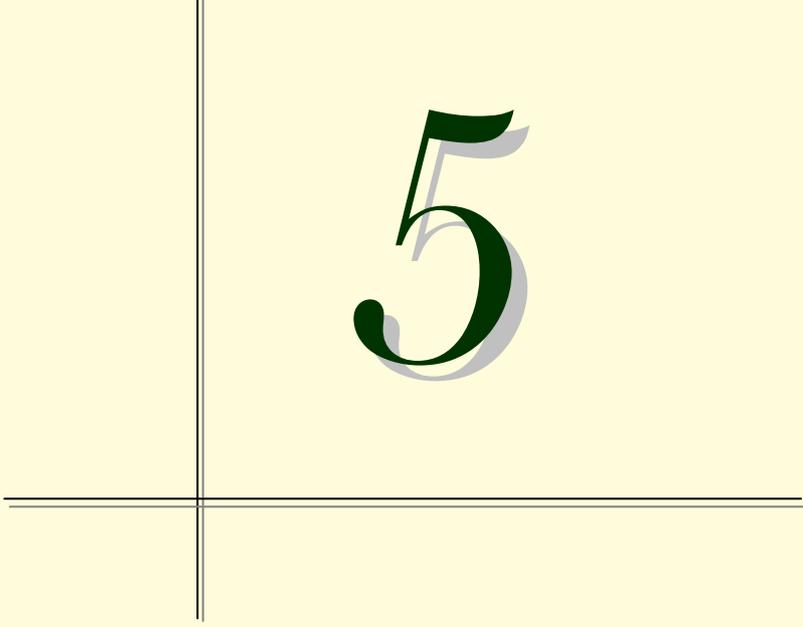
IChE, the apex body of chemical engineering professionals in India kicked off its diamond jubilee celebrations with an international conference on e-waste management on May 18th, in Mumbai .The objective was to look for a roadmap that would promote optimum growth with long-term sustainability for e-waste management in India. The conference touched upon several aspects of e-waste management - the Indian as well as international scenario, recycling and reverse logistics, as well as a detailed understanding of the market dynamics. Poster and paper competitions were also conducted which saw fresh ideas being churned on how best to tackle the problem¹⁷.

4.2 Stakeholder Engagement Initiatives of DA

DA is collaborating with the Indo-German-Swiss e-Waste Initiative to facilitate restructuring of the informal recycling units in Delhi and Bangalore.

DA is closely working with NGOs like Toxics Link and Saahas to raise awareness, bring the industry representatives and determining roles for the stakeholders.

¹⁷ www.iiche.org.in/e-waste.pdf



5

5.0 POLICY MAKING INITIATIVES

5.1 Applicability of regulations in India, including the Basel Convention

e-Waste trade comes under the broad regulatory framework related to environment, foreign trade and local rules & regulations.

Electronic waste is being covered under the broad regulatory framework related to hazardous waste in India. The Ministry of Environment and Forests, Government of India, is the nodal agency at the central level for policy, planning, promoting and coordinating the environmental programs. The Environment (Protection) Act 1986, an umbrella act covers hazardous waste and provides broad guidelines to address it. The policy statement on the abatement of pollution issued by the government of India in 1992 reiterated its commitment towards waste minimization and control of hazardous wastes.

India is a signatory to Basel Convention on the control of trans-boundary movement of Hazardous Wastes and Disposal. India ratified and acceded to it in 1992. The ratification of this Convention obliges India to address the problem of trans-boundary movement and disposal of dangerous hazardous wastes through international cooperation.

The Hazardous Wastes (Management and Handling) Rules, 1989 were introduced under Sections 6, 8, and 25 of the Environment (Protection) Act of 1986 (referred to as HWM Rules 1989). The HWM Rules, 1989 provide for the control of generation, collection, treatment, transport, import, storage and disposal of wastes listed in the schedule annexed to these rules. The rules are implemented through the SPCBs and pollution control committees in the states and union territories. There were a few inherent limitations to the implementation of the HWM Rules, 1989, and amendments to this Rule were introduced in 2000 and 2002, widening the definition of hazardous waste and harmonizing the hazardous waste list with that of the Basel Convention. The following are the major amendments of the Hazardous Waste (Management & Handling) Rule made in the year 2000:

- The schedule listing 18 categories of wastes in the Hazardous Wastes (Management & Handling) Rules, 1989 has now been replaced by 3 schedules.
 - ☞ **Schedule 1:** Describes the processes and waste streams generating hazardous waste. Units operating these processes are now subject to the rules.
 - ☞ **Schedule 2:** Lists the concentration limits of constituents in the wastes. This concentration limit is to be used for classification/characterization of waste stream as hazardous/non-hazardous in case of dispute, similar to the Basel Convention Annexes VIII and IX.
- Responsibility for the identification of sites for establishment of Common Treatment, Storage and Disposal Facilities (CTSDF) and individual TSDF now rests with the occupier, industrial association and the State Government alone.
- Provisions relating to the import and export of hazardous waste for recycling have been expanded to describe in detail the procedure being followed.

Requirements of the re-export of illegal traffic of waste under the Basel Convention have also been incorporated.

- Rules have been worked out governing the design, set-up and closure of landfill facilities.
- A manifest system has been introduced for tracking hazardous waste from the point of generation to the disposal site.
- Authorities responsible for the regulation of imports and exports and monitoring the implementation of provisions of the rules have been mentioned in schedule 4, and
- A fee for authorization and import has been prescribed

Besides these rules, in 1991, the Ministry of Environment and Forests (MoEF), New Delhi issued guidelines for management and handling of hazardous wastes for (a) generators of waste, (b) transport of hazardous waste, and (c) owners/operators of hazardous waste storage, treatment and disposal facilities. These guidelines also established mechanisms for the development of a reporting system for the movement of hazardous waste (the manifest system) and for the first time, established procedures for closure and post-closure requirements for landfills.

For details of the Hazardous Waste (Management & Handling rules visit the website of the Ministry of Environment & Forests, Government of India <http://envfor.nic.in>

▪ **Hazardous Waste Management Rules – Export & Import Issues**

As per Basel Convention, India cannot export hazardous wastes listed in Annex VIII of the Convention from the countries that have ratified the ban agreement. However, the Convention agreement does not restrict the import of such wastes from countries that have not ratified the Basel Convention. It is through the orders of the Hon. Supreme Court of India that the import of such wastes is now banned in the country.

The HW Rules of 1989 control the import of hazardous wastes from any part of the world into India. Under the HWM Rules of 1989, the MoEF and the SPCB are the two recognised statutory organizations to ensure effective approval of import of hazardous wastes in the country. Under the new amendment of HWM Rules of 2002, List A and B of the Basel Convention were introduced as Schedule 3 of the HWM Rules including the provisions relating to illegal traffic.

As per Rule 11 of HW Rules of 1989, import of wastes from any country to India shall not be permitted for dumping and disposal. However, import of such wastes may be allowed for processing or reuse as raw material, after each case has been examined on merit by the State Pollution Control Board. The SPCBs will examine applications from importers and forward such applications with its recommendations and requisite stipulations for safe transport, storage and processing/ disposal to the MoEF.

The Rules also require that hazardous wastes be packed and labelled during transport and that they will be deposited in waste disposal sites selected by the state government after an environmental impact assessment study. Any importer wishing to import hazardous wastes must fill in the necessary information in Form 6 along with a fee of Rs. 30,000 for imports of up to 500 tonnes (extra Rs. 5,000 for every additional 500 tonnes) to the SPCB/CPCB 125 days in advance. As per the HW Rules, 1989/2000/2002, permissions to importers / exporters will be granted by the MoEF only, under Rules 13 (3) and 14 (3). Under this rule, the MoEF must satisfy itself that the importer has environmentally friendly / appropriate technology for reprocessing; that the importer has the capability to handle and reprocess hazardous

wastes in an environmentally sound manner; and that the importer has adequate facilities for treatment and disposal of wastes generated.

Under Rule 14 (3), the MoEF must also consider and approve applications sent by exporters of consignments of hazardous wastes to India (Rule 11 of the un-amended HW Rules, 1989).

