“e-Waste Assessment in India: Specific Focus on Delhi”

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A Quantitative Understanding of Generation, Disposal & Recycling of Electronic Waste

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Prepared by:

BIRD
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FOREWORD

The Indo-European e-Waste Initiative (IEeWASTE) aims to provide improved technologies and skills for holistic management of e-waste through installation of suitable collection, recycling and disposal systems, substitution or minimisation of toxic substances in production and product design, development and enforcement of adequate policies and regulatory systems.

In the last five years through the involvement of various stakeholders there has been widespread awareness and capacity building about the dangers posed due to increasing amounts of electronic wastes. The several workshops, brainstorming sessions, key player dialogues with producers, consumers, NGOs, bilateral agencies, corporate sector, scientific institutions and regulatory agencies have emerged with the building blocks for e-waste management in India. One of the major stumbling block was the absence of regulation pertaining to e-waste. Central Pollution Control Board (CPCB) has now come up with a Guideline for environmentally sound management of e-waste under the Hazardous Waste (Management and Handling) Rules, 2002. The Guidelines provides a road map for the management of e-waste and supports the National Environmental Policy (2006) as well as Tenth Five year plan (2002-2007) which furnishes significant importance to the social status of informal sector. The Guideline also emphasizes extended producer responsibility (EPR) as strategy for making the producers responsible for the entire life cycle of the product for take-back of the electronic products and proper disposal of the waste.

GTZ-ASEM is supporting the Indian government in creating awareness, policy formulation and advocacy, creating management models, assessment and projections for e-waste as well as supporting and capacity building of the formal and informal sector for improved recycling capacity. GTZ-ASEM is working extensively with the informal sector with interventions for provision of safe working environment, reassurance of sustainability, training and capacity building of the workers, occupational health and safety and income stability.
GTZ-ASEM is privileged to implement the IEeWASTE initiative with Indian and European partners, co-financed by EC for creating a sustainable management system of handling e-waste through multistakeholder approach.

Dr. Juergen Bischoff
Director,
GTZ-ASEM

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LIST OF ABBREVIATIONS

ITOPs: IT and Office Products Survey (A study on the IT market in India by IMRB International) ITOP also does an extensive survey across businesses and households to understand the replacement behavior.
MoEF: Ministry of Environment and Forest
CPCB: Central Pollution Control Board
MAIT: Manufacturers' Association of Information Technology
TEMA: Telecom Equipment Manufacturer's Association
CEAMA: Consumer Electronics and Appliances Manufacturers Association
ELCINA: Electronic Industries Association of India
ICA: Indian Cellular Association
SEC: Socio Economic Classification
CAGR: Compounded Annual Growth Rate

EXECUTIVE SUMMARY

The Indo-European-e-Waste Initiative (IEeWASTE) contributes to improved technologies and skills for e-waste management and recycling in India and improved working and living environment of urban dwellers working in the (informal) e-waste recycling sector through better managed e-waste streams, resource protection, reduced health risks and a better economic situation. In the first phase of the project, an extended desk assessment was conducted to gain a reliable overview of Waste Electrical and Electronic Equipment (WEEE) in India. The assessment focuses on identification of e-waste streams and quantification, identification of major stakeholders in the e-waste business, recycling and disposal processes and environmental, health and social impacts. To supplement the desk assessment a rapid field assessment was conducted in Delhi focussing on quantification of e-waste generated and future projections, material flow, processes of recycling and disposal, environmental impact of e-waste recycling and assess capacities of existing stakeholders.

The objectives of the WEEE Assessment study are to develop a sound methodology for estimation the volume of WEEE produced in India (limited to Computers, Television and mobile phones), projections of e-waste over next five years, disposal behavior and recycling practices, identify stakeholders in e-waste trade value-chain, assess capacities of existing recyclers and recommend a national action plan for major stakeholders to ensure proper handling and disposal of e-waste.

Methodology

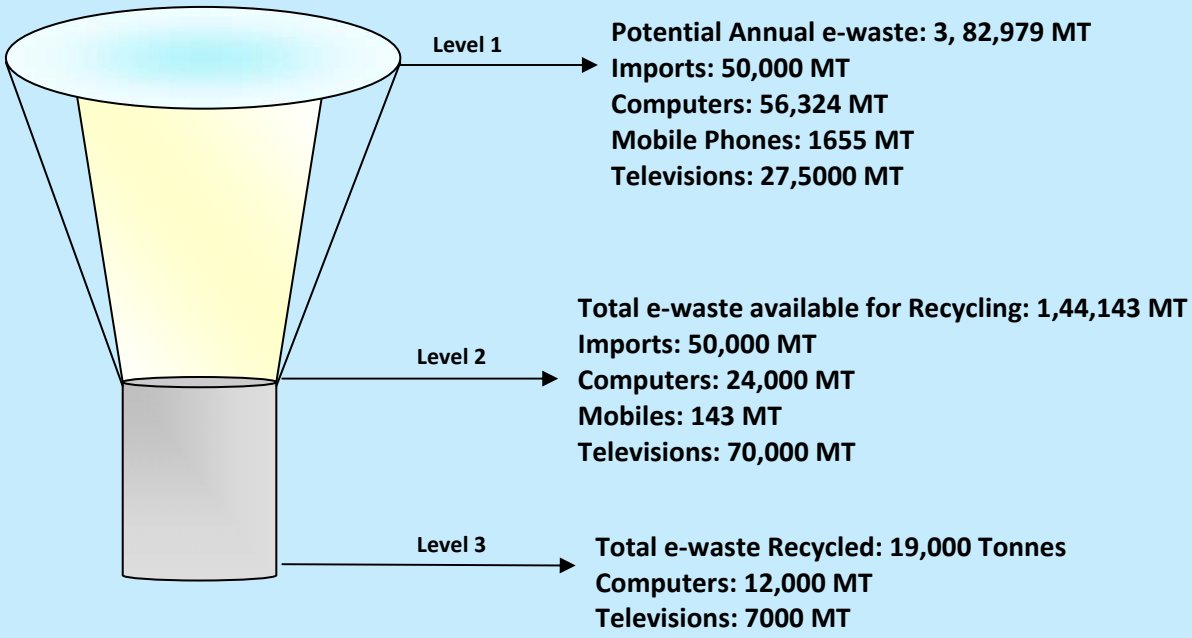
The methodology adopted for e-waste assessment and quantification study is **Funnel Approach** for accuracy and better understanding of the e-Waste production in India. In the funnel approach, the e-Waste quantities are estimated at three levels:

- **Potential Annual e-waste**: It typically includes products at the end of active life which either gets stacked inside warehouses/store rooms or products that are not sold by consumers because of inappropriate resale value or are used for lower level application.

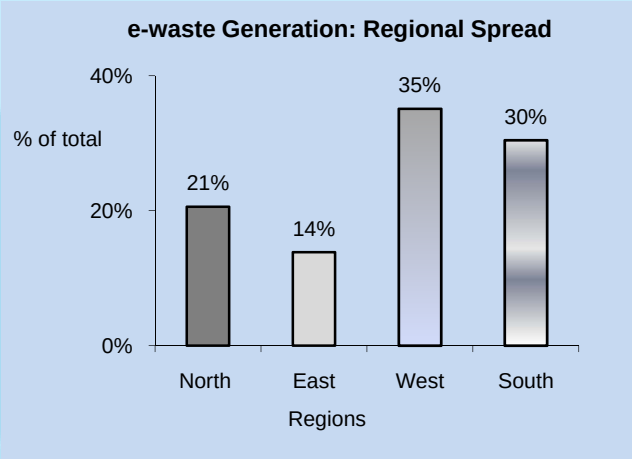
- **E-waste Available for Recycling**: It includes the products that have been exchanged/ sold by their owners. Large quantities of the Waste Electrical and Electronic Equipments get refurbished, reused or relocated to smaller towns or villages.

- **E-waste Recycled**: This includes the disposed electronic products which are actually recycled and would include the dismantled parts and components of the electronic and electrical products.

The total annual e-waste generated in India in the year 2007 is 3,82,979 MT, including 50,000 MT of imports in India. This forms the first level of the funnel as shown in the Figure, specifying the potential annual e-waste generated in India. The next level of the funnel is the amount available for recycling which is 1,44,143 MT but due to the presence of considerable refurbishment market only 19,000 MT of e-waste has been recycled in the year 2007.



Of the total e-waste generated in the country, Western India accounts for the largest proportion at thirty five percent, followed by the South at thirty percent. North and East account for twenty one percent and fourteen percent respectively. While North India is not a leading generator, it happens to be the leading processing centre of e-waste in the country. Currently there are no formal recyclers operating in the north or the east. There are two formal recyclers in the south of India and one in Western India. It is understood that several formal recycling facilities would be coming up across the country in the next couple of years.



Additionally higher per capita income, rate of change of technology and peer pressure contributes to increased rate of obsolescence of electronics. The lack of stringent regulations and awareness in India and presence of cheap labor makes India a destination for dumping of obsolete electronics from developed countries. It is however illegal to import e-waste in India as it is a signatory to Basel Convention that bans the import of hazardous substances in India. Therefore the electronic products are being imported in India in a clandestine manner. Based on the secondary sources, it is estimated that around 50,000 metric tonnes of e-waste is being imported to India every year.

Currently in India, recycling of disposed electronic products is being handled by two segments: Formal recyclers and Informal recyclers. The formal recyclers are handling a minor proportion close to 5% of the overall e-waste recycled in India (19,000 MT) while the rest proportion is being recycled by informal recyclers. The informal recyclers are highly networked and skilled in terms of collection of raw material. The main difference between the formal and informal recyclers is that the formal recyclers comply with the environmental and occupational health and safety norms as they are regularly audited and certified by regulatory agencies

Following recommendations are suggested on the basis of observations and results:

- A specific legislation should be developed on e-waste addressing the problems of imports as well as tackling large quantities being generated in the country itself.
- The manufacturers should take the lead and initiate extended producer responsibility or take-back initiatives either individually or collectively to manage their end of life products in a holistic manner.
- The Government should develop an inclusive model of environmentally friendly recycling wherein informal recyclers also have a stake and their skills are utilized properly.
- The awareness and capacity needs to be built up of consumers, recyclers, government and industry by NGOs and action groups on the hazards posed by improper disposal and measures to be adopted for proper disposal.
- A policy to be drafted for institutional users of computers where all the buyers of IT products must include methods of disposal of computers in their IT policy document. It should also be mandatory for the institutional users to declare their annual procurement, replacement and disposal of computers in their annual reports.
- The refurbishment or recycling business can become a profitable line of business for the computer manufacturers/vendors by developing a vibrant market for second hand electronic products.
- All the stakeholders should come forth and engage in dialogues to find sustainable solution on the issues of e-waste management.

CHAPTER 1 INDIA E-WASTE ASSESSMENT

1.0 INTRODUCTION

Electronic waste, "e-waste" or "Waste Electrical and Electronic Equipment" ("WEEE") is waste material consisting of any broken or unwanted electrical or electronic appliances. As per the CPCB Guidelines, 2008 e-waste is defined as waste generated from used electronic devices and household appliances which are not fit for their originally intended use and are destined for recovery, recycling and disposal. According to WEEE Directive, the components in WEEE are:

- IT & Telecom Equipments
- Large Household Appliances
- Small Household Appliances
- Consumer & Lighting
- Electrical & Electronic Tools
- Toys, Leisure & Sports Equipment
- Medical Devices
- Monitoring & Control Instruments

Despite its common classification as a waste, disposed electronics are a considerable category of secondary resource due to their significant suitability for direct reuse (for example, many fully functional computers and components are discarded during upgrades), refurbishing, and material recycling of its constituent raw materials. The unauthorized e-waste dismantling, recycling, resource recovery has become a global concern because many components of the above equipment are toxic and non-biodegradable and the processes employed for material recovery are hazardous.

The phenomenal growth of IT and electronics industry, changing lifestyle of people, technological development, low cost availability of electronic gadgets and hunger race has lead to increased rates of consumption of electronic products. The high obsolescence rate, change in application systems, new technological development and peer pressure has lead to increased generation of Waste Electronic and Electrical Equipments (WEEE). Coupled with internal high quantity of discarded electronics, the imports add more to the anguish of this increasing waste stream. The Basel Action Network (BAN) and Silicon Valley Toxics Coalition (SVTC) released the report *Exporting Harm: The High-Tech Trashing of Asia* with the assistance of participating organizations in February, 2002. This report revealed the millions of pounds of electronic waste being exported to developing nations by the developed countries to prevent the escalating mountains of e-waste in their countries. Despite the existence of Basel Convention, designed for prevention of toxic waste exportation from rich to poorer countries, the toxic trade continues at a rampant scale for economic pressures and incentives to export.

The relative novelty of e-waste as a contributor to the urban solid waste stream has meant that there is very little awareness on its safe management. This lack of awareness is further complicated by the lack of proper recycling facilities for e-waste. The households, business, corporate and enterprises are at the similar level in terms of disposal of end-of life electronic products. The legislation specifically pertaining to electronic waste management is lacking in India like other developing nations, thus, the toxic e-waste trade continues in an unsustainable manner. In India, e-waste is segregated, dismantled and recycled in the informal sector based in urban slums. Non Governmental Organizations (NGOs) such as Basel Action Network (BAN), Silicon Valley Toxics Coalition (SVTC) and Toxics Link have revealed that these backyard homegrown recycling industries are working with the most primitive processes (BAN Report, 2002). For example, it is a common-place to find

operations such as open burning of wires to extract re-saleable copper, soaking of circuit boards in open acid bath followed by manual scrapping to extract copper and precious materials next to open drains, mercury and cyanide amalgams to extract gold and other precious metals and breaking and regunning of toxic lead laden CRTs (Williams, 2005). A study by Greenpeace confirms the presence of heavy metals laden dust in the major recycling hubs of Delhi. The analysis of dust samples and ashes confirms the presence of cadmium, lead, zinc and Polychlorinated Biphenyls (PCBs) along with other organic contaminants (Greenpeace).

Presently, India has about 20 million computers which are expected to grow to 75 million by the year 2010 and an estimated 2.2 million computers will be obsolete in 2007. Around 14 million mobile handsets will be replaced for new mobiles in 2007 (IMRB ITOPs Study). Moreover a study by Toxics Link reveals that India generates $1.5million worth of e-Waste annually, with 1050 tonnes of electronic scrap dumped by manufacturers and assemblers (Beary, 2005).

The Indian economy just joined the trillion dollar GDP club- $4.156 trillion (2006). It is now the 4th largest economy and will cross Japan between 2012 and 2014 to become the 3rd largest in the world, 30% of Indian population will be between 25-44 years of age in the year 2020. The young and earning age profile of the Indian population offers huge potential for consumer durables. The total sales of PCs, Desktop PCs & Notebooks registered 6.34 Million units in 2006-07. Businesses have typically accounted for three-fourth of the Desktop PCs sales in India. The rapid growth of telecommunication industry has led to an accelerated growth in Indian mobile phone market. Indian mobile handset market has touched revenues of Rs. 21,434 crores in the year 2006-07. The mobile handset sales in India, including new users and replacements, has increased by 26% to 9.3 crores (93 million) units in 2007.

1.1 Objectives

The objectives of the WEEE Assessment study are as follows:

- To develop a sound methodology to estimate the volume of WEEE produced in India (limited to Computers, Television and mobile phone categories)
- To estimate the quantity of which will be generated over the next five years
- To understand the disposal behavior and drivers of users (households and businesses) of electronic equipment
- To identify and describe the current disposal and recycling practices for the above e-Waste
  - To identify various stakeholders in the e-waste value-chain with a special emphasis on the city of Delhi
  - To assess the capacities of existing recyclers (both formal and informal)
- To recommend an action plan for various key stakeholders (government, manufacturers, associations) to ensure environmentally-friendly method for e-waste handling and disposal

1.2 Stakeholders Interviewed

The various categories of stakeholders met for achieving the objectives of this study are broadly classified into four categories:

1. End Users: including households and institutions
2. Channel Members: Scrap collectors, scrap aggregators, scrap resellers
3. Suppliers & Experts: MAIT, CEAMA, ELCINA, TEMA, HCL, ICA, Toxics Link

4. Formal Recyclers: Bangalore, Chennai and Mumbai

1.2.1 Channel Members

The key channel members (aggregators, segregators and recyclers) of the unorganized trade-chain at various levels were met in and around Delhi, Mumbai and Chennai to map their functioning at different levels and to understand the supply chain. The informal recyclers met as the part of the study were usually present in the outskirts of the cities. The informal recyclers, traders and workers were interviewed by an unstructured discussion and meeting to extract information on their trade chain, regional spread, networking, sourcing of material, refurbishing and reuse, economics and trading/markets of refurbished components, dismantling and processing mechanism and final disposal.
The first area covered while studying this segment was Delhi covering areas like Shastri Park, Mandoli, Krishna Vihar, Mustafabad, Seelampur and Turkman Gate. In Mumbai, regions covered were Kurla and Lamington Road. In Chennai, the Chennai port was visited to understand the movement of imports. The informal sector was not willing to share any information related to their business, like sourcing of material, dismantling and processing of wastes, economics and scale of operation as they were unhappy with earlier interviews and reports which portrayed them as unscrupulous workers performing illegal activities.

1.2.2 Formal Recyclers

The companies recycling e-waste in environmentally sound manner i.e. formal recyclers were also met for in-depth interviews. The three formal recycling facilities met in this category were: Trishyiraya (Chennai), Infotrek (Mumbai) and E-Parisara (Bangalore). The information areas studied in this segment are the scope of work, sourcing of materials, installed production capacities, processes adopted by these formal recyclers, methods of recycling, challenges faced in sourcing and processing of material and initiatives undertaken by them to create awareness in market about their existence.

