

E-WASTE MANAGEMENT



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INTRODUCTION

The Industrial revolution followed by the advances in information technology during the last century has radically changed people's lifestyle. Although this development has helped the human race, the waste generated from such gadgets creates new problems as they contaminate the environment and ultimately affect human health. The technical process acquired during this century has posed new challenges in the management of such electronic waste. For example, personal computers (PCs) contain certain components which are highly toxic, such as chlorinated and brominated substances, toxic gases, toxic metals, biologically active materials, acids, plastics and plastic additives.

The IT industry has attained a remarkable growth in the Indian economy and so has the generation of e-wastes. The increase in consumption of electrical and electronic products, higher usage and repair rates has led to an increase in e-waste. The Indian Personal Computer (PC) industry is fast growing at a pace of 25% growth per annum. Government, public and private industrial sectors are the major source of e-waste in our country accounting for nearly 70% of the total waste generated.

At present, electronic and electrical equipment have become part of our everyday life and their use has increased manifold during the last two decades. The industrial and economic growth in the cities has fuelled greater consumption and thus subsequently generation of a huge volume of e-waste. E-wastes contain over 1000 different substances, many of which are toxic and potentially hazardous to the environment and human health, if these are not handled and disposed in an environmentally sound manner.

E-wastes

E-wastes are generated from used electrical and electronic items such as computers, mobile phones, personal stereos, household appliances such as refrigerators, washing machines, air conditioners, etc. which are discarded or disposed due to the advancement in technology and changes in fashion, style, status or the gadgets nearing the end of their useful life.

E-wastes is defined in “The Hazardous Wastes (Management and Handling) Rules, 2003”, in Schedule 3, as “Waste Electrical and Electronic Equipment including all components, sub-assemblies and their fractions except batteries falling under these rules”.

The recent e-waste (Management and Handling) Rules, 2011, defines “electrical and electronic equipment” as “equipment which is dependent on electric currents or electro-magnetic fields to be fully functional” and further elaborates ‘e-waste’ as “waste electrical and electronic equipment, whole or in part or rejects from their manufacturing and repair process, which are intended to be discarded”.

At present, there is a growing recognition of the e-waste problem in India at the national level and hence, the Ministry of Environment and Forest Government of India has notified the e-waste (Handling and Management) Rules, 2011 effective from 1st May 2012.

Global scenario

More than 50 metric tonnes of e-waste is generated globally in a year. The increasing consumerism and the rise in the sale of electronic goods in all the countries have led to higher percentage of e-waste. This has

become a very serious problem. As per the United Nations (UN's) Report, by 2020, e-waste from old computers would jump by 400% in China and by 500% in India. Apart from these, e-waste from discarded mobiles would be 18 times higher in 2020.

It is estimated that the European Union and the United States account for the maximum e-waste generation during this decade. According to UNEP (United Nations Environment Program) Report, the per capita e-waste generated per annum in India is 1kg as compared to 14 – 15 kg in the European Union.

It is evident from the International Association of Electronics Recyclers (IAER)'s newsletter that used electronic household appliance and IT equipments from household are dumped in landfill areas in the United Kingdom and Japan.

The e-waste management problem is mounting worldwide owing to the increased cost of the recycling process. It is true that rich and developed countries are dumping their toxic wastes including e-waste on developing and under-developed countries.

The Basel Action Network (BAN) estimates that the 500 million computers in the world contain 2.87 billion kgs. of plastics, 716.7 million kgs. of lead and 286,700 kgs. of mercury. Composition of other metals is given below:

Plastic	6.32 Billion Pounds	2866.7 million kgs.
Lead	1.58 Billion Pounds	716.7 million kgs.
Cadmium	3 Million Pounds	1.36 million kgs.
Chromium	1.9 Million Pounds	0.86 million kgs.
Mercury	632,000 Pounds	286,700 kgs.

(one pound = 0.4536 kilograms)

The average 14-inch monitor uses a tube that contains an estimated 2.5 to 4 gms. of lead. The lead can seep into the ground water from landfills, thereby contaminating it. If the tube is crushed and burned, it emits toxic fumes into the air. Thus, proper scientific and environmentally sound management is the need of the hour while disposing or recycling wastes.