Please refer Annex XI for schedule 7 of the HW Rules, 2003, which details the authority, duties of various authorities for management of hazardous waste in India.

▪ **Loopholes in the Current Legal System**

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

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 old 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

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.

▪ **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.

The Convention has provided for two lists. List A found in Annex VII 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-VII 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.
- **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 include most computer circuit boards and much other electronic equipment), are indeed hazardous wastes according to Basel Convention. Similarly, 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 stand in direct opposition to what has been in the Basel Convention.

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 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, and 14 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 which is currently lacking in India.

5.2 Policy Making Initiatives

▪ **WEEE Task Force**

A National WEEE Task Force was formed in July 2004, headed by Chairman CPCB and consists of officials/representatives of MoEF, CPCB, Ministry of IT,

regulatory agencies (representatives of SPCBs), NGOs, Industry Associations/Industry (MAIT, TEMA, CETMA, ELCINA, CII), experts in the field and producers both formal & informal. The mandate of national task force is to identify, plan and implement all issues related to e-waste in India.

One of the thrust areas is to study the feasibility and format legislation on the handling and recycling of e-waste, not only as an environmental protection measure, but also to keep pace with international legislations such as the WEEE Directive in the EU. Led by CPCB, this covers issues of developing national guidelines permission for starting formal recycling operations, developing 'WEEE Rules', formulating standards and licensing procedures,

- **Central Pollution Control Board Guidelines**

The Central Pollution Control Board (CPCB) has formulated its guidelines for e-waste management for the entire country¹⁸. Based on the outcomes of studies regarding amounts of e-waste, its growth rate and applied recycling processes in India and the national workshop on electronic waste management the need for the proposed guidelines were identified due to the presence of *toxic components*, Increasing amount of e-waste and Lack of environmentally sound recycling infrastructure in the country.

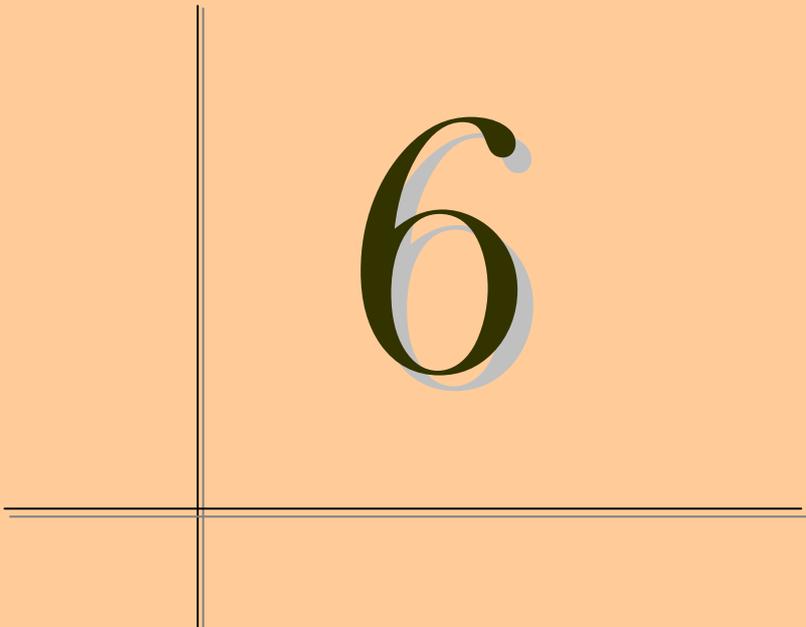
A meeting was held by EWA at Infosys Technology Ltd, Bengaluru on 17th October, 2007 to formulate industry views and suggestions on the Draft Guidelines of CPCB for Environmentally Sound Management of e-Waste. EWA sent out letters to more than 100 Industries /Associations, seeking their views/suggestions on various aspects of the Draft Guidelines. This was done after efforts were made to get the consent of the representatives of the MoEF and the CPCB to participate in an interactive meeting with concerned stakeholders. However there was no response from either the MoEF or the CPCB, EWA took the initiative to convene a meeting of stakeholders. (*Refer Annex VI Comments / suggestions received from Stakeholders on the CPCB Guidelines*)

- **DA in Policy Consultations**

DA coordinated a meeting with major NGOs working in the field of e-waste management in India on 11 September 2007 in New Delhi to discuss future role of NGOs in e-waste management and share observations and recommendations on CPCB's Draft Guidelines for Environmentally Sound Management of Electronic Waste. The views on the guidelines were later verbally communicated to the Ministry of Environment and Forests. Refer *Annex VII* for details.

As part of the Local Area Environmental Committee DA has been flagging the issues related to ESM of e-waste to concerned departments in the national government and is also advising the Delhi government on setting up a facility for managing e-waste in Delhi and neighbouring areas i.e. the National Capital Region by a private entrepreneur.

¹⁸ <http://www.cpcb.nic.in/docs/e-waste.html>



6

6.0 POTENTIAL FOR ESM OF e-WASTE – AN ANALYSIS

6.1 Potential for promoting ESM of e-waste in India

Relevance and need for an appropriate legislative framework, economic incentives to adopt environmentally sound practices and technologies, scope for extending the life of products through reuse, refurbishment and repair and awareness creation have been assessed to determine the potential for promoting ESM of e-waste in India.

e-Waste generated by discarded computers, mobile phones, batteries, and other electronic goods is a growing concern around the world including India. According to “The Economist” (2005) e-waste is one of the fastest growing waste fractions. It accounts for around 8 % of all municipal waste in industrialized countries. e-Waste contains many toxic chemicals and these harmful substances can be released easily if precautions are not taken to handle them carefully. Refer Annex VIII Components of e-waste.

With the fastest growing markets of tele-communications and mobile telephony on one hand leading to increasing investments in the IT and IT-enabled sectors and on the other there is a growth of the informal sector handling e-waste, India is faced with increased use of e-appliances and challenges of properly managing the e-waste. India's computer population is expected to grow from 15 million now to 75 million in 2010. Mobile telephones are likely to increase in numbers from 75 million to 200 million by 2010.

The electronic industry in the country is currently worth \$10 Billion but according to estimates, has the potential to reach \$ 40 billion by 2010¹⁹. The electronic industry in India constitutes just 0.7 % of the global electronic industry. However the demand in the Indian market is growing rapidly and investments are flowing in to augment manufacturing capacity. The Indian electronic equipment production grew at 25 percent in 2005 and is expected to reach a growth rate of 50 percent in 2010²⁰ while the software industry has grown from a mere US \$ 150 million in 1991-92 to a staggering US \$ 5.7 billion (including over \$4 billion worth of software exports) in 1999-2000.

The numbers of mobile subscribers in India have increased more than 235 times from 1997 (678460) to October 2007 (160013642)²¹. India has become the second largest mobile handset market in the world and the Indian market could soon become a global hub for mobile handset manufacturers. According to a study by Research and Markets, Ireland, the Indian mobile handset market is worth about US\$ 2 billion. Major handset manufacturers like Nokia, Samsung, Motorola, Sony Ericsson, LG etc. are currently operating in Indian market for cellular handsets. However, their business mainly comprise of imports of readymade handsets or importing the components and reassembling and selling the same in India. Manufacturing facilities in

¹⁹ Electronic Industries Association of India formerly Electronic Component Industries Association
www.elcina.com

²⁰ India e-news Feb 8 2007

²¹ Quarterly Statistics of Subscribers, Cellular Operators Association of India www.coai.com

the country are coming up. Nokia has already stated production of handsets in the country.