1.2.3 Experts

The Experts on the subject and manufacturers were met to understand the trends & market of computers, television and mobile phones in India. . The information gathered from in-depth structured interviews was on the average age of the electronic products, current and past trends of Market Size, replacement rate, expected quantity of e-waste produced from these three products and immediate steps that can be taken by the industry to resolve the issue of e-waste. The Experts met were Industrial Associations like Manufacturers Association of Information and Technology (MAIT), CEAMA, Electronic Industries Association of India (ELCINA), Telecom Equipment Manufacturer's Association of India (TEMA), Industries like HCL, Indian Cellular Association (ICA) and NGOs working on the issue like Toxics Link.

1.2.4 End Users

The End Users were met in Delhi and NCR region to understand the disposal pattern of electronic equipments. The respondents met in this segment comprises of households and business segment to collect primary data through structured discussion guide.

2.0 INDUSTRY OVERVIEW

The electronics industry is presently the World's largest and the fastest growing manufacturing industry. The Indian industry is also affected by the global markets resulting as one of the largest markets for electrical and electronic products.

2.1 Indian Economic Growth

The Indian economy is changing remarkably with a 6% average GDP growth in the year 1980-2002 to 9.2% in the year 2005-2006 (Table 1). Indian economy just joined the trillion dollar GDP club- $4.156 trillion (2006). It is now the 4th largest economy and it will cross Japan between 2012 and 2014 to become the 3rd largest in the world. The 30% of India's population will be in the age group of 25-44 years in 2020. The young and earning age profile of the Indian population offers huge potential for durables.

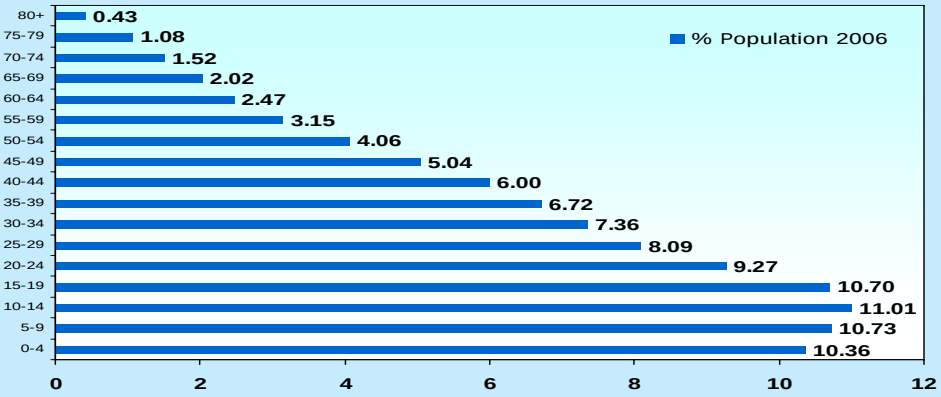


Figure 1: Population of India by Age (Total Population 2006: 1.11 Billion)
(Source: Government Census of India)

The electronic industries have emerged as the fastest growing segment of Indian industries in terms of production, internal consumption and export. This growth has significant economic and social impact as the rapidly increasing consumption and obsolescence rates of electronic products are leading to higher generation of e-waste. The demographic data (Table 1) shows that the base of rich class has increased from 15 million people (2001-02) to 30 million people (2006-07) and they are the highest consumer of durables.

2.1.1 PC market in India – Trends

PCs sales surpassed the 6 Million mark in the year 2006. The sales of PCs, Desktop PCs & Notebooks combined, registered 6.34 Million units in 2006-07, pegging a growth rate of 26% over the previous year (ITOPS, a study on the IT market in India by IMRB International). The Desktop market growth rate is given in Table 2. While the growth has slowed down over the years, the market is still expected to keep growing at 15-20% over the next few years. The household segment, e-Governance projects of the Government of India, Education, Media Professionals and BFSI segments are the major growth drivers. The notebook PC sales are increasingly eating away into the share of desktops sales. The share of notebook PC in the PC market has increased to 13%. The ITOPs data given in Table 3 shows the share of desktops and notebooks in overall PC market. There has been a definite trend towards replacement of desktop PCs by notebooks in the relatively affluent households in India, especially in the Tier I towns. Further, replacement rate of PCs in the new age Services sectors such as BPOs, KPOs, IT, BFSI, Advertising, etc. is on the rise. Some services sector

companies replace nearly one-fourth of their PC installed base in one year itself. The PC yearly sales for the year 2002-06 are given in Figure 2.

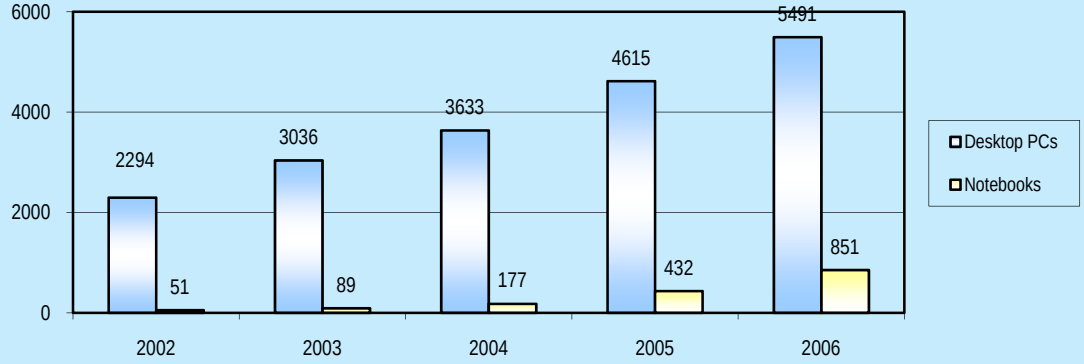


Figure 2: PC Sales (in 000's)

The desktop PC market is reaching the maturity phase while notebooks are just in the beginning of growth phase. The households and business share in the overall PC sales from year 2002-06 is given in Figure 3. Businesses have typically accounted for three-fourth of the Desktop PCs sales in India

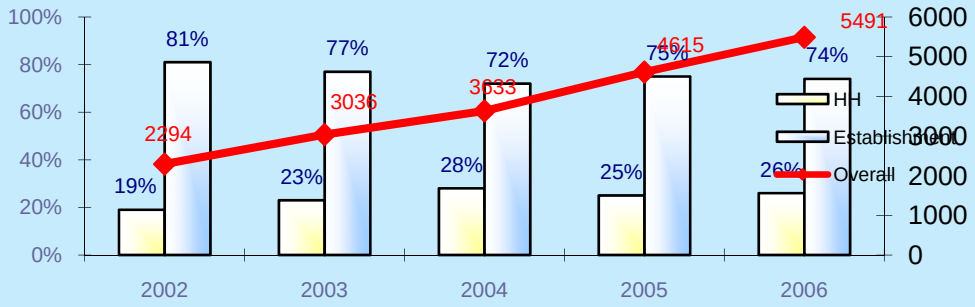


Figure 3: Households and Businesses Share in the overall PC Sales

The break-up of desktop PC sales by different businesses is given in Figure 4. Service companies are the majority buyers of Desktop PCs in India. Among the Industry Verticals, Media & Professionals, Education Segment, BFSI and IT/Software/Hardware have added significantly to the growth in the Establishment segment.

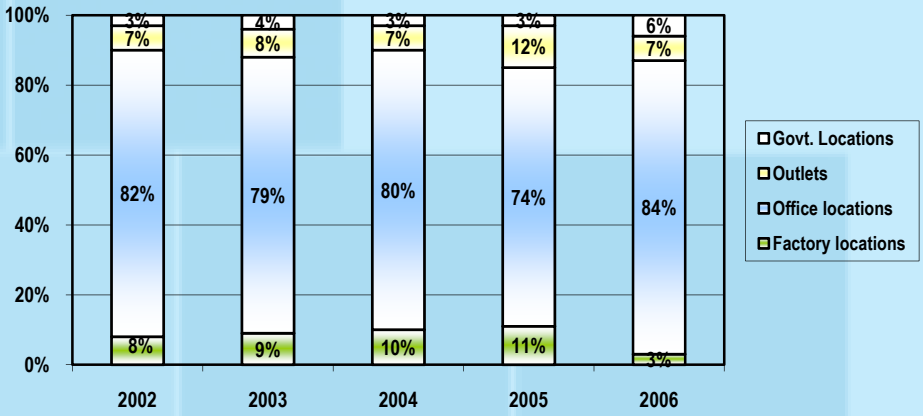


Figure 4: Break-up of Desktop PC sales by different Verticals of Businesses

Large companies contribute bulk of Desktop PC sales as shown in Figure 5. The number of large companies as users is small in number and contributes major towards market size , thus a regulation on PC disposal practices targeting the producers will help in tackling the e-waste problem significantly.

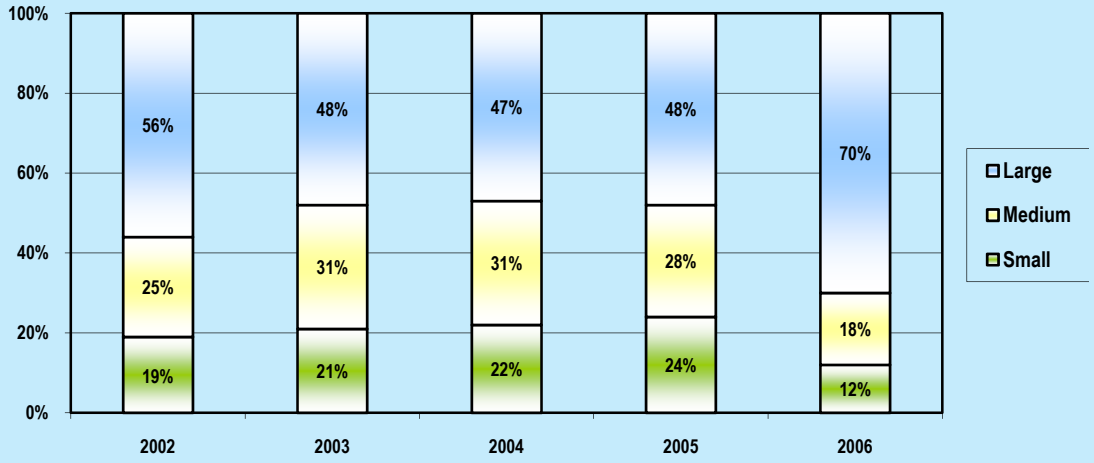


Figure 5: Break-up of Desktop PC Sales by Size of Organizations

The top 4 cities have traditionally accounted for bulk of Desktop PC sales in businesses as shown in Figure 6. Effective PC disposal in large businesses in the top 8 cities of India will make a significant reduction in e-waste quantities.

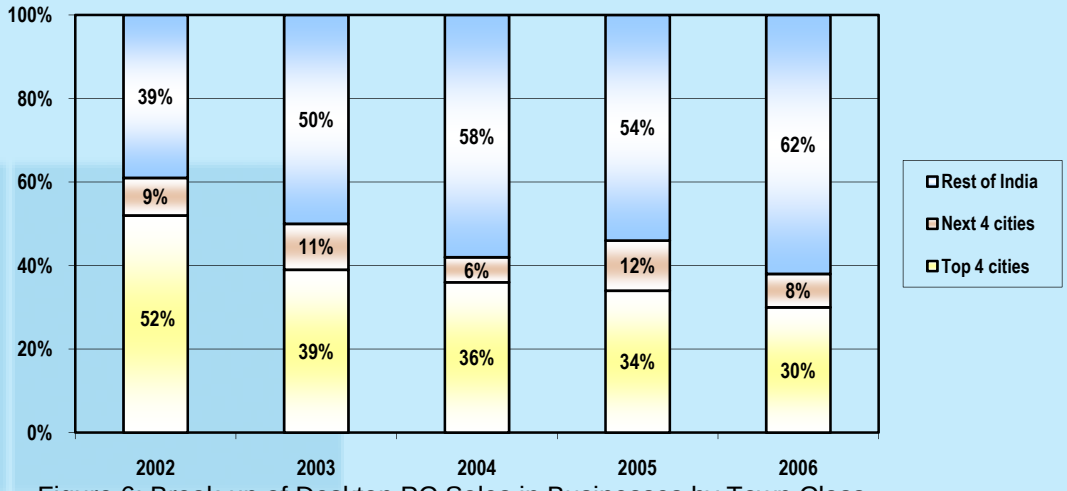


Figure 6: Break-up of Desktop PC Sales in Businesses by Town Class

Robust PC sales are expected in the light of Services sector growth, consumer purchases and lowering prices. The sales forecast of desktop and notebooks sales for the year 2008-2012 is given in Figure 7.

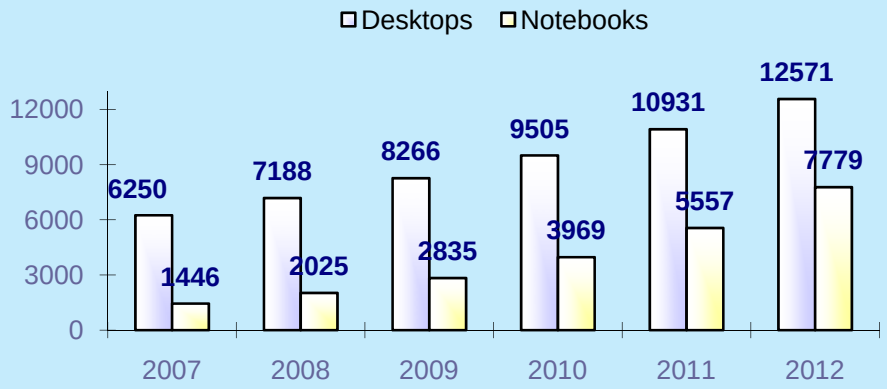


Figure 7: Sales forecasts of Desktop and Notebook Sales for next five years (in 000's)

2.1.3 Mobile Market in India: Trends

Indian Telecommunication industry has shown a tremendous growth in the past five years. Even though the fixed line market share has been dropping consistently, the overall (fixed and mobile) subscribers have risen to more than 250 million by the end of 2007. The growth rate of mobile phone subscribers from the year 2000-2007 is given in Table 4. The Break-up of GSM and CDMA mobile phone subscribers is given in Figure 8. The telecom reforms have allowed the foreign telecommunication companies to enter Indian market which has still got huge potential. International telecom companies like Vodafone have made entry into Indian market in a big way. With saturation in the urban market, growth in Indian mobile market will be driven by an increased focus on the rural market, aggressive promotions, and handset bundle offers. In March 2007, mobile subscribers in rural India accounted just 20% of the Indian mobile subscriber base. However, it is forecasted to grow at a Compounded Annual Growth Rate (CAGR) of more than 47% during 2007 to 2010. Rural India will account for around 35-38% of the total mobile handset sales by 2010.

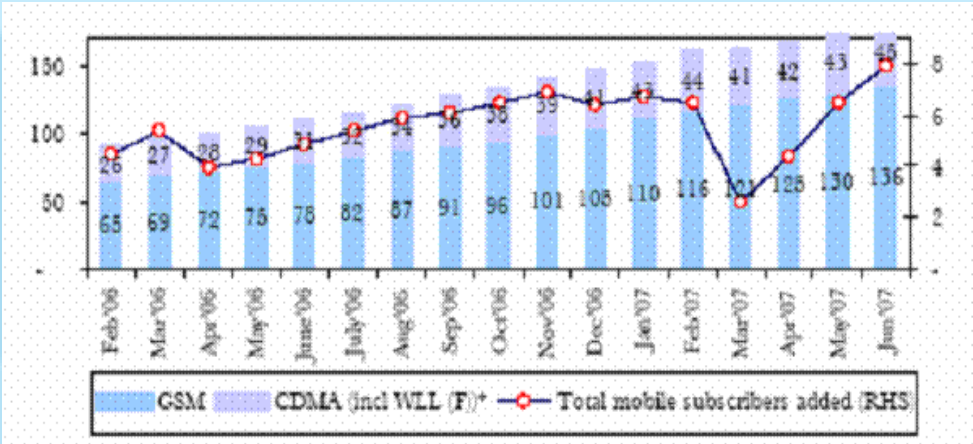


Figure 8: Break up of GSM & CDMA Subscribers

The rapid growth of telecommunication industry has lead to an accelerated growth in India's Mobile Phone market. The growth rate of top mobile companies and their revenues is given in Table 5. Indian Mobile handset market has touched revenues of Rs.21,434 crores in the year 2006-07. The revenues were at around Rs. 14,258 crores in the last year; a growth was around 62%. The mobile handset sales, including new users and replacements, in India has

increased by 26% to 9.3 crores (93 million) units in 2007. Without counting the replacement sales, around 4 million handsets are being sold each month. Assuming that a quarter of mobile phone users change their mobile phones every year, the replacement market would be around 12 million mobile phones in a year. Two years ago, the replacement market for mobile phones was barely 8-10% of the total sales, at present, it accounts for a 20-25% share which implies that almost one-fourth the number of each year's sales is the number of mobile phones entering the e-waste stream (Source: RNCOS – 2007, TRAI, AUSPI, MCIT).

2.1.3.1 Growth Factors

The primary reason for the successful Indian mobile market is the mantra of "quantity for lower cost". The rapid growth in the telecommunication sector has been boosted mainly by many growth factors like availability of cheaper handsets, declining telecom tariffs, aggressive promotions from operators and handset bundling schemes, newer locations getting added up in the geographies of mobile coverage, substantial youth population is propelling the market, advances in technology, fast growing middle class, extensive privatization of industries, availability of phones in the branded retail shops and CDMA operators moving towards open market.