E-waste in India

India is the second largest e-waste generator in Asia. According to the Manufacturers' Association of Information Technology (MAIT), India generated about 3,30,000 metric tonnes of e-waste in 2007, which could multiply enormously and reach 800,000 metric tonnes by 2012. The Indian Market Research Bureau (IMRB) Survey of 'E-waste generation at Source' in 2009 states that out of the total e-waste volume in India, television and desktops and servers contributed 68% and 27% respectively, while imports contributed 2% and mobile phones, a mere 1%. Till 2010, there are about 23 recycling units registered with Central Pollution Control Board (CPCB).

More than 90% of the e-waste generated in our country ends up in the unorganized market for recycling and disposing. According to MAIT, a mere 19,000 metric tonnes of e-waste are recycled in the formal sector and there is no accountability for the rest which is recycled in the informal sector. Only 10% of the total e-waste is available for recycling by the Recyclers Association, which was formed in July 2009.

As stated in the 'Occasional Paper' published by the Rajya Sabha Secretariat, 2011, 65 cities in India generate more than 60% of the total e-waste generated. Ten states generate 70% of the total e-waste with

Maharashtra ranking first followed by Tamilnadu, Andhra Pradesh, Uttar Pradesh, West Bengal, Delhi, Karnataka, Gujarat, Madhya Pradesh and Punjab. The top 10 e-waste generating cities are Mumbai, Delhi, Bengaluru, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat and Nagpur.

E-waste in unorganized sector

The unorganized sector consists of a cluster of small and informal trading houses not governed by health and environmental regulations. The formal recycling firms face stiff competition from the unorganized sector. The formal recyclers do not use chemicals or incinerators like informal recyclers but use environmentally sound practices in recycling. The informal recyclers have mushroomed in the peri-urban areas and their operations are hazardous leading to environmental and health problems.

Printed circuit boards, cables and plastic casing, poly-vinyl chloride (PVC) coated copper cables and plastic computer casings releases highly toxic dioxins and furans when burnt to recover valuable metals, mercury switches; mercury in flat screens, poly-chlorinated biphenyl's (PCB's) present in older capacitors and transformers; etc. pose great danger to environment.

Dismantling is important in e-waste management and recycling process. Some dismantlers also serve as recyclers and export the generated e-waste.

Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and

their Disposal was adopted on 22 March 1989 and signed by 173 countries at Basel, Switzerland. The agreement was formulated mainly to prevent the economically motivated dumping of hazardous wastes by rich countries in poor countries.

The overarching objective of the Basel Convention is to protect human health and the environment from the adverse effects of hazardous wastes. Its scope of application covers a wide range of wastes defined as “hazardous wastes” based on their origin and/or composition and their characteristics.

According to the Basel Convention, Environmentally Sound Management as defined and adopted in the hazardous waste rules in India is, “Environmentally sound management of hazardous wastes or other wastes’ means taking all practicable steps to ensure that hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes”.

The 10th Anniversary of Basel Convention on Hazardous Wastes in 1999 convened at Basel adopted a declaration on the environmentally sound management of hazardous wastes. The declaration emphasized the urgent need to reduce the generation of hazardous wastes in terms of quantity and hazardousness representing a major shift towards cleaner production mechanism.

The declaration sought to guide the activities of the Convention in specific areas, as given below:

- ❖ active promotion and use of cleaner technologies and production methods;

- ❖ further reduction of the movement of hazardous and other wastes;
- ❖ the prevention and monitoring of illegal traffic;
- ❖ improvement of institutional and technical capabilities – through technology when appropriate – especially for developing countries and countries with economies in transition;
- ❖ further development of regional and sub regional centres for training and technology transfer; and
- ❖ enhancement of information exchange, education and awareness-raising in all sectors of society.

The Basel Convention has made it mandatory that any country exporting hazardous wastes must obtain the prior permission of the importing country. Initially, the Basel Convention had not highlighted the issue of e-waste although there were rules for recycling and export of hazardous wastes from developed countries to the developing countries. However, the World Forum on E-wastes held at Nairobi in November 2006 finally brought the issue into primary focus. It was stated in the Conference that some 20 to 50 million metric tonnes of e-waste were generated worldwide every year, comprising more than 5% of all municipal solid waste.