Recent estimates suggest India generates approximately 146,000 tonnes of e-waste annually²². In addition to generating e-waste computers and electronic equipment, which is discarded in the west, are sent to India in huge quantities. Strict domestic laws and higher recycling and/or disposal costs has resulted in transportation of the e-waste from the developed nations to the developing countries in Asia and Africa. While the developed countries escape from the strict regulations on the disposal of hazardous waste the developing countries create more job opportunities for their working population. Till 1992, Africa was the favourite dumping ground for the Western world. However with the enforcement of the Basel Convention by all the African countries, South Asia has become the favorite dumping ground, despite all South Asian countries being signatories to the Convention. According to British Environment Agency (BEA), e-waste exports are worth hundreds of millions of Rupees. Last year, such waste involved tens of thousands of old computers, 500,000 television sets, 3,000,000 refrigerators, 160,000 tonnes of other electrical equipment and millions of discarded mobile phones, all sent to Asian countries like India, China and Pakistan. Following China's ban on imported electronic waste in November 2004 India has emerged as the largest dumping ground of e-waste for the developed world²³.

Despite being signatory to the Basel Convention, there is no legal framework to deal with the issues of e-waste management in the country. As per the Basel Convention, India cannot export hazardous wastes listed in Annex VIII of the Convention from the countries that have ratified the ban agreement. However, the convention agreement does not restrict the import of such wastes from countries that have not ratified the Basel Convention.

It is through the orders of the Hon. Supreme Court of India that the import of hazardous wastes is now banned in the country. The legal basis therefore is regulated in the "Hazardous Waste Management and Handling Rules (1989/2000 amended)". This document also controls the import of hazardous waste from any part of the world into India. However, import of such waste may be allowed for processing or reuse as raw material.

The major problem related to e-waste management in the country is that of disposal and recycling. Illegal e-waste processing continues undeterred because disposal of obsolete electronic equipment has become a lucrative business in India. Unlike the developed countries, there are no set norms for handling of electronic waste, and secondly cheap labour makes disposal cost-effective and profitable for local traders. The lack of national regulation and/or lax enforcement of existing laws are promoting the growth of an informal economy in India. While it is a source of livelihood for the urban and rural poor, it often causes severe risks to humans and the local environment. Refer Annexure V Effects of E-Waste Recycling on Health and Environment.

There are no standard practices for collection and recycling of e-waste at present in the country. Until recently management of e-waste was synonymous with selling e-waste to a scrap dealer from where it reached informal sector recyclers. The e-waste finds its way to the informal sector through dismantlers and scrap dealers involved in segregation of the e-waste into various components like PCB's, plastic, CRT etc. who

²² Toxics Link 2005

²³ www.china.org.cn/english/BAT/110670.htm

buy the waste through auctions, from waste collectors and/import waste. Some of this segregated e-waste is used as secondhand products, while some are dismantled for the recovery of precious/valuable metals. Refer Annex IX Mechanisms Employed for Recovering Components.

The rest of the e-waste, which are not recycled and reused, is thrown in open dumpsites or burnt. The informal recyclers buy items for extraction of various valuable metals. e-Waste recycling is mainly motivated by the recovery of value contained in the PWBs (printed wiring boards), which is retrieved by extracting precious metals (mainly Gold, Silver, Palladium) with wet chemical processes, involving highly toxic substances such as nitric acid , Mercury and Cyanide. Untrained people, resulting in a high impact on their health and the environment, do these activities. It is essential that India take note of this menace or it will have to pay a heavy price for environmental degradation. There is an urgent need for promotion of the environmentally sound management principles in managing e-waste in the country.

Under the Basel Convention ESM means taking all practicable steps to ensure those hazardous wastes or other wastes are managed in a manner, which will protect human health and the environment against the adverse effects, which may result from such wastes.

The environmentally sound management of used or end-of-life equipment needs to be viewed in the context of integrated waste management and life cycle approach to products. It is important to develop policy and economic tools that aim at reducing the amount of hazardous wastes being dumped or finding its way into landfills. The Secretariat of Basel Convention points out the following as pre-requisites for sound management of e-waste:

- An appropriate legislative framework;
- Sustainable development policies, including policies on the collection, recycling and recovery of electronic and electrical wastes and ones that address the transboundary movements of such wastes;
- Economic incentives for environmentally sound practices and technologies;
- Green design aimed at reducing the use of hazardous materials in electrical and electronic products and enhancing their recyclability;
- Closing the loop for recyclables;
- Extending the life of products through reuse, refurbishment or repair;
- Elimination of hazardous constituents in products;
- Worldwide environmentally sound management standards or criteria for recycling and final disposal of electronic wastes;
- Action to prevent illegal traffic;
- Broad public awareness;
- Public-private partnerships to engage all stakeholders;
- Regional level playing field on how to deal with export and import of electronic and electrical wastes;

Efforts to adopt the ESM principles for e-waste management in India have been sporadic. While there is no legislation in place as yet, a few corporate organizations

are making an effort for practicing ESM of e-waste by initiating good practices for segregation, collection and recycling of e-waste as well as R&D of green products. NGOs are also promoting informal sector inclusive recycling models in association with industry associations and donors.

6.2 Partnership at a City Level for e-waste management

Development Alternatives is associated with the implementation of the concept of *clean e-waste channel* in Bengaluru, for small e-waste products like dry cell batteries, CDs and floppies. The programme is a joint initiative of Saahas and WeP Peripherals, a company that provides IT peripheral products and solutions and printing services, with association of DA. Development Alternatives is implementing the programme in 10 schools. So far around 75 collection centres have been set up in various schools, corporate offices and public locations. Awareness programmes are conducted regularly to inform the public about the toxic content of such e-waste and therefore the need to dispose it safely. Till date every month around 100 kg of such products are being collected. This is however only a fraction of the total waste of this nature generated in the city. These are further sent to E-Parisaraa, an authorised formal e-waste management facility in Bengaluru.



e-Waste Collection Bins

6.3 Emerging Good Practices for e-Waste management in India

In the recent past, models for e-waste management in India have been emerging. A few are discussed below.

Through a consultative process GTZ-ASEM, along with EMPA and Toxics Link have proposed two different models for e-waste management in India

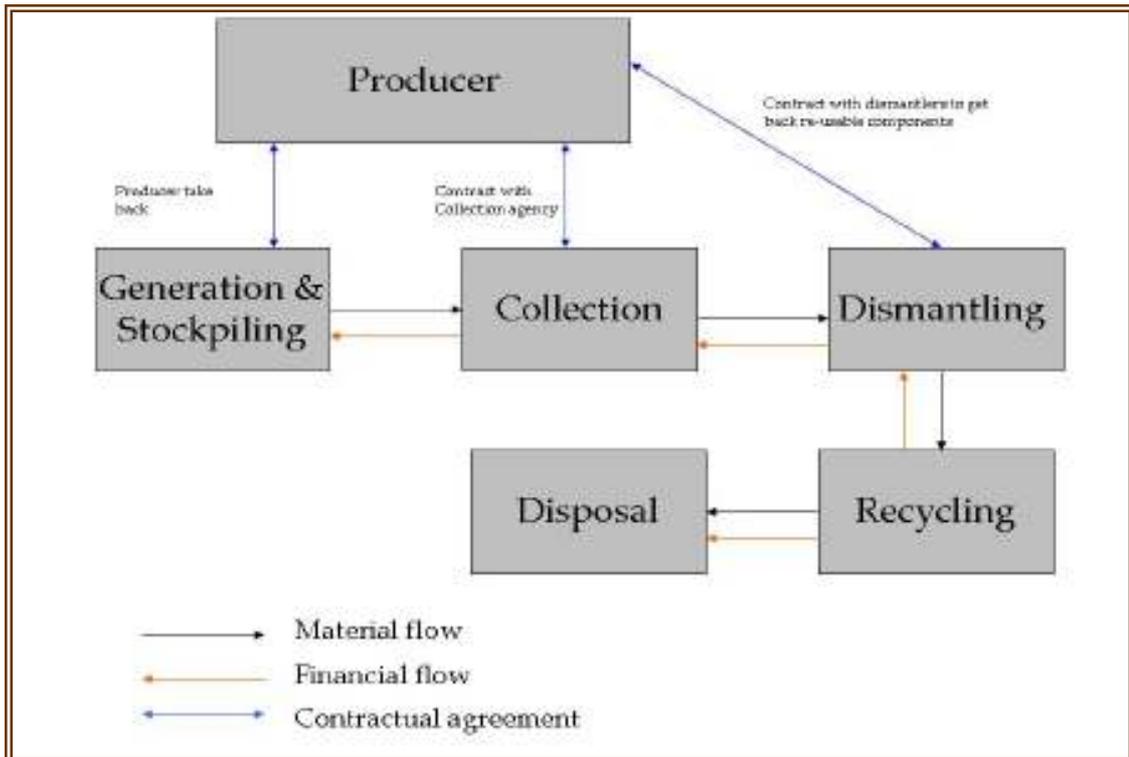
1. Individual Producer Responsibility Model

Each producer is independently responsible for managing the e-waste generated by their products. The producers announce take-back policies and have contractual agreements with the collection agency which collects the waste from the generator at least free-of-cost. The producers, through the collection agency, however pay a fixed price for their products/ components to the generators, as in the collective responsibility model.