Base: 21,434 Crores

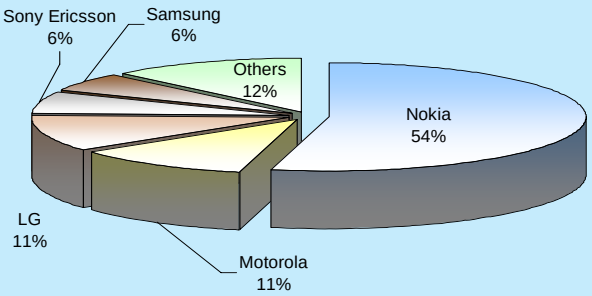


Figure 9: Share of Top Players in 06-07 Revenues (Source: ORG-Gfk)

Nokia, Motorola & LG lead in mobile handset market as shown in Figure 9. These three big players can be targeted to undertake manufacturers' responsibility for managing end of life mobile phones.

2.1.4 Television Market in India: Trends

The current size of the industry (in terms of revenue) is Rs.191 billion and projected size by 2011 is Rs.519 billion growing at a CAGR of 22%. However still India has about 50% penetration of TVs, phenomenal potential exists if we compare with the potential of other markets like China (98%), France (235%), Japan (250%) and US (333%) (Source: NCAER).

2.1.4.1 Growth Factors

Various factors contributing to this growth of television industry are as growing income levels, falling prices of new Televisions, consumerism & high purchasing power, technological improvements in the Television and related industries. The Figure 10 depicts the market size of Black & White (B&W) and Color televisions since 12 years (1995-2007). Sales of B&W televisions are decreasing but color televisions sales are increasing at a higher rate.

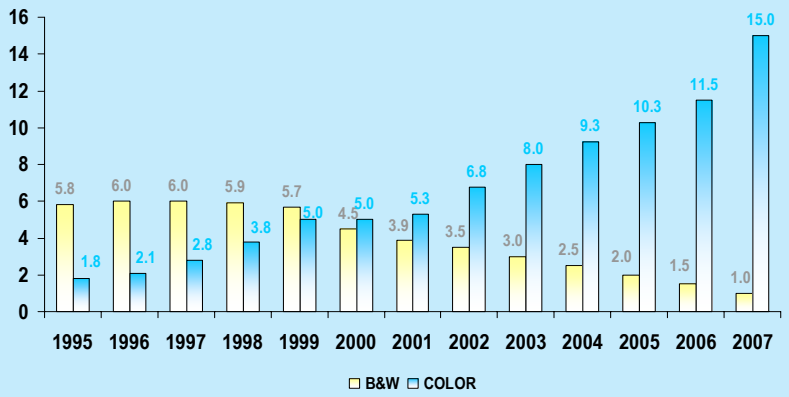


Figure 10: Market Size of Televisions (1995-2007)

The region wise breakup of television sales from the year 1996-2004 (Figure 11) shows that while West & South lead the way followed by Northern India with significant growth of TV sales. The high growth rate of TVs in the North region points towards a critical need for an organized recycler in North region to take care of the replaced televisions. The Western and Southern India should be focused for organized collection and recycling of Televisions owing to their high sales in the past few years.

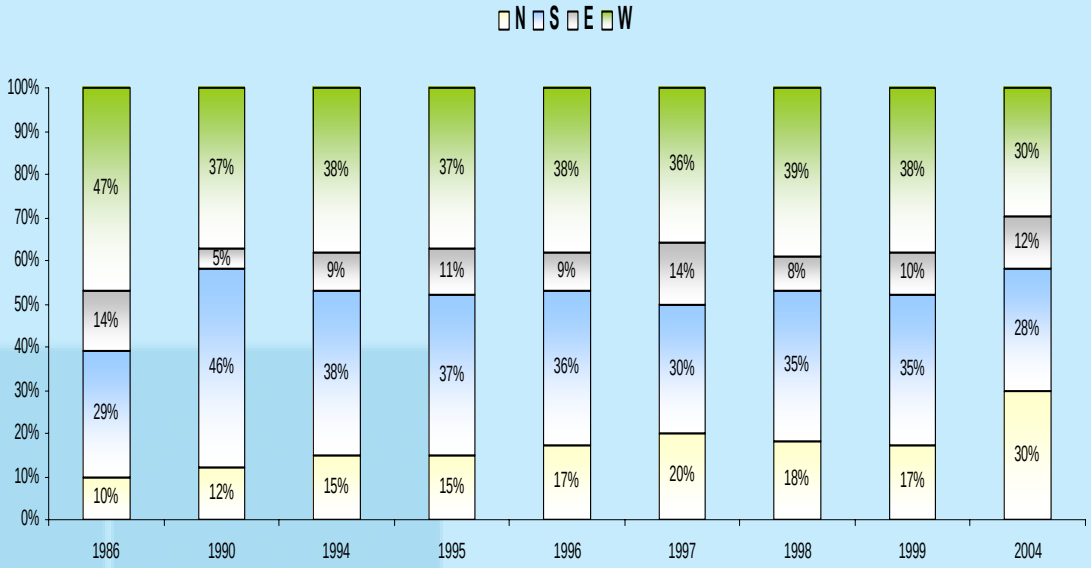


Figure 11: Region wise break-up of Television Sales

The comparison of the TV market growth rate in the year 2005 with the forecasted growth in the year 2015 indicates that the 10 million market size in the year 2005 is expected to rise to 20 million units by doubling in unit numbers for the period of ten years. However the CAGR (%) in 2005 (15%) is expected to fall down to 10% by 2015. An astronomic growth in the households TV is expected to increase from 58 million in 2005 to 234 million in the year 2015 respectively by a whooping growth rate of 300%.

Figure 12 gives a comparative picture of the current television scenario in India and projections for 2015. (Source Figure 11 & 12: INGRES, NCAER, NRS)

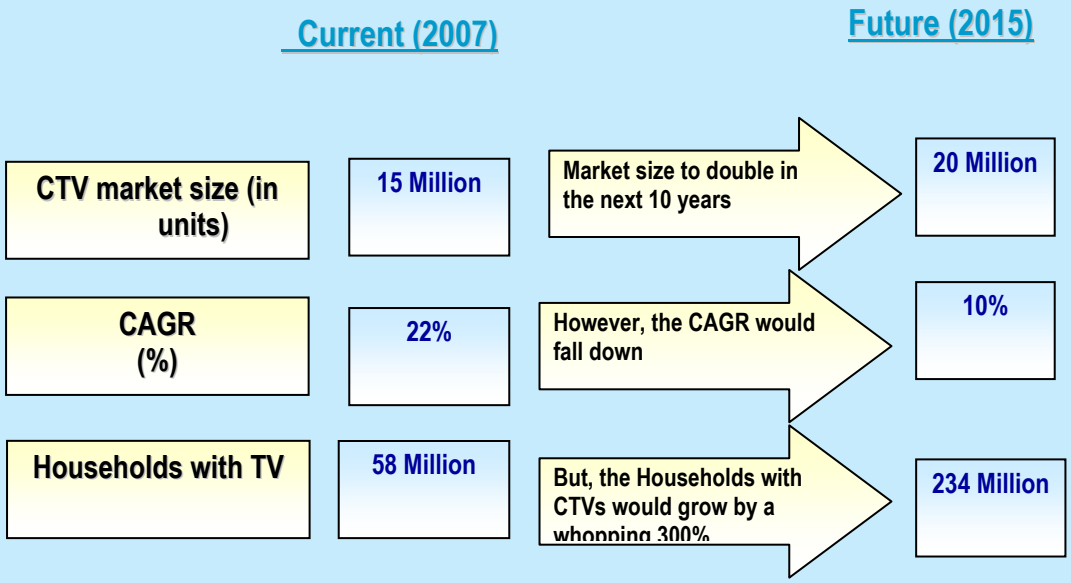


Figure 12: Current Television Scenario and projections for 2015

2.1.4.2 TV Ownership Patterns

Currently Cathode Ray Tube (CRT) conventional television is the most commonly owned television across households in the country. The penetration of CRT Flat television has also increased in last few years. The brands like LG, BPL, Onida and Samsung are the major brands owned across different households. The most preferred size for the conventional as well as Flat TV is 20-21 inches (Bigger screen size is yet to become popular in Indian households) and about more than 50% of the televisions are purchased in the range of Rs. 10,000 – 15,000. Even though the number of large screen and LCD televisions is increasing in Indian Market, mostly commonly owned televisions are the 21 inches Flat screen. Therefore, over the next few years, we will find only conventional CRT TVs in the e-waste cycle stream.

3.0 DISPOSAL PRACTICES

This section discusses the behavior associated with the disposal of used electronic products and mainly consists of three Sources (Generators) of e-waste. The three sources which add to the increased e-waste generation in India are imports, households and institutions (businesses).

3.1 Reasons of Replacement/ Disposal of PCs

Most of the companies in Southern India are bonded with STPI (Software Technology Park India), where these companies have to take approval from STPI before disposing off their computers and other IT products. Thus if a formal recyclers is tied up with bodies like STPI sourcing of raw materials will become organized with a proper collection system. However Vice President of an IT renowned Software Development Company in one of the interviews

stated that about 250-300 non functional computers are lying in their godowns waiting for clearance from STPI for its disposal, thus if even they wish to donate their computers they cannot do it without permission from STPI.

3.2 Import of e-waste

The other major source of e-waste in India other than businesses & households is imports. In the developed countries, it is expensive to recycle the discarded electronics. Thus the electronics are exported to developing nations camouflaged as charity or scrap for enhancing the product useful life. This imported electronics usually have short life or even sometimes it is unfit for use and ultimately adds to e-waste stream. This trade is flourishing in India because of presence of cheap labor that can repair and reuse the equipment/components to extend its useful life. Also the absence of import regulations has made India a favored destination for dumping of e-waste from developed countries. It is, however, illegal to import the e-waste because India is a signatory to Basel Convention for Transboundary Movement of Hazardous Substances. Therefore, electronic products are being imported in a clandestine fashion. The clandestine manner of importing e-waste makes it difficult to estimate the quantities of e-waste imported into India. Based on the secondary sources, it is estimated that around 50,000 metric tonnes of e-waste is being imported to India every year.

3.3 E-waste Recycling Practices

Currently in India, recycling of disposed electronic products is being handled by two segments namely formal and informal recyclers. It has been estimated during study that 19,000 MT/ year is the total e-waste recycled in India. Of the total e-waste recycled in India 95% is recycled by informal recyclers while only 5% by formal recyclers. This small proportion handled by formal sector suggests that they lack networking and proper collection of e-waste. They have large capacities but the absence of legislation in India for collection and disposal of e-waste paves way for unorganized collection, material segregation and extraction.

3.3.1 Formal e-waste Recyclers

The main objective of the formal recyclers is that all waste electronic and electrical equipments (WEEE) is collected, stored, dismantled and recycled in an environmentally sound manner**.** For complying with these objectives no chemicals, incineration processes and wet extraction processes are carried out without proper facilities. The formal recyclers also comply with occupational health and safety norms of the workers so that they are not exposed to toxic and hazardous elements present in e-waste.

3.3.1.1 Collection Method

Talking about the current scenario, all the formal recyclers are sourcing their raw material (i.e. used electronic products) from the corporate segment only. Most of these recyclers tie up with the institutions and sign a contract to pick up their used electronic products after fixed time periods depending upon the extent of usage and disposal of electronic products by the organization. Once these tie-ups are done, not only the waste computers are collected, but all the electronic appliances which pose a threat to the human health and environment are collected for example waste tube lights, CDs, batteries, cables etc.

3.3.1.2 Geographical Spread

As the presence of formal recyclers is not widespread across the country unlike informal recyclers, they cannot source this material from households. An organized formal recycler informed that they cannot source raw material as much as informal sector because they cannot search every nooks and corner of the country. This suggests that the organized network of the unorganized sector should be tied up to a formal recycler or a collector, so that they do not work as competitors to formal sector, instead they utilize their trade chain and supply dismantled and segregated materials to formal recyclers. This model needs to be strengthened by the support of government, NGOs and formal recyclers so that the informal sector is organized as collectors and dismantlers. Figure 13 suggests the processes followed by formal recyclers in Indi

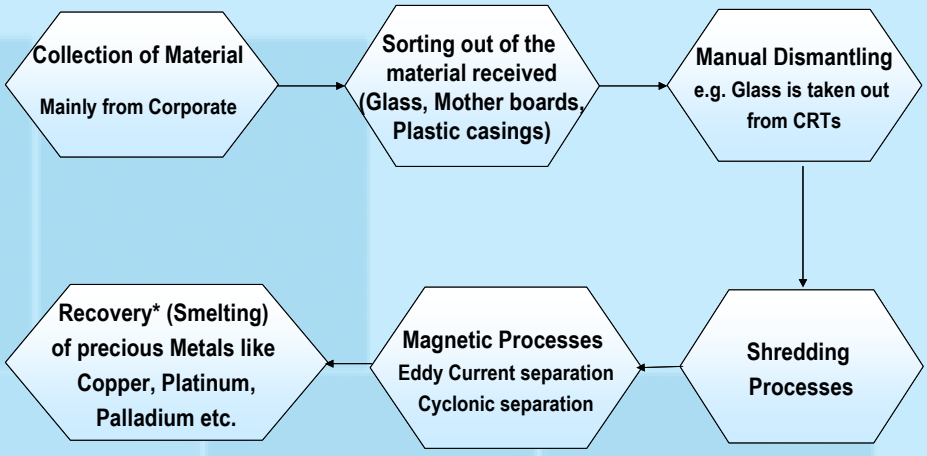


Figure 13: Process Followed by Formal Recyclers

*In India, there is no facility for Smelting process for the recovery of precious metals from the residual mixture in an environmentally sound manner. This mixture is sent to Umicore Refinery, Belgium for the recovery. This quantity of residual mixture is around 5% of the

overall quantity recycled by these recyclers. The comparison of three formal recycling is given in Figure 14.

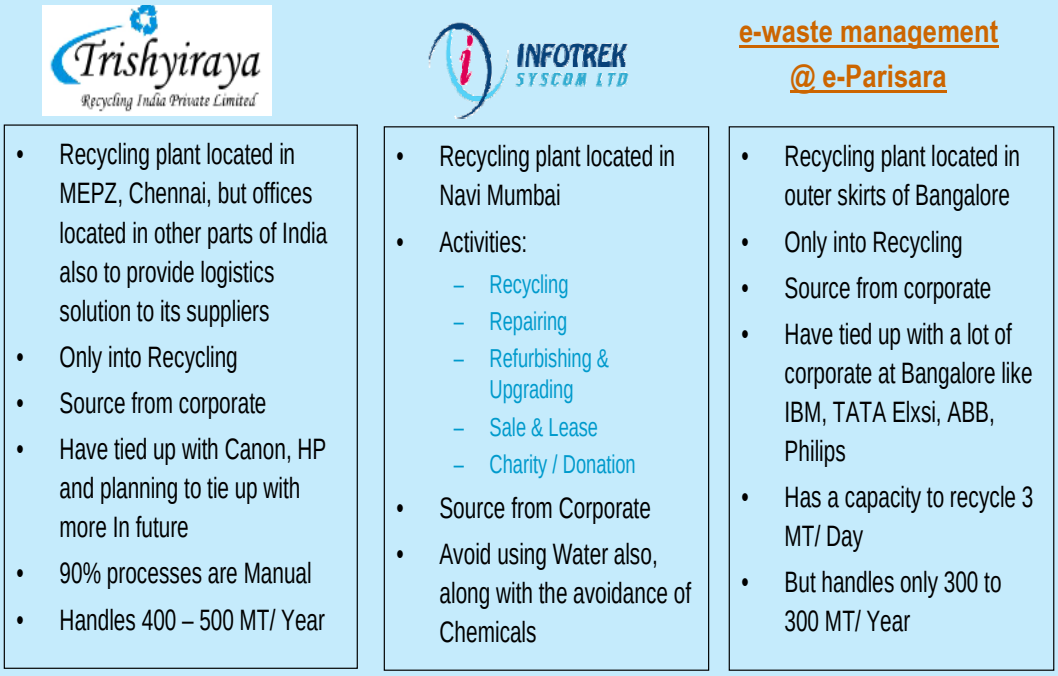


Figure 14: Comparison of Three Formal Recycling Facilities in India

3.3.1.3 Comparison between Formal and Informal Sector

Two main differences between the formal and informal recyclers are as follows:

- All processes occur in closed chambers complying with regulatory norms
- Wet extraction and open burning for recovery of materials is not practiced by formal recyclers

To support the above mentioned differences an example of CRT handling by the two kinds of recyclers is considered. The informal recyclers collect the old CRTs and either refurbish in televisions or dismantle them to recover lead and dispose the left outs (glass, metal laden dust) in the landfill. Whereas the formal recyclers break the CRTs in closed chambers using equipments like diamond cutters under vacuum, thus preventing the environment and workers from exposure to toxic elements like Lead. Informal Recyclers soak PCBs in the acid bath for recovery of copper, whereas in case of formal recyclers recovery of precious metals occurs at state of art refineries/smelters. The formal sector workers use gloves and masks to avoid exposure to hazardous elements in contrast to informal sector workers. The formal recyclers are regularly monitored and audited by regulatory agencies like State Pollution Control Board for complying with environmental norms and certification.

3.3.1.4 Challenges faced by Formal Recyclers

The overall challenges faced by the formal recyclers can be divided into three parts as follows:

- **Sourcing Stage**

The proper disposal of electronic waste is not mentioned in the environmental policies of most of the organizations, so they are not worried about the method of disposal. The only concern with these organizations is the value they get in return of their scrap equipments. Those organizations which had their parent company outside India were somewhat pressurized about the environmentally friendly disposal of their IT products as their producers take the responsibility and pay the price for disposal of e-waste. Mostly the companies ask for money from these recyclers before giving off their end of life products. Also reaching out to the customers is also a huge investment required by these formal recyclers. The logistics is to be provided by the recyclers for the material to be collected and recycled. Thus for covering entire India, presence at 9 locations also is not enough for these formal recyclers.