Collection

The collection in this model is managed by not-for-profit collection agencies which are regulated by the appropriate authorities like the DPCC and CPCB. The individual producers have contracts with the collection agency and on behalf of the producer; the collection agency implements the producer take back schemes. The collection agency also collects from retailers as well other generators of e-waste through an extensive network of collection centres. As in the model with collective producer responsibility, there is scope for the involvement of the informal sector in the collection and storage of e-waste.

Fig 3. Individual Producer Responsibility Model



Dismantling and recycling

The roles and responsibilities envisaged for the dismantler and recycler remains the same in both the individual and producer responsibility models. However, in the individual responsibility model, the collection agencies would supply the material to the dismantlers and recyclers and not the collective producer body.

Financing

The financing of the Individual Producer Responsibility Model would depend, amongst other things, on the inherent material value of the EEE. This would be the most crucial element in determining whether another financial instrument, like an Advanced Recycling Fee (ARF) to be levied at the point of sale, is necessary at all. The price, inclusive of ARF, would therefore reflect the true price of the product including the environmental cost of the product. For instance, products like computers which have inherent material value that can cover the entire cost of recycling could potentially be recycled by levying a nominal or even zero ARF (see the Toxics Link paper for an example of Computers). However, products which do not have sufficient material value at the end of useful life will need to be recycled by levying either a visible or invisible ARF. Therefore under the individual responsibility model, there would be a menu of ARF ranging from zero to positive amounts, depending on the inherent material value of the end of life product. The exact amounts would depend on the producers' estimation of the recycling costs and the nature of contracting with the recyclers. If Individual Responsibility is a component of a larger Collective Responsibility Model, the proposed ARF might go down because the collective organization would be able to take advantage of economies of scale.

2. Collective Producer Responsibility Model

This proposed collective e-waste model has in its centre the electrical and electronics industry, which comprises of not only the manufacturers but also the importers and assemblers of the EEE (Electrical and Electronic Equipments). The model recommends a very important role for the manufacturers/producers of electronic goods and proposes that they come together as consortium and establish an organisation, which takes the responsibility of the end-of-life disposal of products being manufactured or assembled by them. This organisation, which can be established with support from all producers, can be designated as 'Producer Responsibility Organisation (PRO)' and will largely be responsible for environmentally sound management of e-waste.

Structure of PRO: It is suggested that the PRO operates as a non-profit organization built on the ethos of Corporate Social Responsibility (CSR) and be an active participant in this process. The top management of this PRO should have representation from various sectors making it a truly multi-stakeholder organisation. The cost of establishing this organisation needs to be supported by the individual companies. The details on the contribution made by individual companies can be worked out through detailed deliberation. A part of revenue can also be generated through the sale of the e-waste being sold to the recycler/dismantler. The PRO should operate with full operational transparency.

Function of PRO: The Producer Responsibility Organisation will take on overall responsibility of the complete recycling process of e-waste with different levels of engagements in various processes. The PRO will take on direct responsibility of collection and storage of all WEEE generated across the country and then pass this on to the dismantler/recycler for a price. He can outsource these operations (tying up with existing informal sector) but will still be responsible for ensuring proper collection and storage. Also the individual producers can run their own take back systems but have to tie up with the PRO for final disposal and recycling.

The collection mechanism of the proposed model

1. **PRO take-back:** The PRO will provide free collection for the waste and the generators will be paid for the material according the product type (fixed by PRO). A proper reporting system has to be established for this to ensure transparency.
2. **Dealer take-back:** The dealers selling such products will have to take back the old products and the generators will get a discount on new purchase of electrical and electronic goods (the end-of-life cost can be fixed according to product type). These products will be then transferred back to the PRO with proper reporting.
3. **By existing informal network:** One of the biggest challenges to this model is from the existing informal sector and the operators will need to address this. The best option may be to channelise this sector in the collection and storage of waste from various sources, which is then passed onto authorized distribution channels. The informal sector will tie up with the PRO to ensure accountability.

Box 2. Case Study of Electronics City, Bengaluru

A large number of software companies operate from Software Technology Parks under the STP scheme in Bengaluru. The STP scheme is an export oriented scheme and provides the companies with several substantial benefits. One of these benefits is that all the imports of hardware and software in the STP units are completely free of duty. Also, all the companies under that scheme are exempted from payment of corporate income tax up to 2010.

Over the last one year, the Indo-German Swiss Partnership on e-waste is working in close association with Electronics City Industries' Association (ELCIA) founded in 1992 to introduce and implement a Clean e-waste Channel (CeWc) in Electronics City. Saahas has also been involved and provided some support to the programme. Electronics City is one of India's Software Technology Parks (STP) located in Bengaluru. It consists of 100 STP units. Electronics City is divided into phase 1 and phase 2. Villages are located all around Electronics City. Some of the villagers make their living by collecting the considerable amount of waste that is generated in this industrial cluster. Everything that still is of a value is resold whereas the invaluable parts of waste are burnt or disposed somewhere on the land surrounding Electronics City. It is very likely that the villagers also deal with e-waste.

ELCIA is committed to take pro-active steps in the protection of environment. Unfortunately, ELCIA's authority is very limited and companies interact with ELCIA only if they see immediate benefit. A survey conducted by Swiss Federal Laboratories for Materials Testing and Research, a major research organization in Switzerland (EMPA), the Swiss partner revealed that safe and environmentally friendly disposal of waste is not a high priority with most companies. Moreover, improper management of waste has not caused problems and therefore many companies do not see any benefit in introducing changes. The survey also gives good insight into the existing systems and practices with respect to e-waste generation and flow. *Refer Annexure X EMPA Study in Electronics City (2007), Bengaluru*

The need assessment has shown that most companies are willing to fund a part of the channel that is non profitable to a certain extent. Moreover, the need assessment has also shown that companies expect almost 50% of their e-waste to be profitable for recycling. They intend that 15% is non profitable and needs funding, and the 35% they would expect to dispose of for free.

ELCIA and its members shall pay the initial cost for infrastructure. With the surplus that comes from running the Clean e-Waste Channel, ELCIA can cover its own initial investment and the cost of one of its member companies. If ELCIA makes profits out of running the collection point, this profit shall be given back to the companies. Assuming a minimum e-waste flow per year of 225 tons, it will take 12 years to break even. Assuming the maximum estimate of 560 tons, it will only take 3 years. ELCIA has obtained authorisation from KSPCB for storing e-waste recently and the collection will start shortly.

The Second Byte Initiative

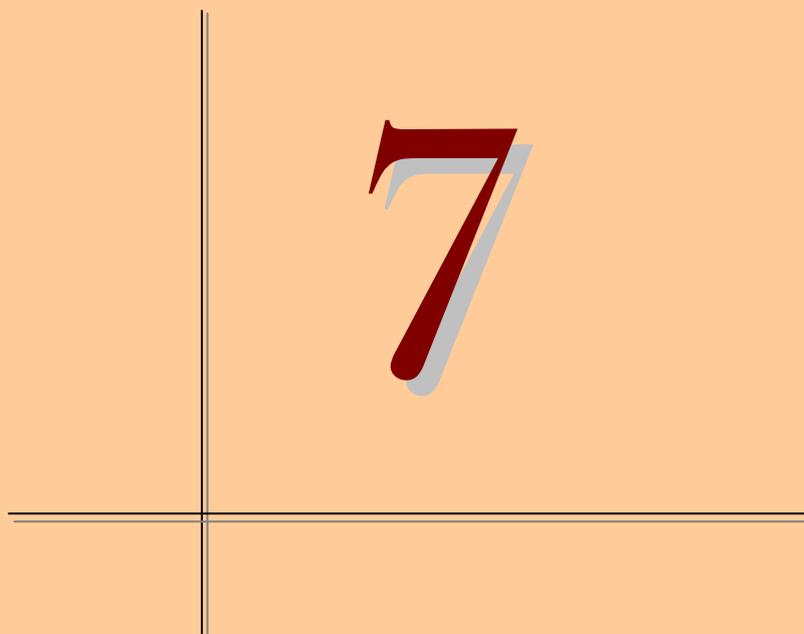
Second byte has been formed as a not-for-profit company. Second byte aims to assist NGOs access second hand computers and other peripherals. Second byte will assist in the procurement; refurbishing and enhancing such hardware from IT companies, other industries and international donors for non profits organisations.

Quite often, corporate companies which wish to donate their 'used' computers have limited access of the development sector and hence tend to operate with limited knowledge about the magnitude and nature of potential beneficiaries. This affects both the parties in a significant manner. Lack of a database of the need in the development sector forces them to auction computers for a pittance to dealers who refurbish them and sell them in the grey market. The only other choice seems to be indiscriminate disposal to NGOs which may result in unethical disposal of e-waste.

Development sector characterised by NGOs operating in interior corners of villages have limited technical knowledge of screening usable from e-waste. They further lack in-house expertise of how to or what to upgrade, in the process wasting essential funds on costly and unnecessary enhancements. For example, computers received without the operating system and that need repair, enhancements or refurbishing are most often of little or no use. To effectively use the donated computers, NGOs have to invest in hard disks, Operating Systems and content. In many cases OS cannot be updated without a copy of the earlier licensed OS or its details in the hard disk, creating a catch 22 situation.

Besides being an intermediary agency between the corporate and development sector, Secondbyte has focus on the following:

1. Form regional networks involving all stakeholders to create greater awareness of issues around e-waste and effective e-waste management.
2. Work towards e-waste management and corporate e-waste responsibility.
3. Work towards a national policy of e-waste regulation with special focus on computers and other user devices by IT/ITES companies, Corporate and development agencies.



7.0 CONCLUSIONS

7.1 Conclusions

Interactions with the major industries in India reveal the fact that currently the issue of e-waste is not dealt as priority by the top management. With no regulatory requirements the companies find no obligation to deal with the issue. However following several deliberations by the NGOs in India and more importantly with the CPCB's Draft Guidelines for Environmentally Sound Management of Electronic Waste coming into being, the concerns for managing e-waste in India is getting adequate attention of all stakeholders. Nevertheless the interpretation of the guidelines and development of strategies, that have on-ground impact, would be important in the future.

Consultations with various companies, organisations and banks have identified several bottlenecks which is preventing the implementation of better e-waste management in the country including:

- **Lack of motivation of the top management** - the interest with respect to e-waste is not an issue when taken up by top management
- **Lack of understanding of the definition of e-waste** – Since there is no clear definition of e-waste presently (by the regulatory authorities) and hence there is no proper segregation of e-waste. In most companies the e-waste generated come under two departments – facilities (electrical waste including lamps) and IT. Most often Electrical equipment is not included as e-waste. Thus it is put along with other regular scrap and the finance department then calls for a tender and the same is sold to a regular scrap dealer. The equipment, which is IT, related is generally under contract with a vendor who has supplied the equipment. The vendor is contacted to take back the equipment at the end of life. This then is sold to regular scrap dealers and reaches the informal recycling sector.
- **Donation of obsolete equipments** - Companies continue to donate obsolete equipments to schools without monitoring what happens to the donated material when it reaches its end of life.
- **Lack of authorised recycling facilities in the country** - There is an urgent need for the government to promote more e-waste recycling facilities to encourage competition and better prices for e-waste.
- **Lack of legislation** - Most companies feel that e-waste legislation is very important to bring in a systems approach to e-waste management. The legislation must clearly define e-waste and the limitations in terms of quantities of e-waste generated for better management of e-waste.
- **Participation in Tender Process** - The authorised e-waste recycling facilities must take part in the tender process, which is a requirement for government facilities and public sector units for managing e-waste.
- **Lack of trained personnel** – Most companies especially public sector and service industries lack qualified and trained staff looking after e-waste management leading to poor understanding of the issues at hand.

- **Lack of collection centres** – only a few cities in India have recycling facilities and the collection systems for these facilities are restricted due to logistical and geographical problems.

7.2 Recommendations

In view of the above gaps recommendations for efficient management of e-waste is elaborated below.

- **Regulating e-waste** - India should formulate e-waste legislation with immediate effect so as to make mismanagement of e-waste by companies punishable under the law. There must also be clear cut policies governing all imports and exports of e-waste, including computer monitors, mobiles, whole computers and circuit boards to prevent illegal imports of e-waste from other countries.
- **Extended Producer Responsibility (EPR):** EPR is a product and waste management system in which manufacturers or producers not the consumer or government takes responsibility for the environmentally safe management of their product when it is discarded. The producers and manufacturers of the electronic and electrical goods have so far not applied the principle of EPR in India. The government must seriously think about implementing EPR in the country for electronic and electrical manufacturers and bulk consumers. The producer should be directed to take back a product at the end of its useful life either directly or through a third party. This will help place the burden of a product's environmental impact clearly back into the hands of those who design it in order to provide immediate incentive for improvement and not pass the cost of disposal to the government and the public.
- **Environmentally sound recycling** – The government must promote environmentally sound recycling in the country. This includes
 1. Authorising more formal recycling facilities, which have occupational health and safety measures for employees and environmental safeguards.
 2. Informal sector inclusive model – since the informal recycling in the country is a source of livelihood for a large population a system must be devised to include the already existing entrepreneurs. Their expertise and knowledge of e-waste must be utilised by upgrading their skills and facilities for segregating, reusing and dismantling e-waste. This can be done through training programmes and government schemes to help the existing facilities upgrade.
 3. Recovery of precious materials - recycling to ensure clear, safe and efficient mechanisms for recovering raw materials must be promoted. Studies have shown that the informal sector generates a high environmental impact during the recovery of materials and the efficiency of the recovery is much lower when compared to large mechanised refineries with professional staff. Therefore the role of the informal sector in the recovery of precious materials must be stopped and they should be encouraged to collect and segregate material for recovery and send it to a mechanised refineries either in the country or abroad, for e.g. this has recently been initiated by e-Parisara in Bengaluru who exported a consignment to Umicore Precious Metals Refining in Belgium). E-Parisara is open to idea of joining hands with smaller recyclers to export material to Umicore on a regular basis using their export license for a fee. This type of arrangement can be encouraged.
- **Green products** – The producers should place emphasis on research and development of products that use less hazardous materials and / can be recycled in a safer manner. Use of environmentally safer materials in the production and

consumption of fewer materials must be promoted. Design of products that last longer would help reduce the quantities of e-waste. This would involve considerable investment by companies.

- **Advance Recovery Fee (ARF)** An additional charge, can be imposed on the consumer at the time of purchase of electronic equipment to pay for the disposal of the material at the end of its useful life. At present as India is collecting service tax and educational cess on all products.
- **e-waste collection centres for small consumers:** In the last two years a lot of focus has been placed on e-waste management in the corporate sector. Systems have been established and awareness programme continue to take place regularly. There is however a considerable quantity of waste generated by households, institutions and small establishments, which continue to remain, ignored. Some attention now needs to be devoted to this segment. Collection centres must be set up in different parts of the country to encourage collection from small generators which is currently being thrown with the regular garbage and is ending up in Landfills.