- **Processing Stage**

As there are no smelting units in India, these recyclers are at a loss by sending the crushed mixture to other countries for the recovery of precious metals in an environmentally sound manner. The cost of transportation and recovery is very high thus the formal recyclers claim that they are at economic loss. Trishyiraya, Chennai informed us that sending one container of mixture to Umicore (Belgium) costs around Rs. Ten Lacs as service charges. He also informed that in return of the precious metal mixture sent to refineries (99%-99.5% of metals are recovered) the recyclers, receive only the value which is decided by the refineries. The infrastructural cost for setting up a state-of-art smelting facility in India is a huge investment, thus the recyclers will have to continue with this process till some entrepreneurs sets up precious metal refinery in India.

- **Lack of Awareness among users**

Along with the absence of legislations, lack of awareness among the consumers both businesses as well as households is one of the biggest challenge for the formal recyclers. A huge amount of investments is being done to create awareness and build the capacities of consumers on e-waste issues and proper disposal. The formal recyclers arrange for video CDs, advertise on news and other media, arrange collection drives, set bins for disposal of floppies, CDs, batteries, mobiles etc at prime locations and organize workshops across India to enhance awareness. An established formal recycler informed that they spend around 80% of their overall revenue on awareness creation programme.

3.3.2 Geographical Spread of Informal Recycling in India: Mumbai

Mumbai acts as a main contributor and generator of WEEE because of huge commercial and financial activities. The regions where WEEE is handled in and around Mumbai are: Kurla, Saki Naka, Kamthipura-Grant Road, Jogeshwari and Malad. Mumbai & Chennai are top importers of junk computers and electronic waste in India because of presence of ports. Based on the field work done in Mumbai, it is observed that none of the informal recycler agrees that they are importing e-waste or have a second hand market of e-waste. They claim

that they are only repairing the non-functional electronics and providing functional goods to consumers after its repair. A local newsletter in Mumbai called Computimes provides information on imports in the form of advertisements entitled imported computers for sale. It was found that traders from Delhi purchase PCBs on per kg basis from Mumbai, Kolkata and Bangalore. A comparison of the methods adopted by informal recyclers for e-waste collection, dismantling and disposal in Delhi and Mumbai is given in Table 6.

4.0 ELECTRONIC WASTE ESTIMATES

4.1 Method of Estimation

Most of the used electronic products are either relocated or given to relatives/ friends for further use or because of lack of proper collection systems, households and institutions are not sure of the actions to be taken with their old computers or televisions, so they store these products inside their warehouses/ store rooms for a long period of time. Even when the products are sold or exchanged, a lot of refurbishments and reselling happens and only some part is recycled. As the unorganized recycling involves a lot of legal and jurisdiction issues, the unorganized players are not at all open to any kind of research or study on this subject. Therefore, for accuracy and better understanding of the e-waste production in India, a Funnel Approach has been developed as shown in Figure 15.

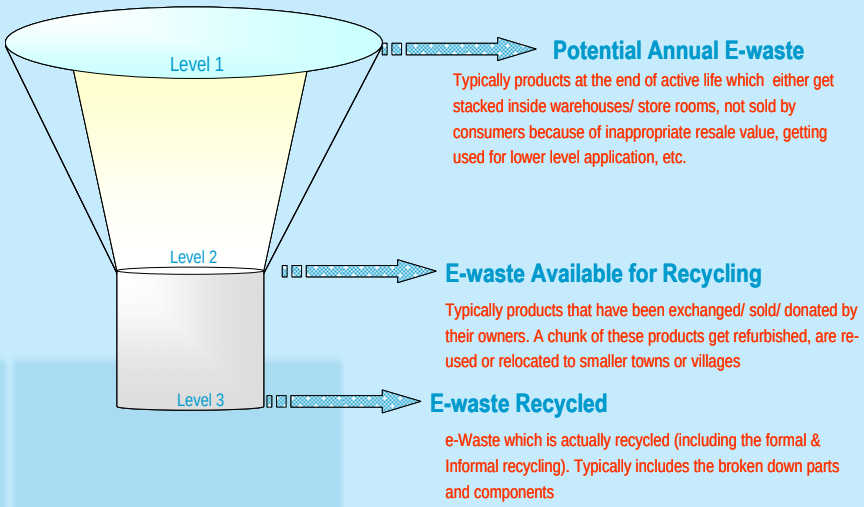


Figure 15: Funnel Approach for e-waste estimation

Level 1: Estimation of Potential Annual e-waste

Quantity at this level was calculated by applying Input and Obsolescence method to all the three products. Table 7 briefly describes the steps followed for the calculation of potential annual e-waste

Level 2: Estimation of e-waste Available for Recycling

In case of computers, quantity at this level was calculated by using the replacement percentage derived from ITOPs. ITOP does an extensive survey across businesses and households to understand the replacement behavior. The total number of computers disposed by households and businesses was used to calculate the replacement percentage

and quantity of e-waste available for recycling. In case of Televisions & Mobile phones, quantity at this level was derived on the basis of inputs from expert interviews and channel member insights. This was also validated through the primary survey done in Delhi. Channel members of informal e-waste trade were interviewed to understand from them the break-up of the material received by them in terms of what quantity is actually recycled and what is given in second hand or refurbished market. The data presented in Table 8 and 9 gives ITOPs data on computer market size of business segment and households. On the basis of ITOPs data, the estimates were made on e-waste from computers, as given in Table 10 & 11. The overall e-waste from Desktops and Notebooks and projections till 2011 is given in Table 12-14. The data on television market size provided by CEAMA is given in Table 15 and mobile phone market size by TRAI is given in Table 16. The e-waste generated from mobile phone replacements is given in Table 17 & Table 18 and e-waste from televisions is given in Table 19. The region wise e-waste generated in the year 2007 is given in Table 20.

Level 3: Estimation of e-waste Recycled

This quantity was derived on the basis of interviews with formal recyclers, informal recyclers and experts.

4.2 Domestic e-waste generated from Computers (2007)

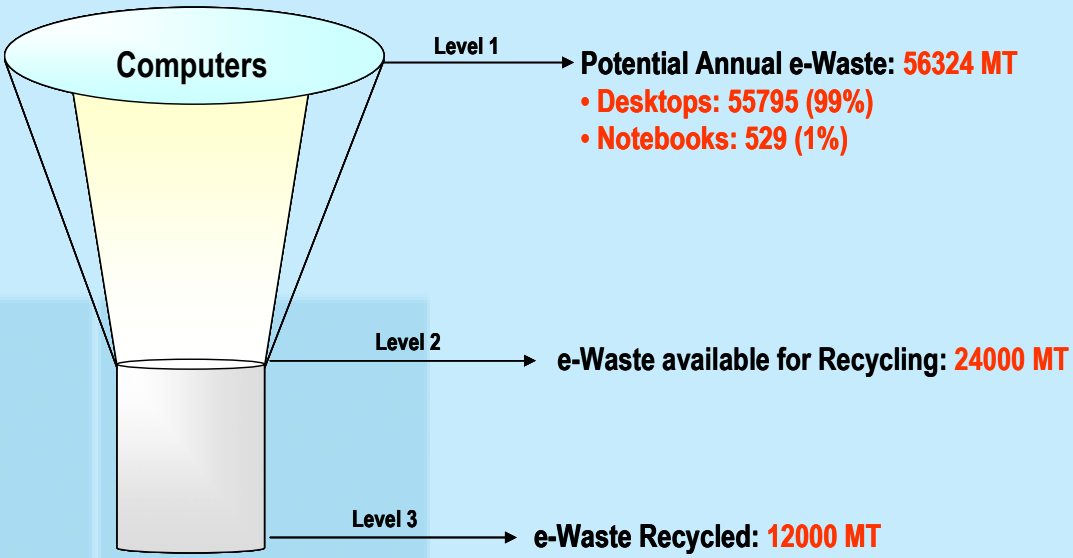


Figure 16: e-waste generated from Computers in the year 2007

As Desktops contribute 99% to the overall e-waste generated, the detailed profile of waste generated from Desktops is presented the Figure 17.

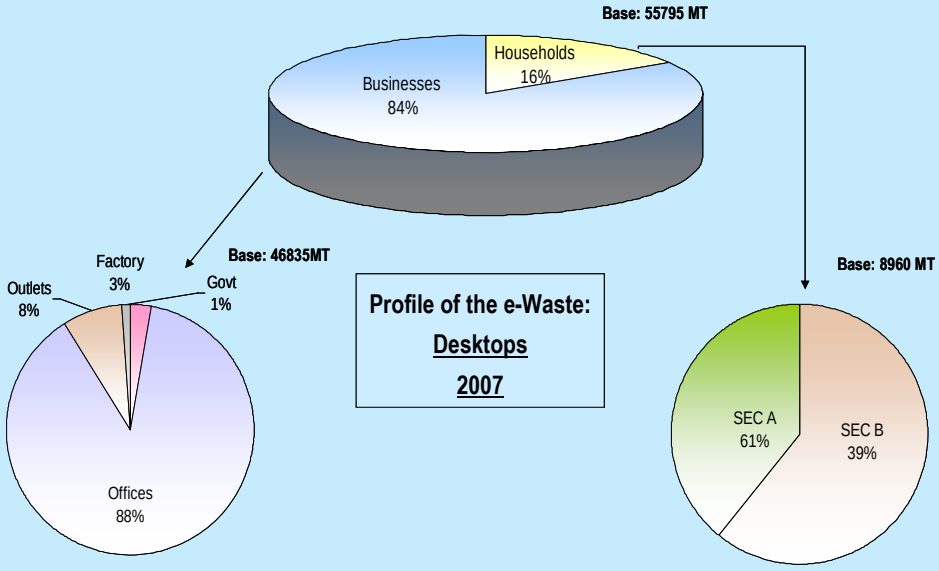


Figure 17: Profile of e-waste from Desktops in 2007

The Figure 18 represents the forecasts of potential annual e-waste from desktops over the next five years:

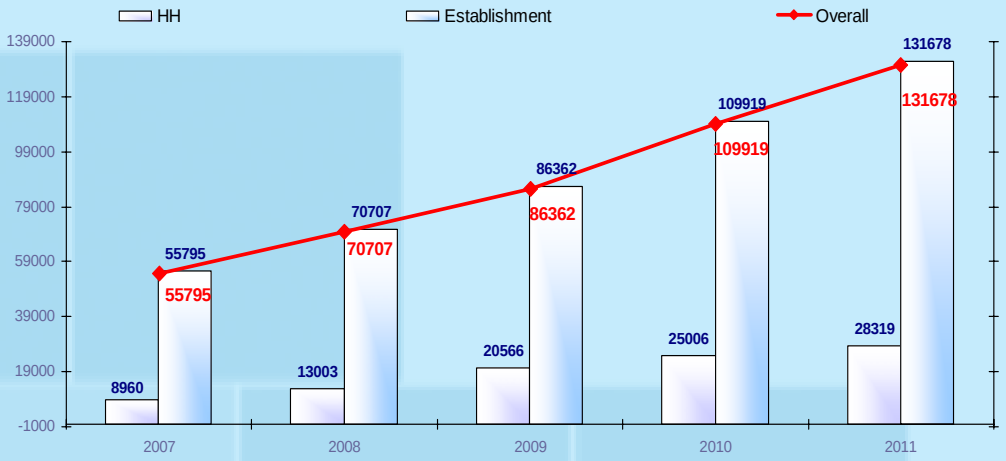


Figure 18: Forecasts of Potential Annual e-waste from Desktops (in MT)

The profile of e-waste forecast (Figure 19) suggests that in the coming years, all the actions related to e-waste management should focus on offices of service organizations as they are the maximum generators of e-waste

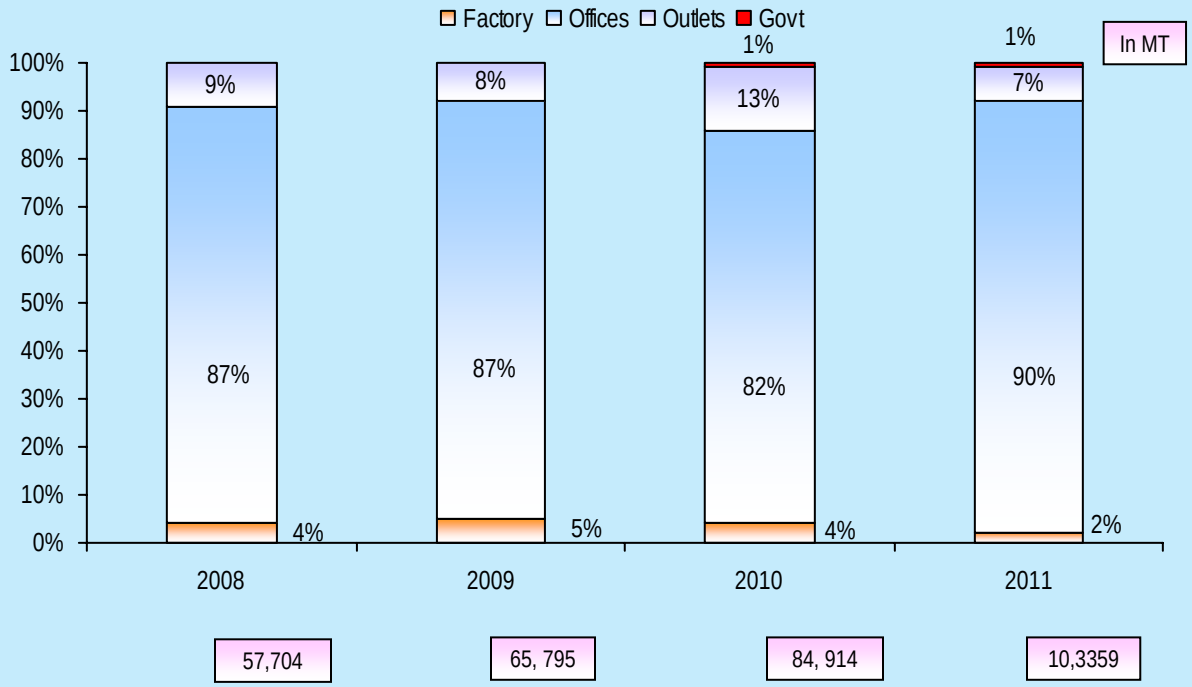


Figure 19: Forecasts of Desktops e-waste from Businesses (in MT)

4.3 Domestic e-waste generated from Televisions

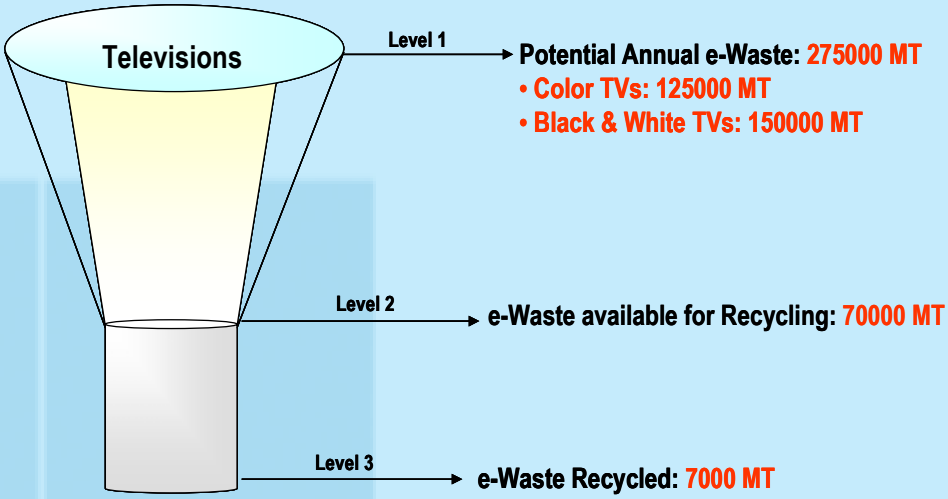


Figure 20: e-waste from Televisions: Year 2007

It was found that in case of televisions; a lot of relocation happens to the nearby villages, towns and cities, resulting into repeated cycles of reuse. As a result, there is a huge gap between the potential e-waste generated and the e-waste actually recycled.

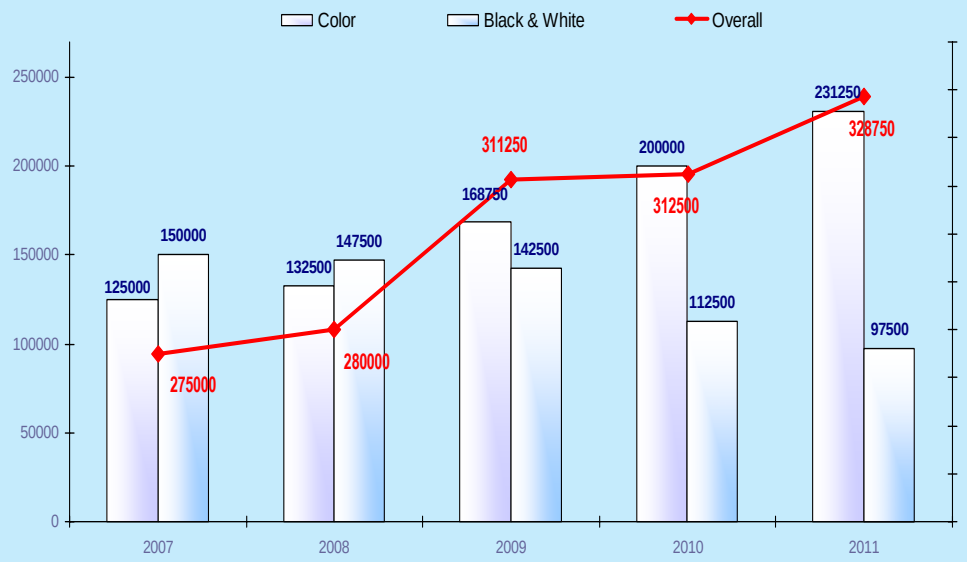


Figure 21: Forecasts of Potential Annual e-waste from Televisions for next five years (in MT)

Figure 21 indicates that till 2010 maximum amount of Televisions entering e-waste stream would be Black & White televisions.