Discussions with key manufacturers and MAIT show an inclination to get processes initiated to cover this segment. This would include:

- **Setting up collection centres:** A public private partnership can be evolved whereby the local body allocates space for several collection centres located strategically across the city.
 - Individuals/small establishments can bring in obsolete equipment and deposit the same in these centres.
 - The manufacturers/association can partner in this venture by bearing all the other costs including publicity, running the centre and other overheads.
 - NGOs can be involved to run the center on a day to day basis
 - e-waste collected will be inventoried, segregated and sent to the authorized e-waste vendor
- **Awareness-** Although several awareness programmes have been conducted for the industry and corporate companies over the last few years there is a lack of awareness on e-waste management on the part of the consumers and small business establishments. There is also a lack of awareness on the issue in public sector undertakings and government organisations. Efforts must be made by government, NGOs, industry and industry associations to reach out to the general public through posters, flyers, awareness programmes, advertisements and documentary films.

Annexure

COMMENTS / SUGGESTIONS RECEIVED FROM STAKEHOLDERS ON THE CPCB GUIDELINES.

Immediately after Publication of the Draft Guidelines on the Website of CPCB, EWA, Electronic Waste Agency (an Indo-German-Swiss Initiative) studied the same and a special meeting of the Managing Committee of EWA was convened to discuss the issue and formulate its views/suggestions. The Managing Committee discussed the matter in detail, and made the following Recommendations:

1. Whether the proposed guidelines address the major objective of “Environmentally Sound Management of e-waste”?
2. Whether the” Definition “of e-Waste, as proposed is satisfactory-acceptable to all stakeholders; viz. Manufacturers, Consumers, Recyclers & Regulatory Agencies?
3. Whether the Municipalities / Local Bodies would be capable of handling “Non-hazardous e-waste” as proposed in the Guidelines?
4. Whether there was a time limit in the web site of CPCB to offer suggestions / comments on the Guidelines? and
5. Whether there was any proposal to organize National / Regional Workshops-Seminars to elicit suggestions-views from interested parties.

The following industries, associations and organizations furnished their Suggestions – Comments on the Guidelines:

1. Manufacturers Association for IT Industries, Southern Region, Bangalore.
2. Swiss Federal Laboratories for Material Testing & Research (EMPA)
3. Intel Corporation Ltd.
4. Toxics Link
5. E-Parisara Pvt Ltd, Bangalore.
6. Electronic Waste Agency.

In addition, the Draft Guidelines were also discussed in a closed door workshop during the Ro7 World Congress on “Recovery of Materials & Energy for Resource Efficiency” in Davos, Switzerland on 2nd Sep 2007, when representatives of EWA, EMPA, SECO and ASEM-GTZ were present.

A meeting was held by EWA at Infosys Technology Ltd, Bengaluru on 17th October, 2007 to formulate industry views and suggestions on the Draft Guidelines of CPCB for Environmentally Sound Management of e-Waste. The meeting was Chaired by Dr. A. Ravindra, Chairman, EWA and Sri S. Gopalakrishnan, CEO & M.D, Infosys Technology Ltd. Addressed the Participants.

Some of the major Recommendations made during the Meeting are as under:

1. The Guidelines, while being too detailed and comprehensive, containing considerable data/information on various Technical aspects of e-waste, hazardous content of some of the Products, Processes adopted at various levels etc, do not clearly bring out the Primary Objective of the intended Notification /Rules, and also do not fix Responsibility on any particular Agency for ensuring "Compliance". In this context, the Swiss Legislation was quoted as an example, and it was felt that the Final Notification / Rules , which would eventually be issued in this connection should contain:
 - a. Objectives in clear & unambiguous terms;
 - b. Persons / Organisations responsible for proper/ scientific disposal, collection, transportation & Processing;
2. Definition of E-Waste, as proposed , appears to be too broad & may cover/ include a large number of Electrical-Electronic Products, some of which, not being hazardous may unnecessarily add to the volumes and create complications/ confusion among all concerned. It was therefore felt that a broad categorization of the most important product groups be attempted, on lines similar to the one adopted by the European Union in its WEEE Directive.
3. Proposal to distinguish "Hazardous" and "Non-hazardous " e-waste, may not be desirable due to the following reasons:
 - a. Option of such distinction, at the Consumers level, may result in even Hazardous Wastes entering the Municipal Waste Stream;
 - b. Such option may also lead to blatant misuse by unscrupulous agencies; and
 - c. Municipalities / Local Bodies are ill-equipped to handle even the non-hazardous wastes.
4. It was felt that "End-of-life-WEEE " per-se, is not hazardous , but it is the Processing of WEEE, in particular processes which attempt to Recover Materials/ Precious Metals from such WEEE, which is Hazardous. This aspect may be appropriately taken care of in the final Notification / Rules.
5. It was felt that ,in order to ensure effective collection of end-of-life WEEE , the Producers (or their agents) should take major responsibility ,and to achieve this, they should put in place an effective "Take Back Scheme " , as is prevalent in some of the Developed Countries. In this regard, the efficacy of the existing legislation in respect of Lead Acid Battery (Management & Handling) Rules needs to be examined thoroughly, and loop holes / deficiencies, if any, have to be plugged.
6. It was the Consensus of the Meeting that, Plastics, of all kinds, should be prohibited from being dumped in Landfills.
7. It was strongly felt that the Unorganized- Informal Sector has a definite role to play in Collection, Sorting, and Dismantling of e-waste, but they should not be permitted to engage in Hazardous Processes to recover Precious Materials/ Metals. In order to protect large employment in the unorganized sector in the above permissible activities and at the same time eliminate environmentally unsafe activities in the sector, serious efforts are required to create proper linkages between the unorganized Sector & the

authorized Recyclers ,who have proper facilities, processes & technologies to undertake recovery of precious materials/ metals.

8. In order to achieve the above, there is need to encourage NGOs who are active in these areas. In particular, it was felt that, EWA, which is a multi-stakeholder agency, with strong presence of Industry/Industry Associations; Research Organisations such as EMPA/GTZ; and Regulatory Bodies such as KSPCB, CPCB & STPI, could be utilized for this purpose, by according it the required legal status under appropriate statutes.
9. It was noted that there is some thinking on imposing “Geographic / Locational Restrictions” on the area of operation of even, the authorized Recycling Units. This, it was felt , was unnecessary impediment, since mere transportation of end-of-life WEEE is not hazardous ,and with proper documentation/permits for movement of WEEE, across borders, it would be possible to track the final destination .Moreover, collection of waste ,at least from Households & Small Businesses, throughout the country is mostly done by the unorganized sector, and if proper linkages are created between the unorganized sector & the authorized recyclers, there is no reason why effective tracking cannot be enforced.
10. It was noted that the Guidelines are silent on the serious issue of Unauthorized/Illegal imports of Waste/Scrap electrical and electronic equipment, which some time are received as “Used/Second hand equipment for refurbishing/ Reuse”. Recent press reports of a container load of Municipal Waste, with hazardous e-waste; being received in the country is a pointer to this. It was felt that appropriate provisions must be incorporated in the Final Notification to prevent such imports, and import of e-waste, if any, should be only under full compliance of the Basel Convention and must be permitted only by Recyclers who have necessary Technical Know-how, Facility & Capability to handle such items.
11. Producers should voluntarily indicate details of the hazardous substances contained in their products; their location; proper methods for handling/ processing such products when they reach end-of-life, likely impact on personnel/environment if handled improperly, etc in product literature/catalogues.
12. Producers, who manufacture RoHS compliant products, to reduce/ eliminate end-of-life problems, should be encouraged by an appropriate scheme of Incentives under CDM or similar mechanisms.
13. Authorized Recycling units, with significant investments, should be treated on par with “Infrastructure Projects”, so that they can avail concessional Institutional Finance as also the applicable incentives.
14. The matter regarding levy of an appropriate “ Advance Recycling Fee “, as prevalent in some developed countries, needs to be discussed with concerned stakeholders, and an acceptable scheme evolved in a phased manner.
15. Regulatory Bodies, such as the Central & State Pollution Control Boards, should be strengthened adequately to meet the challenges.