4.4 Domestic e-waste generated from Mobile Phones

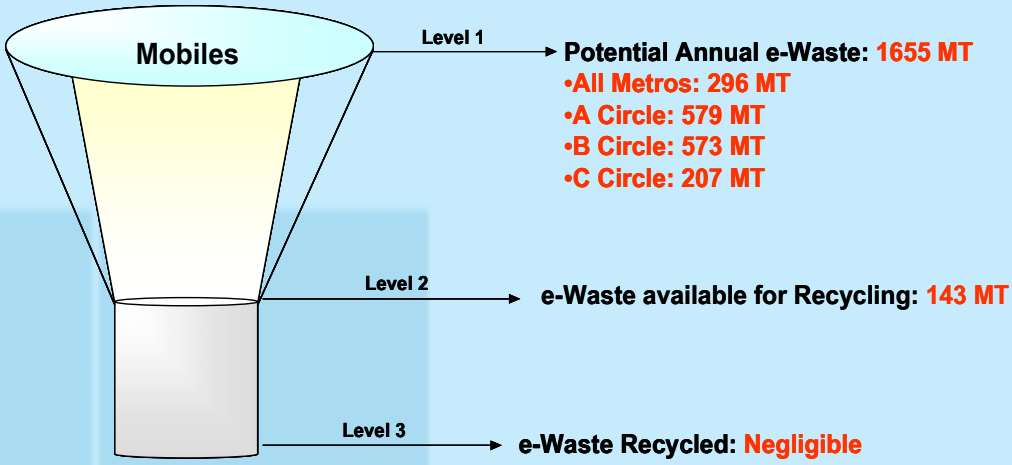


Figure 22: e-waste from Mobile Phones: Year 2007

It was found that in Case of Mobile phones, almost all the components of a handset gets reused by repairs and refurbishments, leading to negligible quantities reaching landfill or recycling stage. Major reason for the reuse of mobile phone components is as high as 34% duty on imports of components. There is a huge growth in number of mobile phones entering the e-waste stream from 2008 to 2010 as shown in Figure 23.

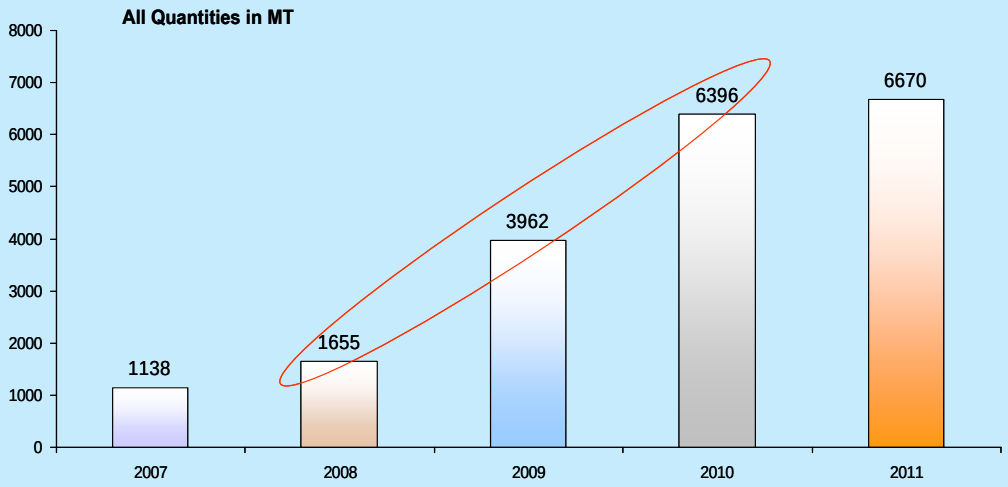


Figure 23: Forecasts of Potential annual e-waste from Mobile Phones

4.5 Total e-waste generated (Computers, Mobiles, Televisions & Imports)

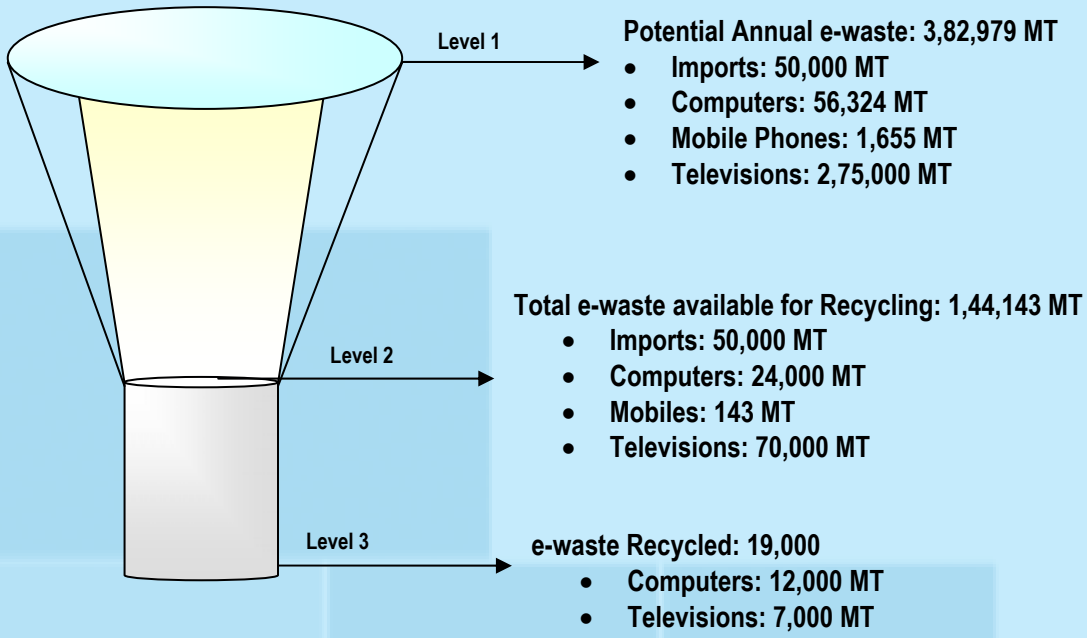


Figure 24: Total e-waste generated in India in 2007

CHAPTER 2 DELHI E-WASTE ASSESSMENT REPORT

1. INTRODUCTION

In the past few years, technology advances in electronics have boosted the economic development and improved the general lifestyle of the common man. The rapid consumption, and obsolescence, of electrical and electronic equipments has resulted in a newly identified waste stream known as Waste from Electronics and Electronic Equipments (WEEE). WEEE comprises of end of life computers, laptops, mobiles, television, washing machines, personal stereos, telecommunication equipments, instruments, toys and medical devices etc. The electronic waste is classified as hazardous wastes as it contains many toxic ingredients including halogenated compounds and heavy metals with the potential of polluting the environment and damaging human health, if not processed, recycled or disposed-off properly.

Delhi, the capital city of India, is also one of the major regional hubs for e-waste recycling. Several studies, since 2004 have depicted Delhi as the hub of informal recycling of e-waste for reuse, extraction and recovery of precious metals. The sources of e-waste in Delhi are individual consumers, MNCs, public and private enterprises, manufacturing defects and imports. The e-waste imported into Mumbai and Chennai ports also makes its way into the Delhi and NCR region. It is predicted that Delhi employs 25,000 workers in scrap yards which handle 10,000-20,000 tonnes of e-waste annually. 25% of the electronic wastes generated are from computers.

Delhi rapid assessment focuses on quantification of e-waste generated in the Delhi NCR, understanding material flow and trade chain in Delhi, processes of recycling and disposal covering informal sector, environmental impact of e-waste recycling and to assess the capacities of existing stakeholders.

1.1 Objectives

The objectives of the WEEE Rapid Assessment Study, Delhi are as follows:

- To develop a sound methodology to estimate the volume of WEEE produced in Delhi (limited to Computers, Television and Mobile Phone categories)
- To understand the disposal behavior and drivers of users (households and businesses) of electronic equipment
- To identify various stakeholders in the e-waste value-chain in the city of Delhi.
- To assess the capacities of existing recyclers (both formal and informal)

2. METHODOLOGY

To address the specified objectives, it was essential to understand and establish the e-waste trade chain by identifying roles of each stakeholder in the trade economics. This study was based on field visits and collection of primary data at various locations of Delhi and supported by secondary research and data. The tools used for the study were structured discussions guides, open ended questions and informal questions and discussions. The interviews and discussions were structured to collect the quantitative data and to understand the mindset of different stakeholders in terms of trade economics, disposal practices and reasons, expectations from formal recyclers, traders, collecting agency and government, growth rates and general awareness on the hazards posed by e-waste. The various categories of stakeholders met are broadly classified into four categories:

- End Users: including households and institutions
- Channel Members: Scrap collectors, scrap aggregators, scrap resellers in Delhi
- Suppliers & Experts: Industrial Associations like MAIT, CEAMA, ELCINA, TEMA, Industries like HCL, ICA, NGOs working on the issue like Toxics Link
- Formal Recyclers: In Bangalore, Mumbai & Chennai

2.1 End Users

The end-users were met in Delhi and NCR region to understand the disposal patterns of electronic equipment. The respondents met in this segment can be divided into two broad segments:

- Households
- Businesses

In case of households, interviews were done on the basis of two criteria:

- Socio-Economic Classification (SEC): The respondents were segregated in SEC A, SEC B and SEC C households. The SEC is done on the basis of education and occupation of the chief wage earner of the households.

- Disposal Rate: The second criteria for selecting the households were those which have disposed of either a computer, television or a mobile phone in the past two years. The households complying with this criterion were mainly questioned about the age of the products disposed by them, reasons and considerations related to the disposal and the method adopted for disposal.

In the case of Businesses (Institutional users) mainly service organizations were met in and around Delhi. The selection criterion was the same as that of the households i.e. must have disposed of at least one computer, mobile phone or television in the past two years. After identification of the organization they were asked about their IT ownership and disposal behavior, typical growth rate and replacement rates in the installed base of PCs each year.
The Institutional End Users were also asked about their expectations from the formal recyclers in terms of monetary and other services like logistics, timely pick-up of the waste etc. Both the end user segments were also questioned to judge their level of awareness and knowledge about e-Waste problem. The same was explained to all the end users.

Detailed Profile of the end users met in the survey (Representative Sample) Base 413

Respondents in various User segments

Households	
SEC A	149
SEC B	158
SEC C	90
Total	397

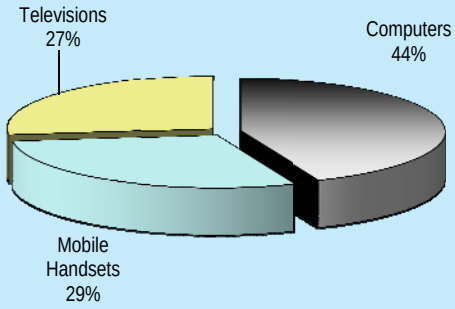


Figure 25: Detailed profile of the End Users

Profile of Households by Type of Product Disposed

Businesses	
Manufacturing	55
Services	148
Total	203

Businesses	
Small (11 to 50 Employees)	98
Medium (50 to 500 Employees)	59
Large (500+ Employees)	46
Total	203

2.2 Channel Members

The Key Channel Members (aggregators, segregators and recyclers) of the unorganized trade at various levels of trade chain were met in and around Delhi. The interviews were conducted with the channel members present in Turkman Gate, Shastri Park, Jamrudpur, Nehru Place, Seelampur and Mayapuri. The major objective of the in-depth interviews was to identify the geographical presence of these informal trade channel members across Delhi region. Once the important areas were identified, the unstructured, informal questions were administered to the members present in these areas. The main objectives of the discussions were to understand the dynamics related to procurement/sourcing of raw material, value gained or lost at each stage of the process, scope of work of different channel members, method of processing, marketing and business operations.

It was observed that majority of the respondents in this segment were apprehensive of sharing any kind of information related to their business. The discussions were kept informal to gain confidence and extract detailed information. The workers were reluctant to talk initially as they claimed that the past visitors and studies have portrayed them as illegal operators with crude environmentally hazardous processes. The workers were more forthcoming when the owners of the units were not around.

2.3 Formal Recyclers

As there was no formal recyclers in Northern Region especially Delhi and NCR region, the interviews were conducted in Bangalore, Chennai and Mumbai for formal recyclers.

2.4 Experts

The Experts and Manufacturers were met to understand the trends & market of computers, mobiles and televisions. The in depth interviews were structured to understand the average age, current and past trends of market size, expected quantity of e-Waste produced from these three products and immediate steps to be taken by the industry to address the e-waste issues. The stakeholders met were as follows:

- **Manufacturer's Association of Information Technology (MAIT)** represents 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. 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, BIS, ESC, NIC, STQC, CII, TEMA, ELCINA, CETMA, etc. for the advancement of the IT Industry in India. MAIT recognises the importance of Information Technology Industry growing with sound business relations with the rest of the world, exchanges industry data, published reports and newsletters and encourages cross attending of annual events as a part of its effort to promote international understanding.

- **ELCINA Electronic Industries Association of India (Formerly Electronic Component Industries Association)** is committed to the promotion of electronics manufacturing culture in the country focusing on components - the building blocks of electronics industry. Apart from the basic objective of promoting hardware manufacturing through active representation and advice to the Government, ELCINA has been networking with national and international technical institutions and business promotion bodies to further the interests of its members. Today, in an increasingly liberalised environment, there is greater focus on professional and value-added services rendered by the Association to the Electronics and IT Community. ELCINA has widened its horizons and broadened its activities to include the development of entire Electronics and IT Hardware, including components & assemblies, consumer electronics, telecom, IT, industrial/professional, defence / strategic electronics and other emerging areas like medical and automobile electronics, embedded systems and hardware design.

- **Telecom Equipment Manufacturer's Association of India (TEMA):** TEMA covers more than 90 percent of telecom equipment manufacturers as well as components and cables manufacturers, cellular and paging service operators and a large number of public and private sector units as well as many multinational companies. TEMA is affiliated to leading international telecom industry associations. Quite often, some Government decisions relating to Indian telecom industry are channelized through TEMA which also plays an important role in proposing the names of technical experts from the Industry to various telecom committees of the Government, and industry

associations, namely, CII, FICCI, ASSOCHAM and PHD. TEMA plays an active role in dissemination and exchange of information from the Government, foreign agencies, embassies, trade missions, Indian missions abroad and leading international trade associations. TEMA also closely interacts and exchanges information of mutual interest with international organizations like ITU, PTC, AEU, TIA (USA), TIA (Korea), and ATIA (Australia) and GAIA (Spain).

- **NGOs like Toxics Link:** Toxics Link emerged from a need to establish a mechanism for disseminating credible information about toxics in India, and for raising the level of the debate on these issues. The goal was to develop an information exchange and support organization that would use research and advocacy in strengthening campaigns against toxic pollution, help push industries towards cleaner production, and link groups working on toxics and waste issues. Toxics Link is the pioneer organization to bring forth the issue of e-waste and imports in India in the year 2002.

- **Indian Cellular Association (ICA):** ICA is the apex body of the mobile industry comprising manufacturers, brand owners, application and solution providers, distributors, retailers and eminent consumers of mobile handsets. The Association has been constituted to provide value and service to the mobile cellular industry in India by fuelling its growth, improving competitiveness, helping create a legal and ethical market and regulatory environment, thereby providing long-term benefits of mobile connectivity to the Indian masses.

- **Industries like HCL:** HCL is a leading global Technology and IT Enterprise with annual revenues of US$ 4.9 billion. The HCL Enterprise comprises two companies listed in India, HCL Technologies (www.hcltech.com) and HCL Infosystems (www.hclinfosystems.in). Its range of offerings span R&D and Technology Services, Enterprise and Applications Consulting, Remote Infrastructure Management, BPO services, IT Hardware, Systems Integration and Distribution of Technology and Telecom products in India.

3. DISPOSAL PRACTICES

The section discusses the behavior associated with the disposal of used electronic products and mainly consists of three Sources (Generators) of e-waste. The interviews and discussions were molded to figure out the reasons of disposal and awareness on the toxicity associated with e-waste. The reasons for disposal were quite important to know as it would help in structuring policies and institutionalizing the framework of implementation. The three sources which add to the increased e-Waste generation in India are imports, households and institutions (businesses).

3.1 IT Ownership & Disposal Behavior: Businesses

Almost 94% of the organizations do not have any policies for disposal of IT products. A minor proportion, i.e. 6%, of the business segments from the base of 203 have IT policies for disposal of end of life electronic and electrical appliances. Therefore it is important to

understand the reasons for no policies in the organizations on the disposal of IT products; this might be due to a lack of awareness on dumping of e-Waste in municipal waste stream or a lack of e-waste specific regulatory regime for management of end of life IT products.

- **Annual percentage replacement**

  Most of the organizations are replacing less than 10% of the computers each year. In case of Manufacturing organizations, none of the organization met replaces annually more than 40% of their PC installed base. Whereas in case of services organizations, almost 10% of them replace more than 40% of their PCs annually (Table 21-23).

- **Reasons of Replacement/ Disposal of PCs**

  In case of Businesses nearly 40% of the organizations replace their IT products because of incompatibility with latest technology so this is the most important factor for the replacement of Computers (Table 24). Other than the quantitative survey done across 203 organizations in Delhi, a qualitative study was also done across India to understand the disposal practices of service organizations. In these qualitative in-depth interviews were conducted mainly for target respondent segment that is IT and ITES sector organizations like Polaris, Sutherland BPO, Slash support, Trident etc. The results indicate that 30% of the organizations replace computers due to technical problems and 17% organizations try to keep up and match with the latest trends. About 8% of the organizations replace products due to higher affordability at lower price and only a minor proportion i.e. 2% of the organizations dispose off as per the IT guidelines. Based on the qualitative insights of IT Managers of service organizations, the major reasons for replacement are incompatibility with latest software, economical to purchase a new computer rather than upgrading a three year old PC and the depreciation value becomes nil at the end of 5 years so they replace with a new PC.

3.2 Methods of Disposal of used PCs

80% of the replaced computers directly enter the e-waste stream either through scrap dealers or through second hand markets and exchange or buy back schemes (Table 25). This implies that the first step of managing e-waste is to come up with a proper collection system involving the intermediaries of second hand market (e.g. retailers at Nehru place) and take actions towards the environmentally friendly disposal of electronic products.

3.3 Considerations while disposal of old PCs

Almost 60% of the business organizations look for best monetary offers while disposing off their old computers from the survey conducted for 203 organizations. At the same time 33% of the business organizations look for convenience as the most important factor to get rid off their used PCs (Table 26). Therefore, while planning the e-waste collection and management system, it is important that recyclers pay a fair price to the suppliers for the e-waste collected as well as for other services like logistics and timely pick-ups.

3.4 Awareness & Knowledge among Businesses on e-waste management

The in-depth interviews with the businesses indicates that 78% of the organizations have brief understanding about e-waste generation but lack knowledge on the environmentally sound disposal of end of life IT equipments (Table 26). This lack of knowledge corroborates the figure on the lack of proper disposal of end of life equipment as 94% of the organizations do not have any policies which assign the responsibilities to the producers for the e-waste generated by them.

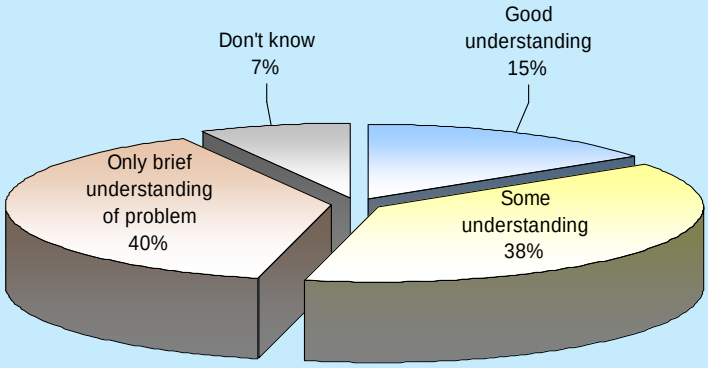


Figure 26: Level of Awareness & Knowledge about the e-waste problem

3.5 Exposure to e-waste Concept for Understanding the Attitudes

The respondents were interviewed about their awareness and level of knowledge about e-waste and its hazardous effects. The Concept Card, below, was used to understand their level of exposure to the actual e-waste problem:

Box 1 Concept Card signifying electronic waste generation, collection and recycling

ELECTRONIC WASTE GENERATION

The fast rate of technological change has lead to the rapid obsolescence of electronic gadgets–generating electronic waste in the process that gets added to the waste stream.

ELECTRONIC WASTE COLLECTION

The Electronic waste so generated finds its way to a group of informal recyclers through various scrap collectors and electronic product dealers.

ELECTRONIC WASTE RECYCLING

The informal recyclers then disaggregate the electronic waste into smaller parts and components and further recycle those parts to obtain final material like plastic, glass, metals etc.

HEALTH & ENVIRONMENTAL IMPACTS OF ELECTRONIC RECYCLING

The highly toxic chemicals found in the different components of computer parts can contaminate soil, groundwater and air, as well as affect the workers of the unit and the community living around it. Research has shown that some steps of the recycling chain, especially related to material recovery, are highly dangerous and risky. Hence, it is imperative that the general population should hand-over electronic

Followed by this exposure to the concept to e-waste, the respondents were

requested to share their views on the following statements:

- They will take additional pains to dispose the electronic waste in an environmentally sound manner
- They are ready to accept a lower price for their old computer if it is disposed in an eco-friendly way
- They are not worried about the method of disposal but they should get the best price in exchange of their old products
- They should have convenience in waste disposal no matter whatever process is adopted for its management

The disposal considerations were opposite to the considerations before the concept of e-waste was explained to the respondents. Those 66 organizations who said that "Convenience" is the most important factor while disposing of e-waste, agreed to take additional pains to make sure that the used electronic products are disposed off in an environmental friendly manner (Figure 27).

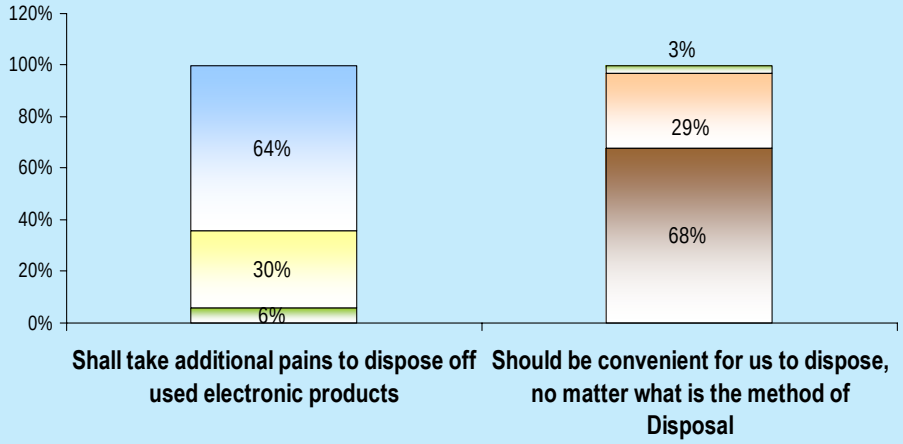


Figure 27: Reaction After exposure to the e-waste concept: Additional pains

Those respondents who had Best Price & Best Exchange offers as the most important considerations, are now ready to accept a lower price if the products are disposed off safely (Figure 28).

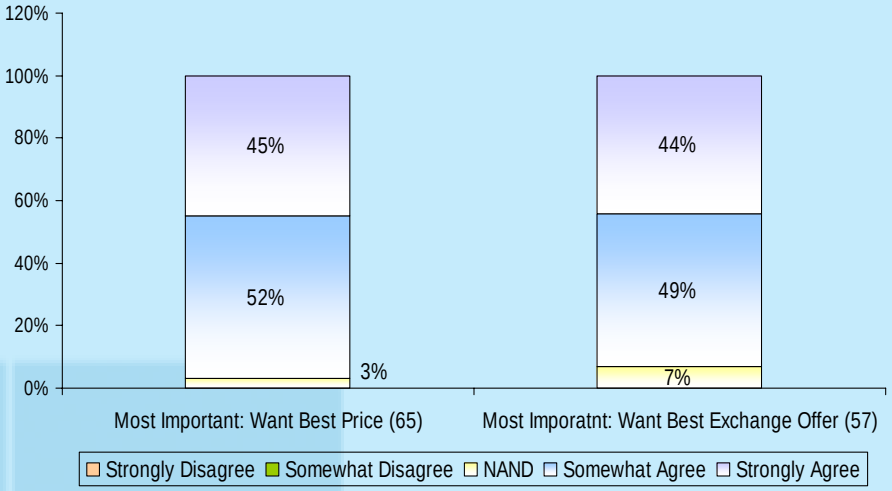


Figure 28: Reaction After Exposure to the e-waste concept: Lower price

3.6 Expectation of Businesses from Organized Recyclers

Approximately 22% of the organizations prefer logistics followed by 19% organizations expecting better price and prompt payments (Table 27). 15% of the organizations demand for wide geographic coverage and timely pick up from the formal recyclers or collecting agencies. In terms of most important services expected from the formal recyclers 34% of the organizations recognize that logistics is the most preferred service followed by best exchange price.

4. DISPOSAL BEHAVIOUR: HOUSEHOLDS

The households were surveyed in and around Delhi for understanding the reasons and age of replacement, methods and considerations for disposal, general awareness on electronic products related hazards and proper disposal mechanism.

4.1 Reasons and Age of Replacement

Identifying the reasons and age of replacement of the electronic products at the household level forms a very important component as they also contribute towards the increasing obsolescence rates and e-waste generation rates.

- **Computers**

  The in-depth interviews for the base of 432 households suggests that average age of disposed computers is 4.3 years (Table 28). The most common reason for replacing computers is technical failure as 28% respondents prefer to purchase a new computer rather than upgrading or repairing an old PC. The other reasons for changing PCs is obsolete technology (25%), latest trends (16%) and better technology at affordable price (14%). Almost one fourth of the computers are replaced to keep up with the latest trends and aesthetics.

- **Televisions**

  The results indicate that televisions are more likely disposed off by the people in case of technological failures as they prefer to exchange with a new one rather than repairing non-functional equipment (39%) (Table 29). The other driving forces for television replacement are to match with latest trends and technology (26%) and upgraded features (19%). The average age of television disposal is 7.2 years. Peer pressure plays a more important role in the replacements of televisions (10%) as compared to computer replacement (2%).

- **Mobile Phones**

  The base of 191 households was surveyed for mobile phone disposal. The average age of mobile phone is 2.2 years which is the least in comparison to television and computers (Table 30). The reasons for disposing mobiles are technological problem (39%), latest trends (30%) and upgraded features (14%).

4.2 Methods of Disposal

The in-depth interviews conducted for the households also suggest the methods adopted for the disposal of end of life electronic equipments as given in Table 31. The most common method adopted for computers, mobiles and television disposal is passing on to a relative, neighbour or friend. This trend is mostly practiced for computer disposal (77%) followed by mobiles (65%). The TVs and computer are not directly disposed in waste bins. About 25% of the electronic products that enter the e-waste market are through second hand/scrap market or through exchange schemes.

4.3 Considerations for Disposal

The results indicate that 33% of the Indian households expect best price in exchange of their electronic appliances followed by convenience of disposal (29%) while only 2% are concerned for environmentally sound disposal (Figure 29).

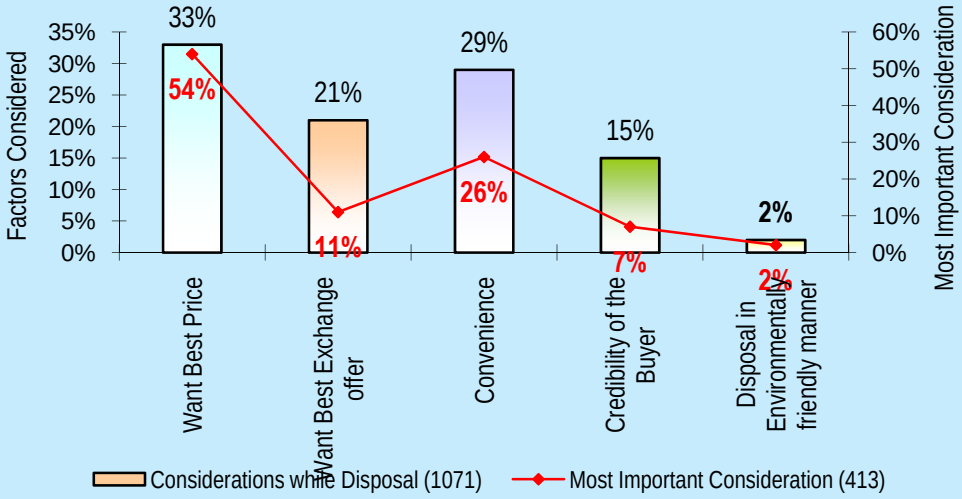


Figure 29: Considerations while disposing off used electronic products

4.4 Awareness about e-waste issues

The interviews indicate that 32% of the households are almost unaware of the e-waste and its proper disposal while 58% have some awareness about the issues. Thus it is important to build the capacity of the household sector on the repercussions of improper e-waste disposal and extending the useful life of the electronics by repair and refurbishing of electronics.

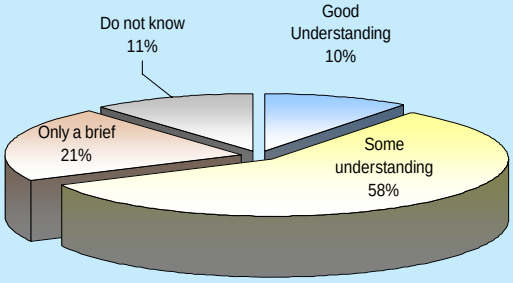


Figure 30: Level of Knowledge among All Households

4.5 Considerations while Disposal after Exposure to e-waste Concept Card

As in the case of businesses, the same concept card was administered to the households as a tool to raise awareness of the interviewed households. Approximately 85% of the respondents who sought convenience in disposing off their used electronic products were now ready to take additional pains to make sure that their old electronic products are disposed of in an environmentally sound manner. About half of the respondents who wanted best price for their old products were now ready to accept a lower price if the waste is disposed of properly.

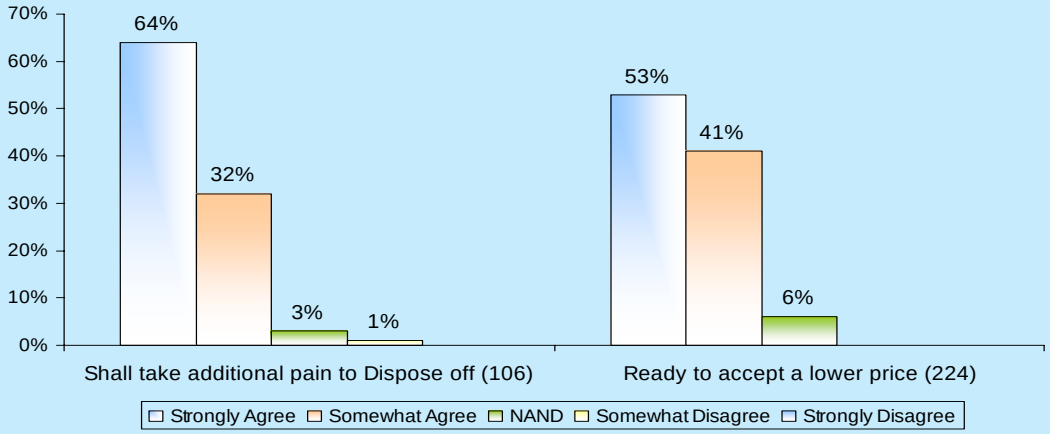


Figure 31: After exposure to e-waste concept, level of agreement to take additional pains and accept lower price

5. ELECTRONIC WASTE RECYCLING PRACTICES

Currently in India, recycling of disposed electronic products is being handled by two segments, namely, the formal and the informal recyclers. It has been estimated during the study that approximately 19,000 MT/ year is the total e-waste recycled in India. Of the total e-waste recycled in India, 95% is recycled by the informal recyclers while only 5% is recycled by the formal recyclers. This small proportion handled by formal sector suggests that they lack networking and proper collection of e-waste. They have large capacities but the absence of legislation in India for collection and disposal of e-waste has meant that these players do not have the necessary mandate for proper collection and face competition in the entire supply chain from the informal sector.

5.1 Informal Recyclers

The informal sector comprises of unstructured small scale enterprises with meager financial outlays.

- **Reason for Existence**

There are various processes involved in recycling and re-use of the electronic waste. India is a significant producer of e-Waste, due to the growth of the IT industry in past five years, technology becoming obsolete at faster rates, higher affordability of electronics, changing life styles at a rampant pace, high purchasing power and availability of promotional events like exchange schemes. At the same time, there has hardly been any development of recycling infrastructure in the formal sector in India over the last five years. Further, since it is relatively expensive to recycle the discarded electronic items they are illegally exported to developing nations masked as charity and donation or scrap. The availability of cheap labor along with the lax implementation of regulations has made India a destination of import of electronic waste from developed countries.

The frequent visits to the informal recyclers in and around Delhi established that thousands of people are thriving on this recycling business for years. In most cases all the family members i.e. elders, kids, women are engaged in these homegrown, backyard industries. The workers were hostile, to talk and discuss, about the e-waste issue as they believed that they were not polluting the environment by just dismantling and segregating the components. They accept the fact that open burning of wires or wet extraction chemical processes are not safe for environment and it is done mostly in Mandoli and Krishna Vihar in UP-Loni border. The places visited like Shastri Park, Seelampur and Turkman gate are clustered residential

areas. The Municipal Corporation of Delhi had recently conducted sealing drives for industrial operations or commercial activities in residential areas. Thus the recyclers in these areas have suffered a setback in their business operations. This was also a major reason for the hostility of the workers in these areas. They also informed that earlier many institutions, NGOs and individuals have visited them to understand their operations. They believe that this has resulted in further economic losses to their business as these reports were published in newspapers, reports and magazines. The resulting strict government vigil and ultimately, the sealing drives lead to the closure of many units.

There is a huge untapped potential in the recycling Industry, as only a minor proportion of it is being handled by organized sector. However, due to the lax implementation of regulations and low start up costs, the barriers to entry in the business are relatively small. As a result a large number of families are surviving on this business. An informal recycler in Shastri Park informed that in Delhi alone thousands of families are engaged in this business and mostly all the family members work on e-waste.

- **Informal Recyclers: e-waste Trade Value Chain**

  The e-waste trade value chain can be divided into four broad steps with following stakeholders and activities at each step as shown in Figure 32.