**MEETING NOTES OF THE NON GOVERNMENTAL ORGANISATIONS DISCUSSION ON THE
“CPCB’S DRAFT GUIDELINES FOR ENVIRONMENTALLY SOUND MANAGEMENT OF
ELECTRONIC WASTE” HELD ON SEPTEMBER 11, 2007 AT DEVELOPMENT ALTERNATIVES.**

AGENDA: Discussion on CPCB’s “Draft Guidelines for Environmentally Sound Management of Electronic Waste”

PARTICIPANTS:

- Mr. Ramapati Kumar, Team Leader, Greenpeace;
- Ms. Rachna Arora, Programme Associate, GTZ-ASEM;
- Mrs. Richa Tyagi, Business Community Foundation;
- Mr Satish Sinha, Associates Director, Toxics Links;
- Ms. Priti Mahesh, Senior Programme Officer, Toxic Links;
- Mr Rajneesh Sareen, Regional Programme Coordinator, WWF – India;
- Ms Madhur Das, Director, Business Development, WWF – India;
- Dr. (Ms.) K Vijaya Lakshmi, Assistant Vice President (Environment) Development Alternatives;
- Mr. Arupendranath Mullick, Development Alternatives;
- Ms. Riti Kushwaha, Development Alternatives;
- Ms. Trapti Dubey, Environmental Executive, Development Alternatives.

Venue: Development Alternatives Office, Vasant Kunj, New Delhi.

The major observations and recommendations made by the participants on the draft guidelines are as follows:

Observations

- The CPCB’s draft guideline does not provide the efficient approach to solve emerging and serious problem of e-Waste management as these guidelines do not have binding on anyone and it will be more of recommendations type.
- Approach given in the guidelines were more towards the treatment of e-waste, rather the guidelines should also focus on management of the e-waste.
- In spite of the guidelines been made, there is an urgent need for a separate regulation for environmentally sound management of e-waste, specific to the Indian context.
- In spite of having regulation to stop the trans boundary movement of hazardous waste, e –Waste coming to the India by the route of charity and illegal dumping. There is need of assigning clear responsibility to concern department to tackle this problem.

- Lack of awareness in public, informal and formal sector is the major obstacle of proper management of e-Waste at the level of collection, segregation, recycling.

Recommendations

- The concept of Extended Producer Responsibility shall also be applied in India with the help of stringent regulation. As big players are not fulfilling their responsibilities to overcome the problem of e- Waste management and double standard followed by international manufacturers for India and other parts of the world should also take into the consideration.
- Regulatory authority shall look into the option of providing incentives to consumer for the development of proper and feasible channel between consumer, Informal sector and formal sector for the recycling of e-Waste, as this can be a viable solution of the problem arises during collection of e-Waste.
- Inclusion of informal sector for addressing the recycling problem will be very beneficial both in terms of economic and proper management.
- Research and Developments efforts are required for manufacturing of green product via reducing or eliminating the use of toxic chemical at the level of manufacturing/designing stage itself.
- Recycling and treatment mechanism provided should not be rudimentary. It shall be more comprehensive and practically applicable.

COMPONENTS OF E-WASTE

E-waste contains over 1,000 different substances and chemicals, many of which are toxic and are likely to create serious problems for the environment and human health if not handled properly. However, classification of e-waste as hazardous, or otherwise, depends on the amount of hazardous constituents present in it. E-waste contains many toxics such as heavy metals, including lead, cadmium, mercury, Polychlorinated Biphenyls (PCBs), Poly Vinyl Chloride (PVC), etc, in some components.

Lead

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

Cadmium

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

Mercury

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

Hexavalent Chromium/Chromium VI 29

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

Plastics (including PVC):

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

Brominated flame retardants (BFRs):

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

Barium

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

Beryllium

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

Toners

Found in the plastic printer cartridge containing black and colour toners

Phosphor and additives

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

- Phosphor is an inorganic chemical compound that is applied as a coat on the interior of the CRT faceplate. Phosphor affects the display resolution and luminance of the images that is seen in the monitor

Source: Toxics Link, New Delhi

EFFECTS OF E-WASTE RECYCLING ON HEALTH AND ENVIRONMENT.**Health Hazards**

Source of e-wastes	Constituent	Health effects
Solder in printed circuit boards, glass panels and gaskets in computer monitors	Lead (Pb)	<ul style="list-style-type: none"> • Damage to central and peripheral nervous systems, blood systems and kidney damage. • Affects brain development of children. • Reproductive system in adults
Chip resistors and semiconductors	Cadmium (Cd)	<ul style="list-style-type: none"> • Toxic irreversible effects on human health. • Accumulates in kidney and liver. • Causes neural damage. • Teratogenic.
Relays and switches, printed circuit boards	Mercury (Hg)	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • Asthmatic bronchitis. • DNA damage. • Nasal ulcers • Lung cancer
Cabling and computer housing	Plastics including PVC	<p>Burning produces dioxin. It causes</p> <ul style="list-style-type: none"> • Reproductive and developmental problems; • Immune system damage; • Interfere with regulatory hormones
Plastic housing of electronic equipments and circuit boards.	Brominated flame retardants (BFR)	<ul style="list-style-type: none"> • Disrupts the functions of the endocrine system.
Front panel of CRTs	Barium (Ba)	<p>Short term exposure causes:</p> <ul style="list-style-type: none"> • Muscle weakness; • Damage to heart, liver and spleen.
Motherboard	Beryllium (Be)	<ul style="list-style-type: none"> • Carcinogenic (lung cancer) • Inhalation of fumes and dust. Causes chronic beryllium disease or berylliosis. • Skin diseases such as warts

Environment hazards

Computer / e-waste component	Process	Potential Occupational Hazard	Potential Environmental Hazard
Cathode ray tubes (CRTs)	Breaking removal of copper yoke and dumping	<ul style="list-style-type: none"> • Silicosis • Cuts from CRT glass in case of implosion • Inhalation or containing cadmium or other metal 	Lead, Barium and other heavy metals leaching in to groundwater, release of toxic phosphor
Printed circuit boards	De-soldering and removing computer chips	<ul style="list-style-type: none"> • Tin and lead inhalation • Possible brominated dioxin, beryllium, cadmium, mercury inhalation 	Air emission of same substances
Dismantled printed circuit board processing	Open burning of waste boards that have had chips removed to remove final metals	<ul style="list-style-type: none"> • Toxicity to workers and nearby residents from tin, lead, brominated dioxin, beryllium, cadmium and mercury inhalation • Respiratory irritation 	Tin and lead contamination of immediate environment including surface and ground waters. Brominated dioxins beryllium, cadmium and mercury emissions
Chips and other gold plated components	Chemical stripping using nitric and hydrochloric acid along riverbanks	<ul style="list-style-type: none"> • Acid contact with eyes, skin may result impermanent injury • Inhalation of mist and fumes of acid chlorine and sulphur dioxide gases can cause respiratory irritation to severe effect including pulmonary edema, circulatory failure and death 	<ul style="list-style-type: none"> • Hydrocarbons, heavy metals, brominated substances • Acidifies the river destroying fish and flora
Plastic from computer and peripherals e.g. printers, keyboards etc.	Shredding and low temperature melting to be reutilized in poor grade plastics	Probable hydrocarbon, brominated dioxin and heavy metal exposure.	Emissions of brominated dioxins and heavy metals and hydrocarbons

Computer wires	Open burning to recover copper	Brominated and chlorinated dioxin, polycyclic aromatic hydrocarbons (PAH) (Carcinogenic) exposure to workers living in the burning works area	Hydrocarbons ashes including PAHs discharged to air, water and soil.
Miscellaneous computer parts encased in rubber or plastic e.g. steel rollers	Open burning to recover steel and other metals	Hydrocarbon including PAHs and potential dioxins exposure	Hydrocarbons ashes including PAHs discharged to air, water and soil
Toner cartridges	Use of paint brushes to recover toner without any protection	<ul style="list-style-type: none"> • Respiratory tract irritation • Carbon black possible human carcinogen • Cyan, yellow and magenta toners unknown toxicity 	Cyan, tallow and magenta toners unknown toxicity
Secondary steel or copper and precious metal smelting	Furnace recovers steel or copper from waste including organics	<ul style="list-style-type: none"> • Exposure to dioxins and heavy metals. 	Emission of dioxins and heavy metals