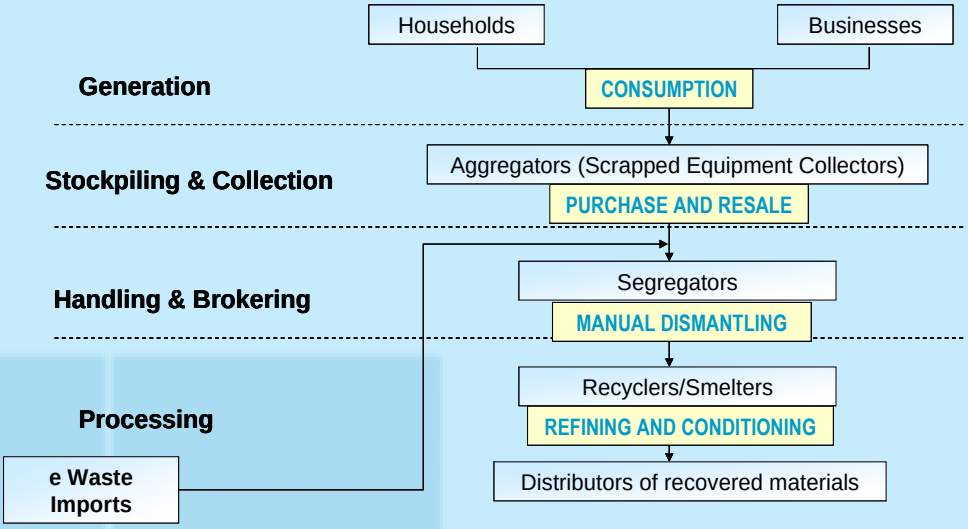
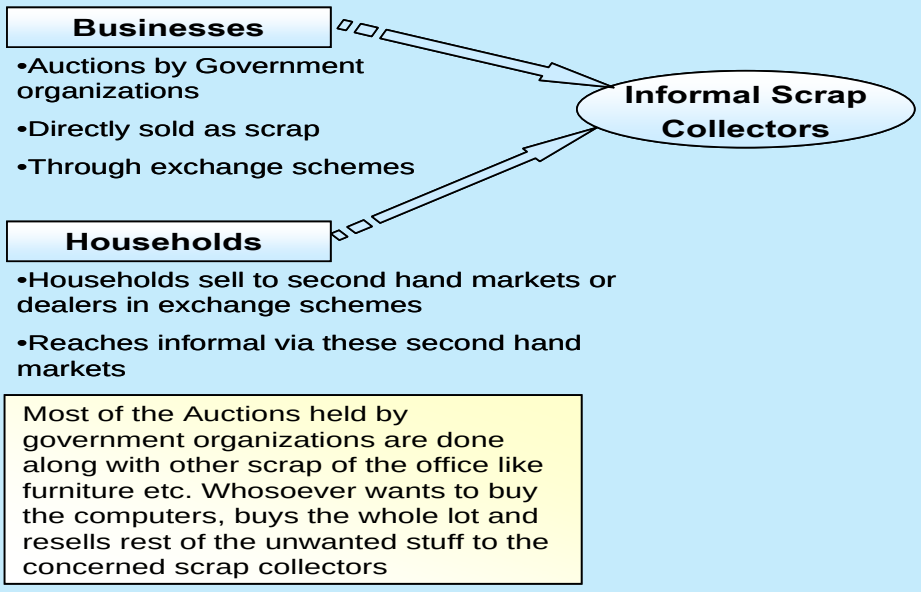


Figure 32: E-waste Trade Chain

Step 1: Sourcing By Informal Recyclers



Step 2: Aggregation

The actual e-waste trade begins when the old computers, televisions and mobile phones reach the scrap collector. The recyclers informed that an old computer maybe purchased between Rs. 200 (non working box) to Rs 2000 (working condition). The scrap collector then checks the material received and sorts the material into three parts as material which can be resold in second hand market, repaired/ refurbished and resold and what is to be sent for recycling. Typically 80% of the material entering this trade can be repaired, refurbished and resold and only 20% of the electronic products are recycled.

Step 3: Segregation & Dismantling

The in-depth interviews with the informal sector helped us in understanding and scaling the economics of their business (Figure 33). The products which cannot be resold “as it is” are dismantled either by the scrap collector himself or he sells it to a dismantler. Once the products are dismantled, the components are again checked if any constituent can be reused. A PCB in working condition is sold at the rate of Rs. 1000 to Rs. 1200 per piece whereas a non working PCBs at the rate of Rs. 70–80 per kg. The monitors are sold at the rate of Rs. 300/piece and hard disks at rate of Rs. 100/piece. The rest of the parts like plastic casings and glass are sold at a very cheap rates e.g. Plastic at Rs. 12-15/kg, Chips at Rs. 300/kg (for copper extraction).

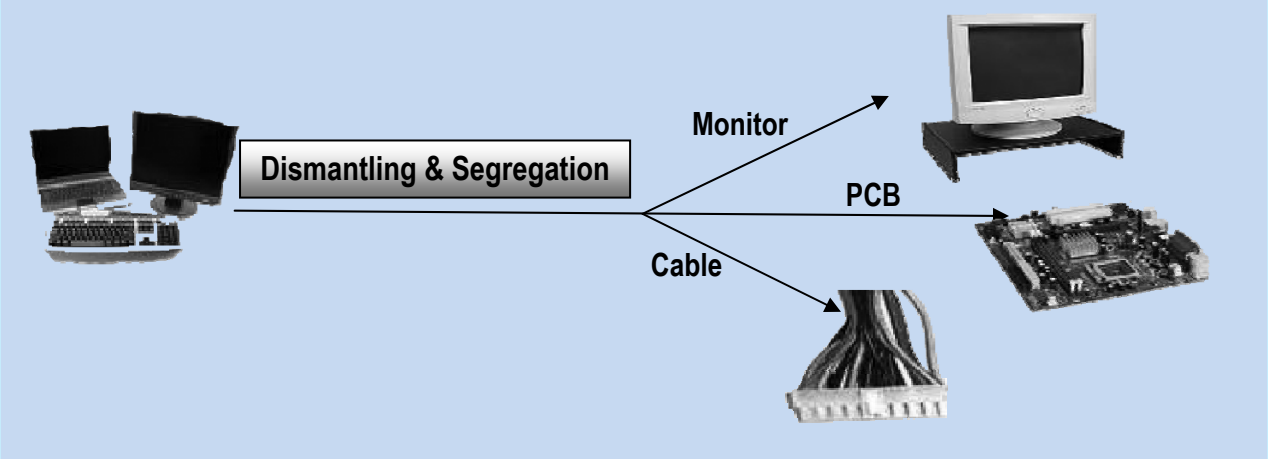


Figure 33: Dismantling of Computer into components

Step 4: Recycling

The final step after aggregation, segregation and dismantling of the waste electronic products is recycling. The CRT which cannot be re-gunned is broken down for glass extraction. The job work is well designed in the informal supply chain as the person who is engaged in dismantling will perform only dismantling and disintegration and will supply the components to recycler for extraction of precious metals. The dismantlers informed that for the gold pin extraction the de-soldered wire boards are sent to Meerut, UP. The final materials obtained at the end of recycling are further sent for conditioning, for e.g. the glass obtained from breaking CRTs is sent to Firozabad, UP for bangle making or other products.

5.2 Geographical Spread of Informal Recycling in Delhi

Delhi, is a hub of informal recycling of e-waste. The workers in Delhi are illiterate and unemployed youth, children and women who have migrated from the neighboring states of Uttar Pradesh & Bihar. The major dismantling and recycling sites are Seelampur, Shastri Park, Turkman Gate, Mayapuri, Mandoli and Krishna Vihar. The e-waste imported into Mumbai and Chennai mostly makes its way to Delhi as there is a ready market for glass and plastic in the NCR. The important centers of e-waste trading in Delhi are given in Figure 34.

"Delhi alone gets around 70% of the electronic waste generated in the developed world in terms of total Generated internally or brought from outside for recycling,"
Source: 2 Aug, 2006 TIMES NEWS NETWORK

A substantial part of Mumbai's WEEE, both imported and locally generated, is sent to recycling markets located in other parts of the country. The National Capital Region of Delhi is a preferred recycling destination for printed circuit boards (PCBs).
Source: Toxics Link, Mumbai e-Waste Report, Feb 2007

PURCHASE AND RESALE	MANUAL DISMANTLING	REFINING AND CONDITIONING
•Nehru Place (Computers & Mobile Phones) •Ghaffar Market (Mobile Phones) •Lajpat Rai Market (Televisions)	•Nehru Place Basements (Computers) •Jumrudpur (Computer and computer peripherals) •Shastri Park (Computers, Televisions) •Turkman Gate (Televisions, Refrigerators, Computers, Washing machines, Air conditioners) •Mustafabad (scrap segregators for computers) •Dharampura, K Block (Near old Seelampur)	•Seelampur estate •Mundaka (Near Punjabi Bagh) •Mandoli •Nearby towns like Meerut, Gaziabad, Ferozabad, Hapur

Figure 34: Electronic waste recycling areas in Delhi and NCR with specific functions

5.2.1 Profile of major dismantling & recycling areas of Delhi

- **Nehru Place**

Nehru Place is the hub for the dealers interested in purchasing, repairing or selling off their old and used electronic products, mainly computers and peripherals. The imported e-Waste is first in the notice of dealers and scrap collectors of Nehru place. The trucks of used computers are sent to nearby states like UP and Haryana for further use as second hand products. Other than the sale and purchase of old computers (ground level and first floor), some of the individuals are also involved in dismantling and repair activities (basement). Once the computers are dismantled, those parts which cannot be repaired and re-sold are sold to scrap dealers on a per day basis. The components and parts which can be repaired are sold to the end users. There will be around 25 to 30 establishments in Nehru Place involved in sale-purchase and repair of used electronic products, on an average employing 2 adults (between the age of 18 to 30) per establishment. Around 8 to 10 establishments are involved only in dismantling and repair and employ on an average 3 adults per establishment. Other than sale/ purchase, dismantling, repairing and reselling the other major activity occurring is the re-gunning of CRTs.

- **Turkman Gate**

Turkman Gate, today is famous for trading of old electronic products and computer and television disassembly. The traders met in this area informed about the procurement of material through auctions of obsolete office equipments. They even demonstrated newspaper clippings with the advertisements of auctions of office equipments. They claimed that the auctions were not much profitable as they had to purchase all of the equipments, including old furniture and other plastic wastes. The material procured is then segregated for reuse and disassembly of components. The dismantling and re-selling occurs in small shops for sourcing the material to Shastri Park, Seelampur and Mandoli.

- **Shastri Park**

  The dismantling & recycling business employs around 50% population (in every second house) of Shastri Park which includes women and children also. They are primarily engaged in segregating and dismantling operations of computer and its peripherals, refrigerators, stabilizers and air conditioners. Some of the dismantlers in this area are doing this business since two or three decades. These recyclers either source directly from industries through auctions (through auction notices in websites, newspapers), or through middlemen, scrap collectors and vendors from places like Nehru Place and Mustafabad (areas of scrap dealers). Most of the processes are manual utilizing simple tools like hammers, screw drivers, chisel etc. These workers do not use any protective equipment like gloves or masks and believe that there is no pollution or exposure to hazardous materials. Cables and wires are cut and stripped for extraction of copper, but open burning is not found in this area. The recycling/dismantling units are located in the backyards or *godams* inside the houses. The residents, due to the clandestine nature of their operations, were reluctant to talk about any issues related to recycling or old electronic products. Most of them were aware about the changing scenarios of e-waste trade and were reluctant to adopt any changes in their way of working.

- **Seelampur**

  Seelampur is a market for all kinds of electronic scraps due to the widespread dismantling of computers, computer related peripherals, televisions and mobile phones. The area is located in a clustered residential area with dismantling workshops in the basements, backyards or front rooms of the houses. Seelampur is dominated by traders who employ workers usually migrant population for segregation, reuse and dismantling of electronic products. Some of the recyclers in Seelampur were aware of the changes which are about to happen to the e-waste business and were willing to adapt to changes in the current operations. The residents were concerned about the reduction of their business and profit due to the changes as well as the discussions about e-waste recycling in the media. All the residents were ignorant about the health issues like toxicity due to ground water pollution, air pollution due to open burning, usage of personal protective equipments etc. They also mentioned that due to the lack of financial resources, they cannot adopt the occupational health and safety measures.

- **Mandoli**

  This is an industrial area with recycling and processing of e-wastes employing wet extraction processes with little control over the fumes and emissions of solid and liquid wastes. The units are small scale industries with high wall and channel gates. The industry owners were either unavailable at the sites or if present, they were not ready to talk on the issue. The place was filthy all around with yellow fumes of aqua regia used for extraction of metals and black colored effluent and residues spilled over. The area is also dominated by many small scale battery recycling units for extraction of lead from the old batteries. The workers were non-approachable as they were not ready to talk in front of their owners and also the rigorous working hours didn’t permit them to spare few minutes for the discussions.

- **Krishna Vihar**

  The area falls under the Ghaziabad region near Mandoli. Similar to Mandoli, the workers here are employed for extraction of precious metals through wet extraction processes. The workers are usually migrants from UP, Bihar, West Bengal and other neighboring states. The area is dominated by many small scale units like plastics recycling, glass crushing and recycling, battery recycling for extraction of lead and e-waste recycling. The processes employed were usually acid bath dipping of printed wire boards, copper extraction and burning of capacitors. The women and children were usually engaged in copper extraction and stripping of paint from printed wire board. The men were involved in burning of capacitors and transistors, dismantling and breaking as well as for loading and unloading. The units are enclosed by walls, small gates and one to two rooms shed which is used as a house for few workers. The workers were not ready to use protective equipments (occasionally use gloves for Acid dilution and mixing) during the work, as the working efficiency reduces. The workers also told that they work in shifts with highly hazardous operations like burning and acid mixing usually performed in night to prevent the release of toxic fumes during broad daylight.

- **Other areas around Delhi**

  Meerut, Ghaziabad and Firozabad are the neighboring cities (UP) which are the ready markets for gold, plastic and glass recycling respectively, from e-waste.

6. ELECTRONIC WASTE ESTIMATES FOR DELHI

The e-waste estimates includes the desktops share of Delhi generated in the year 2007. The desktops estimate was calculated on the basis of ITOPs data from yearly sales (Table 32-37). The mobiles and television data was not included in the study as mobiles generated in Delhi form a negligible number and television data was not available on a regular pattern. The television data would include the generation and obsolescence pattern of both black and white as well as color television on an yearly basis in Delhi. This annual data on televisions was not available hence the estimates of e-waste generated in Delhi could not be made. The Box 2 presents the e-waste estimates for Delhi.

Box 2: E-waste generated from Desktops in Delhi

The total e-waste generated in Delhi from desktops including the households and businesses segment is 11594 tonnes in the year 2007. The business segment forms a larger share with 10359 tonnes while households generate 1235 tonnes in the year 2007. Amongst households, SEC A forms largest contributor (709 tonnes) followed by SEC B (526 tonnes) and negligible contribution from SEC C. In the business segment, office locations forms maximum share (9116 tonnes), followed by Outlets (778 tonnes), Factory locations (322 tonnes) and government offices (143 tonnes). The e-waste generated from Desktops in the year 2011 will be 16133 tonnes. The business segment forms 85% share (13772 tonnes) while households form 15% share (2361 tonnes) of e-waste generated in 2011.

CHAPTER 3 CONCLUSIONS & RECOMMENDATIONS

Strategic planning is needed to tackle the e-waste as it can lead to serious threats to environment and health. The hazardous materials if not encapsulated or disposed of in sanitary landfills designed for disposal of hazardous wastes can result in leaching of toxicants into groundwater. The presence of organized recyclers who are handling only a minor proportion of the total e-waste being recycled is not going to curb the problem. Therefore, involvement of various stakeholders is recommended to handle the e-waste in an environmentally sound manner with proper storage, reuse and recycling options. To handle the e-waste generated in India, it is necessary that other than the formal recyclers, following stakeholders are involved

- Manufacturers of electronic products
- Government
- End Users

The involvement required is not only at the level of recycling but also at the generation and disposal stages so that the problem can be addressed at the very initial stages. The proposed actions suggested for the various stakeholders at different stages of e-waste value-chain are:

5.1 Role of the Government

Overall Role: The Government should try to develop an inclusive model where informal recyclers have a stake so as to avoid competition in material sourcing between formal and informal sector. This can be achieved by tapping their potentials and networking for collection, segregation, dismantling, repair and refurbishing operations. At the same time, the wet recycling processes, involving the release of toxics into the air, water and soil, must be regulated and controlled. The capacities of the informal sector can be built up by involving NGOs for enhancing their socio-economic status through alternative employment opportunities, increasing their awareness on good housekeeping practices and occupational health and safety. They can also play a major role in mobilizing the informal sector on the path towards formalization and formation of associations. The government can also play a role in regulating the auctions from government offices and making it compulsory that only recyclers possessing environmentally friendly recycling capability will be allowed to buy from government auctions. Government offices can pool their computers and aggregate the waste to be auctioned.

5.2 End Users

The relocation of televisions and component reuse of mobile phones lowers the recycling for these two products. While in the case of computers a significant quantity is recycled in India. Therefore, it is important that attention should be paid to computer waste, especially in the business segment as it contributes 75% to the overall market size for computers. Government should draft legislation for institutional users of computers in such a way that they must include method of disposal in their IT policy document and declare procurement and replacement rate of computers in their annual reports.

5.3 Awareness & Infrastructure Creation

Government should also take initiative to develop recycling capabilities in India especially in Northern India. Incentives could also be provided for setting up of state-of-art recycling facilities in India, so that the precious metal mixture is not sent out of India for extraction. The arrangements should be done for special bins for disposing of small and fast moving electrical waste like batteries, remote controls, electronic toys, video games, CDs, etc. at strategic places. The Government should invest in awareness creation for the end-users, highlighting the possible hazards to the environment and human beings.

5.4 Role of Manufacturers & Vendors

At the Selling Stage
Spread awareness among End-Users by distributing brochures along with the products, mentioning the concept of e-waste and describing the presence of hazardous material in the product. An offer for the buy-back of the product should be made at the time of sale. This offer should clearly mention all the terms related to the price which will be offered in the buy back and method to be followed for disposal by the end-users.

At the Disposal Stage
Manufacturers and vendors should be made responsible to take care of the convenience of the end users for disposing off the products. This can be done by having tie-ups with dealers/retailers for the Buy-back schemes. If possible, some collection or dropping centers can be build for the customers other than the already available dealer locations.