Source : Tata Energy Research Institute

MECHANISMS EMPLOYED FOR RECOVERING COMPONENTS

S.no	Computer component	Recovered Component	Mechanism employed
1.	Monitor	CRT, Circuit Board Plastics, Copper	Dismantling using Screw drivers(The broken CRTs are dumped)
2.	Hard Disk	China steel, Aluminium, Actuator, Circuit Board	Broken using hammer
3.	Circuit Board	Capacitor, Condenser, Copper, Gold	Gold recovery by acid treatment, Copper by heating, Crushing of boards by custom made Crushers.
4.	Printers	Motor, Plastics	Dismantling using Screw drivers
5.	Cables & Wires	Copper, Aluminium	Burning

SWISS FEDERAL LABORATORIES FOR MATERIALS TESTING AND RESEARCH (EMPA)
STUDY IN ELECTRONICS CITY, BENGALURU (2007)

A survey was conducted by EMPA in 2007 in Electronics City. 16 major companies were included in the survey where person's in-charge of e-waste was interviewed. Only 4 companies claim to follow internal policies when it comes to e-waste management.

The survey revealed that almost none of the companies keep track of the cost caused by e-waste management such as storage and logistics. E-waste in the form of computers and other high-end equipment is kept separately. Other devices and items like tube lights and cables, etc are disposed off with regular Municipal Solid Waste. Companies are also seen to continue to donate their waste to institutions without any further follow up of what happens to the waste thereafter. It is known that a large chunk of donated computers finally ends up as scrap with the informal sector since they do not function suitably. However, it can be stated that clear guidelines for management of e-waste do not exist and that it is necessary to provide a legal, environmentally friendly and convenient way to dispose of e-waste for the companies.

On the positive side, most companies admitted that they need to examine their e-waste storage and disposal systems. A majority stated that they would prefer to dispose of their e-waste through a common, collective system in Electronics City. Many companies reasoned that this would be less effort for them, as they would not have to negotiate with the recycler. Especially smaller companies would have a lot of difficulties to get a recycler to pick up e-waste from their premises due to small quantities of e-waste. Some companies, however, have global policies on e-waste that do not allow them to take part in a collective e-waste management system.

Another objective of the survey was to get an idea of the annual e-waste flow and the amount of e-waste stored in storage rooms. Unfortunately EMPA soon realised that this information was very sensitive. Finally the survey was completed with only four companies

Annual e-waste flow for Electronics City

	Minimum	Maximum
Annual per capita e-waste flow	5.8 kg	7.6 kg
Considering uncertainty of data	5 kg	8 kg
All employees in Electronics City	45'000	70'000
Annual e-waste flow in Electronics City	225 t	560 t

From the annual per capita e-waste flow, the annual flow in Electronics City can be calculated. To get the annual e-waste flow for Electronics City, the total number of employees is multiplied with the per capita flow.

To cross check the results that were gained from the e-waste assessment a simple calculation based on only computer waste can be made. Assuming that a computer has a lifespan of 3-5 years in high tech companies and that 70% of all the employees in Electronics City use a computer at work, it can be estimated that every 3-5 years 31500 – 49000 computers become obsolete. Thus, in average approximately 6300 to 16300

computers become obsolete every year. Assuming a total weight of a computer of 25 kg this leads to 157 t - 410 t of only computer waste per year. This matches the figures from the e-waste assessment well considering no other types of e-waste have been considered.

Computer waste estimation

	Minimum		Maximum	
Computer lifespan	5 years		3 years	
Penetration of computers in EC	70%			
Employees in Electronics City	45'000	70'000	45'000	70'000
Obsolete PCs every 3-5 years	31'500	49'000	31'500	49'000
Obsolete PCs per year	6'300	9'800	10'500	16'300
Weight of PC in kg	25 kg (incl. monitor)			
Obsolete PCs per year in kg	157 t	245 t	262.5 t	410 t

Due to the very small amount of data the discrepancy between the minimum and maximum values are quite big. For the definition of the capacity the maximum amount will be considered whereas for the financing the calculations have to be made with the minimum estimate.

The response of the companies to the survey has shown that the companies are not very comfortable with providing information about their e-waste handling practices, not even to help implementing a safe and environmentally friendly method of disposal. It is likely that one reason for this, among others, is the obscure legal situation.

e-waste estimates	
Estimated annual e-waste flow (minimum)	225 tons
70% IT and telecom equipment	157.5 tons
25% lighting & electrical	56.25 tons
5% office equipment	11.25 tons

SCHEDULE – 7 OF HAZARDOUS WASTES (MANAGEMENT & HANDLING) RULES, 2003**[SEE RULE 4(B) AND 12 (4)]****List of Authorities and Corresponding Duties**

S. No.	Authority	Corresponding Duties
1.	Ministry of Environment and Forests under the Environment (Protection) Act, 1986	<ul style="list-style-type: none"> • Identification of hazardous wastes [Rule 3(14)] • Permission to exporters [rule 14] • Permission to importers [rule 13] • Permission for transit of hazardous wastes through India [rule 12(2)]
2.	Central Pollution Control Board constituted under the Water (Prevention and Control of Pollution) Act, 1974	<ul style="list-style-type: none"> • Co-ordination of activities of State Pollution Control Boards/Committees • Conduct training courses for authorities dealing with management of hazardous wastes • Recommend standards and specifications for treatment and disposal of wastes and leachates Recommend procedures for characterization of hazardous wastes. • Sector specific documentation to identify waste streams(s) for inclusion in Hazardous Wastes Rules • Prepare guidelines to prevent/reduce/minimize the generation and handling of hazardous wastes • Registration and renewal of registration of Recyclers/Re-refiners of non-ferrous metal wastes and used oil/waste oil [Rule 19] • Any other function under Rules delegated by the Ministry of Environment and Forests
3.	State Government/Union Territory Government/ Administration	<ul style="list-style-type: none"> • Identification of site(s) for common treatment, storage and disposal facility (TSDF) [Rule 8(2)] • Assess EIA reports and convey the decision of approval of site or otherwise [rule 8(6)] • Acquire the site or inform operator of facility or occupier or association of occupiers to acquire the site [Rule 8(7)] • Notification of sites [Rule 8(7)] • Publish periodically an inventory of all disposal sites in the State/Union territory [Rule 8(7)]
4.	State Pollution Control Boards or Pollution Control Committees constituted under the Water (Prevention and Control of Pollution) Act, 1974	<ul style="list-style-type: none"> • Inventorisation of hazardous wastes [Rule 9(3)] • Grant and renewal of authorisation [Rule 5] • Monitoring of compliance of various provisions and conditions of authorisation including exports and imports • Issue of public notice and conduct public hearing [Rule 8(4)] • Examining the applications for imports submitted by the importers and forwarding the same to Ministry of Environment and Forests [Rule 13 (1) & (2)] • Implementation of programmes to prevent/reduce/minimise the generation of hazardous wastes • Action against violations of Hazardous Wastes (Management and Handling) Rules, 1989
5.	Directorate General of Foreign Trade constituted under the Foreign Trade (Development and Regulation) Act, 1992.	<ul style="list-style-type: none"> • Grant of licence for import of hazardous wastes [Rule 13 (5)] • Refusal of licence for hazardous wastes prohibited for imports or export [Rule 12(7)]
6.	Port Authority under Indian Ports Act, 1908 (15 of 1908) and Customs Authority under the Customs Act, 1962 (52 of 1962).	<ul style="list-style-type: none"> • Verify the documents [Rule 13 (6)] • Inform the Ministry of Environment and Forests of any illegal traffic [Rule 15] • Analyse wastes permitted for imports and exports • Train officials on the provisions of the Hazardous Wastes Rules and in the analysis of hazardous wastes • Take action against export/import violations under the Indian Ports Act, 1908/Customs Act, 1962



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