At the Recycling Stage
Refurbishment or recycling business can become a profitable line of business for the manufacturers. Develop a vibrant market for second hand electronic products (in the line of automobile business). It should be made compulsory for the manufacturers to submit an annual report to the government mentioning the efforts directed towards collection, buy back schemes, refurbishment and recycling operations.

ANNEXURES

Table 1: Ownership of Durables (Source: NCAER)

	1995-96	2001-02	2005-06	2009-10
Cars	16.1	30.0	50.2	91.4
Motorcycles	29.3	70.8	147.6	282.6
CTV Regular	72.0	145.6	213.0	314.0
Refrigerators	86.1	134.0	160.7	224.9
White Goods	149.4	247.1	319.1	451.7

Table 2: Desktop Growth Rate

2002	2003	2004	2005	2006
37%	32%	20%	27%	19%

Table 3: Share of Desktops and Notebooks in overall PC Market

Share in PC market	2002	2003	2004	2005	2006
Desktop PC	98%	97%	95%	91%	87%
Notebooks	2%	3%	5%	9%	13%

Table 4: Yearly growth of Mobile Phone Subscribers

Year	GSM Subscribers (millions)	GSM Annual growth	CDMA Subscribers (millions)	CDMA Annual growth
2000	3.1	94%	-	-
2001	5.05	76%	-	-
2002	10.5	91%	0.8	-
2003	22	110%	6.4	700%
2004	37.4	70%	10.9	70%
2005	58.5	57%	19.1	75%
2006	105.4	80%	44.2	131%
2007	180	71%	85	92%

Table 5: Top Players and their Revenues of last Two Years

Rank	Company	Revenue (in Rs crore)		Growth
		FY '05-06	FY '06-07	(in %age)
1	Nokia	7,892	11,486	45.5
2	Motorola	507	2,387	370.8
3	LG	2,555	2,348	-8.1
4	Sony Ericsson	605	1,386	129.1
5	Samsung	1,020	1,205	18.1
6	ZTE	360	783	117.5
7	Haier	66	294	345.5
8	Huawei	101	132	30.7
	Others	1,152	1,413	22.7
	Total	**14,258**	**21,434**	**50.3**

Table 6: Delhi Vs. Mumbai: Recycling Processes

SNo	Processes	Delhi	Mumbai
1	IC's Extraction from PWB	✓	✓
2	Surface Heating of PWB and Extraction of components	✓	✓
3	Dissembling of Monitor and extraction of components	✓	✓
4	Yoke core and Copper	✓	✓
5	Metallic Core of Transformer and Copper	✓	✓
6	Rare Earth Core of Transformer and Copper	✓	✓
7	Rare Earth Core of Static Transformer	✓	✓
8	Wire PVC and Copper	✓	✓
9	Plastic Shredder	✓	✓
10	Dismantling of Refrigerator and Compressor	✓	✓
11	Gold Extractions from Pins and Comb	✓	X
12	Acid Bath for PWB	✓	X
13	Regunning CRT	✓	X
14	Glass Recovery from CRT	✓	✓
15	Gold Recovery	✓	✓

Table 7: Estimation of Potential Annual e-waste

Process	Computers	Televisions	Mobiles
Step 1: Annual Sales by segment	**Source of Sales Data**		
	ITOPs	CEAMA	TRAI, AUSPI
Step 2: Obsolescence ages applied for calculation of Potential Annual e-waste	**Ages Applied**		
	Households: SEC A: 5, SEC B: 6 & SEC C: 9 Years **Businesses:** Factories: 10, Services: 5, Outlets: 10, Government: 10 Years	**B&W:** 10 Years **Color:** 7 Years	2 Years
Step 3: No. of units and tonnes entering the e-waste trade value chain: Potential Annual e-waste	**Weights Applied**		
	27.2 KG	25 KG	0.083 KG

Table 8 Business Desktop Sales by Activity of Business

Business Desktop Sales by activity of business					
Year	**Business Sales**	**Factory locations**	**Office locations**	**Outlets**	**Govt. Locations**
1997	526000	9%	82%	5%	4%
1998	628180	12%	85%	1%	2%
1999	843907	13%	79%	4%	4%
2000	1117873	11%	81%	6%	2%
2001	1465659	5%	85%	8%	2%
2002	1857851	8%	82%	7%	3%
2003	2337405	9%	79%	8%	4%
2004	2615486	10%	80%	7%	3%
2005	3461043	11%	74%	12%	3%
2006	4063037	3%	84%	7%	6%
2007	4687500	5%	80%	10%	5%
2008	5390625	5%	80%	10%	5%
2009	6199219	5%	80%	10%	5%
2010	7129102	5%	80%	10%	5%
2011	8198467	5%	80%	10%	5%

Table 9 Household Desktop Sales by SEC

Household Desktop Sales by SEC				
Year	**Household Sales**	**SEC A**	**SEC B**	**SEC C**
1997	48400	43%	57%	0%
1998	170878	72%	28%	0%
1999	183283	81%	19%	0%
2000	287454	77%	23%	0%
2001	415981	69%	31%	0%
2002	435792	46%	36%	18%
2003	698186	46%	34%	20%
2004	1017133	51%	28%	21%
2005	1153681	55%	29%	16%
2006	1427554	44%	36%	20%
2007	1562500	45%	35%	20%
2008	1796875	45%	35%	20%
2009	2066406	45%	35%	20%
2010	2376367	45%	35%	20%
2011	2732822	45%	35%	20%

Table 10 E-waste from Desktops (Businesses)

e-waste from Desktops (Businesses)						
Year (e-waste)	**Factory locations**	**Office locations**	**Outlets**	**Government**	**e-waste (in numbers)**	**e-waste in Tonnes**
2007	47340	1523438	130050	21040	1721867	46835
2008	75382	1846550	186992	12564	2121488	57704
2009	109708	2092389	183084	33756	2418937	65795
2010	122966	2561172	415325	22357	3121820	84914
2011	73283	3412951	284413	29313	3799960	103359

Table 11 E-waste from Desktops (Households)

e-waste from Desktops (Households)					
Year (e-waste)	**SEC A**	**SEC B**	**SEC C**	**e-waste (in numbers)**	**e-waste in Tonnes**
2007	200464	128954	0	329419	8960
2008	321166	156885	0	478051	13003
2009	518738	237383	0	756121	20566
2010	634525	284797	0	919322	25006
2011	628124	334567	78443	1041134	28319

Table 12 Overall E-waste from Desktops & Notebooks (in Tonnes)

Overall e-waste from Desktops and Notebooks in Tonnes	
2007	56324
2008	72019
2009	88365
2010	114458
2011	137991

Table 13 E-waste from Notebooks (Businesses)

e-waste from Notebooks (Businesses)	**e-waste (in numbers)**	**e-waste (in tonnes)**
2007	155094	529
2008	376577	1284
2009	532374	1815
2010	1012523	3453
2011	1417533	4834

Table 14 E-waste from Notebooks (Households)

e-waste from Notebooks (Households)	**e-waste (in numbers)**	**e-waste (in tonnes)**
2007		0
2008	7908	27
2009	55256	188
2010	318486	1086
2011	433939	1480

Table 15 Television Market Size and e-waste (CEAMA)

Year	B&W (in millions)	COLOR (in millions)	TOTAL (in millions)
1992	5	0.83	5.83
1993	4	1.5	5.5
1994	3.5	1.35	4.85
1995	5.8	1.8	7.6
1996	6	2.1	8.1
1997	6	2.8	8.8
1998	5.9	3.8	9.7
1999	5.7	5	10.7
2000	4.5	5	9.5
2001	3.9	5.3	9.2
2002	3.5	6.75	10.25
2003	3	8	11
2004	2.5	9.25	11.75
2005	2	10.25	12.25
2006	1.5	11.5	13
2007	1	15	16

Table 16 Mobile Handset Market Size and e-waste

Total handset sales (projected)	2005	2006	2007	2008	2009	2010	2011
All Metros	8057885	10628038	14354806	17279963	19333165	14691964	12376915
A Circles	10849369	20946959	33178970	43550279	51834626	43983482	39259786
B Circles	10380351	21482660	34640941	46438312	56482986	48413839	44495969
C Circles	3174897	8383627	14825652	20820501	27088668	23758929	24126705
Total	32462501	61441284	97000369	128089056	154739445	130848214	120259375

Table 17 E-waste Generated from Handset Replacement (in number)

e-waste generated from handset replacement (projected, in number of handsets)	2007	2008	2009	2010	2011
All Metros	3566284	7637106	10788522	9642857	8544643
A Circles	6978273	16228850	26200697	27321429	25633929
B Circles	6899026	16706170	27741914	29732143	28741071
C Circles	2495912	7159787	12329740	13660714	14758929
Total	19939495	47731913	77060874	80357143	77678571

Table 18 Potential E-waste Generated from Handset Replacement (in tonnes)

Potential e-waste generated from handset replacement (projected) in tonnes	**2007**	**2008**	**2009**	**2010**	**2011**
All Metros	296	634	895	800	709
A Circles	579	1347	2175	2268	2128
B Circles	573	1387	2303	2468	2386
C Circles	207	594	1023	1134	1225
Total	**1655**	3962	6396	6670	6447

Table 19 E-waste from Televisions (in tonnes)

e-waste in Tonnes	**Color TV**	**Black & White TV**	**Total e-waste**
2007	125000	150000	**275000**
2008	132500	147500	280000
2009	168750	142500	311250
2010	200000	112500	312500
2011	231250	97500	328750

Table 20 Potential Annual e-waste Region wise Generation Rate (in MT)

Televisions	**(in MT)**
Overall Potential Annual e-waste in 2007	**275000**
Region wise e-waste	
North	55000
East	38500
West	99000
South	82500
Computers	
Overall Potential Annual e-waste in 2007	**56324**
Region wise e-waste	
North	12955
East	7322
West	17460
South	18587
Mobiles	
Overall Potential Annual e-waste in 2007	**1655**
Region wise e-waste	
North	563
East	281
West	480
South	331
TOTAL Potential Annual e-waste Region Wise in 2007	**332979**
North	68517
East	46103
West	116940
South	101418

Table 21: Percentage Replacement of Computers/ year (Base: 203)

Computers Replaced	Percentage of organizations
0-10%	65%
11-20%	18%
21-30%	11%
31-40%	2%
41-50%	3%
More than 50%	1%

Table 22: Percentage Replacements of Computers by Manufacturing Organizations (Base: 55)

Computers Replaced	Percentage of organizations
0-10%	24%
11-20%	43%
21-30%	22%
31-40%	11%
41-50%	0
More than 50%	0

Table 23: Percentage Replacement of Computers by Services (Base: 145)

Computers Replaced	Percentage of Organizations
0-10%	30%
11-20%	33%
21-30%	17%
31-40%	11%
41-50%	3%
More than 50%	6%

Table 24: Driving Force for Computer Disposal in Business segment (Base: 203)

Reasons for Disposal	Percentage of Business Organizations
Technology compatibility	40%
Latest trends	17%
More affordable features	8%
Economic value nil after depreciation	1%
Upgrade from desktop to laptop	2%
IT Guidelines	2%
Technical problems	30%

Table 25: Methods adopted for Disposal of Computer and IT products in Business segment

Methods	Percentage
Donation	7%
Vendors Buy Back	48%
Sell as Second Hand Product	21%
Sell as Scrap	11%
Sell to Employees	11%
Sell to Recycling Company	2%

Table 26: Consideration for Disposal of Computer & IT products in Business segment (Base: 203)

Most Important Consideration	Percentage of Organizations
Convenience	33
Want Best Price	32
Best Exchange Offer	28
Want to dispose in an Ecofriendly manner	6
Pick-ups & no spending on warehouses	1

Table 27: Expectations from Formal Recyclers (Base 203)

Services Expected	Services	Most Important Service
Logistic	22%	34%
Best Price	19%	25%
Prompt Payment	19%	17%
Wide Geographic Coverage	15%	9%
Quick Pickup	15%	13%
Credibility	6%	1%
Transparency	4%	0%

Table 28: Reasons for Replacing Computers in Households (Base: 432)

Reasons	**Percentage of Households**
More features at less price	14%
Obsolete technology	25%
Technical problems	28%
Latest trends	16%
Aesthetics	12%
Upgrade from Desktops	3%
Peer pressure	2%

Table 29: Reasons for replacing Televisions in Households (Base: 228)

Reasons	**Percentage of Households**
Technical problems	39%
Latest trends & technology	26%
Upgraded Features	19%
Peer pressure	10%
Better Aesthetics	6%

Table 30: Reasons for replacing Mobile phones in Households (Base: 191)

Reasons	**Percentage of Households**
Keep up with latest trends	30%
Upgrade Features	14%
Peer pressure	5%
More features at affordable price	6%
Aesthetics	6%
Technical problems	39%

Table 31: Method of Disposal in Households

Method	Computer(180)	Mobile (122)	Television (111)
Given to Relatives	77%	65%	57%
Donated	1%	4%	6%
Thrown in Dustbin	0%	3%	0%
Sold in second hand market	16%	23%	14%
Sold to scrap dealer	2%	0%	14%
Exchanged for new computer/ mobile/ TV	4%	5%	8%

Table 32: E-waste generated in Delhi from different types of businesses (ITOPs)

e-waste from Different Type of Businesses					
e-waste (Year)	**Factory locations (10 years)**	**Office locations (5 years)**	**Outlets (5years)**	**Government (10 years)**	**e-waste (in nos)**
2007	11835	335156	28611	5260	380862
2008	18845	203121	20569	3141	245676
2009	27427	334782	29293	8439	399942
2010	30742	307341	49839	5589	393511
2011	18321	443684	36974	7328	506306

Table 33: E-waste generated (in Tonnes) in Delhi from different types of businesses (ITOPs)

e-waste from Different Types of Businesses (in Tonnes)					
e-waste in tonnes	**Factory locations (10 years)**	**Office locations (5 years)**	**Outlets (5years)**	**Government (10 years)**	**e-waste in Tonnes**
2007	322	9116	778	143	10359
2008	513	5525	559	85	6682
2009	746	9106	797	230	10878
2010	836	8360	1356	152	10703
2011	498	12068	1006	199	13772

Table 34: E-waste generated in Delhi from different SEC of Households (ITOPs)

e-waste from different SEC of Households				
e-waste (Year)	**SEC A (5 years)**	**SEC B (6 years)**	**SEC C (9 years)**	**e-waste (in nos)**
2007	26060	19343	0	45403
2008	35328	20395	0	55723
2009	77811	26112	0	103923
2010	38071	42720	0	80791
2011	56531	20074	10198	86803

Table 35: E-waste generated (in Tonnes) in Delhi from different SEC of Households (ITOPs)

e-waste in tonnes	SEC A (5 years)	SEC B (6 years)	SEC C (9 years)	e-waste in Tonnes
2007	709	526	0	1235
2008	961	555	0	1516
2009	2116	710	0	2827
2010	1036	1162	0	2198
2011	1538	546	277	2361

Table 36: Overall e-waste from Desktops in Delhi

Overall e-waste from Desktops in Tonnes: Businesses & Households	
2007	11594
2008	8198
2009	13705
2010	12901
2011	16133

Table 37: ITOPs data used for estimation of Desktops in Delhi

Desktops: Business market (Yearly trend)						
Business Desktop Sales by activity of business						
Year	Business Sales	Delhi Percentage Share	Factory locations	Office locations	Outlets	Govt. Locations
1997	526000	25%	9%	82%	5%	4%
1998	628180	25%	12%	85%	1%	2%
1999	843907	25%	13%	79%	4%	4%
2000	1117873	25%	11%	81%	6%	2%
2001	1465659	25%	5%	85%	8%	2%
2002	1857851	22%	8%	82%	7%	3%
2003	2337405	11%	9%	79%	8%	4%
2004	2615486	16%	10%	80%	7%	3%
2005	3461043	12%	11%	74%	12%	3%
2006	4063037	13%	3%	84%	7%	6%
Business Desktop Sales by activity of business						
Year	Business Sales	Sales in Delhi	Factory locations	Office locations	Outlets	Govt. Locations
1997	526000	131500	11835	107830	6575	5260
1998	628180	157045	18845	133488	1570	3141
1999	843907	210977	27427	166672	8439	8439

2000	1117873	279468	30742	226369	16768	5589
2001	1465659	366415	18321	311453	29313	7328
2002	1857851	408727	32698	335156	28611	12262
2003	2337405	257115	23140	203121	20569	10285
2004	2615486	418478	41848	334782	29293	12554
2005	3461043	415325	45686	307341	49839	12460
2006	4063037	528195	15846	443684	36974	31692

Household Desktop Sales by SEC					
Year	**HH Sales**	**Delhi's Percentage share**	**SEC A**	**SEC B**	**SEC C**
1997	48400	15%	43%	57%	0%
1998	170878	15%	72%	28%	0%
1999	183283	15%	81%	19%	0%
2000	287454	15%	77%	23%	0%
2001	415981	15%	69%	31%	0%
2002	435792	13%	46%	36%	18%
2003	698186	11%	46%	34%	20%
2004	1017133	15%	51%	28%	21%
2005	1153681	6%	55%	29%	16%
2006	1427554	9%	44%	36%	20%

Household Desktop Sales by SEC					
Year	**HH Sales**	**Sales in Delhi**	**SEC A**	**SEC B**	**SEC C**
1997	48400	7260	3122	4138	0
1998	170878	25632	18455	7177	0
1999	183283	27492	22269	5224	0
2000	287454	43118	33201	9917	0
2001	415981	62397	43054	19343	0
2002	435792	56653	26060	20395	10198
2003	698186	76800	35328	26112	15360
2004	1017133	152570	77811	42720	32040
2005	1153681	69221	38071	20074	11075
2006	1427554	128480	56531	46253	25696

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