E-waste recycling guidelines

E-waste recycling unit is an industrial operation requiring clearance from various environmental management and enforcement authorities for establishment and effective operation. The guidelines for recycling facility should be in line with the existing 'Guidelines for Environmentally Sound Management of

E-waste' published by the Ministry of Environment and Forests, Government of India and the Central Pollution Control Board (CPCB). These guidelines provide the stakeholders the Best Available Practices (BAT) and the technologies used all over the world for effective e-waste management.

The e-waste recycling unit is considered similar to other industrial units handling hazardous substances that may cause air and water pollution. The industry has to obtain Environmental Clearance (EC) under the Environmental Clearance notification of 2006. E-waste also forms part of the waste category in the Hazardous Wastes (Management and Handling) Rules amendments 2008. It is mandatory that all the e-waste recyclers, dismantlers and collection centres should register with the concerned State Pollution Control Boards and Central Pollution Control Board (Refer Annexure – I, II and III).

The stakeholders will have to be made aware of the new rules and its provisions. The consumers should also be made aware of the hazardous constituents of e-waste.

Impact of E-waste on Environment and Human health

Disposal of e-waste is a major problem faced by many nations across the globe. Computer wastes that are land filled produce contaminated leachates which eventually pollute the groundwater. Acids and sludge obtained from melting computer chips if disposed on the ground cause acidification of the soil. Nowadays, water is being transported to faraway towns to cater to the demands of the population. Letting out the e-waste leachates into river, threaten the very survival of human beings.

Incineration of e-waste can emit toxic fumes and gases, thereby polluting the surrounding air. Improperly monitored landfills can cause environmental hazards.

Mercury will leach out when certain electronic devices, such as circuit breakers are destroyed. The same is true of polychlorinated biphenyls (PCBs) from condensers. When brominated flame retardant plastic or cadmium containing plastics are land filled, both polybrominated diphenyl ethers (PBDE) and cadmium may leach into the soil and groundwater. It has been found that significant amounts of lead ion are dissolved from broken lead containing glass, such as the cone glass of cathode ray tubes, which gets mixed with acidic waters and are a common occurrence in landfills.

Not only does the leaching of mercury pose specific problems, the vaporization of metallic mercury and dimethylene mercury, both part of Waste Electrical and Electronic Equipment (WEEE) is also of great concern. In addition, uncontrolled fires may arise at landfills and this could be a frequent occurrence in many countries. When exposed to fire, metals and other chemical substances such as extremely toxic dioxins and furans (TCDD tetrachloro dibenzo-dioxin, PCDDs-polychlorinated dibenzo-dioxins. PBDDs-polybrominated dibenzo-dioxin and PCDFs--poly chlorinated dibenzo furans) from halogenated flame retardant products and PCB containing condensers can be emitted.

The most dangerous form of burning e-waste is the open-air burning of plastics in order to recover copper and other metals. The toxic fall-out from open air burning affects both the local environment and broader global air currents, thus depositing highly toxic byproducts in many places throughout the world.

E-waste Management – the need of the hour

Even today, a majority of the electronic waste items are stored as such due to lack of awareness and clarity with regard to the safe disposal and management of e-waste. This electronic junk lies unattended in houses, offices, warehouses etc. sometimes mixed with household wastes which are finally disposed along with Municipal solid waste, thus causing serious health and environmental problems. As per the report of the Ministry of Environment and Forests, India generated 1,46,800 tonnes of E-waste during the year 2005 and the quantity is expected to reach several times by the year 2020. However, the existing e-waste recycling facilities are comparatively less in our country.

Electronic Waste (Management and Handling) Rules 2011

Now it is illegal to dump the old televisions, mobile phones or laptops into garbage bins or sell any of these items to the local scrap dealer. Under the Electronic Waste (Management and Handling) Rules 2011, effective from 1st May 2012, such waste must be routed to one of 73 authorized recyclers in India. “The rules allow a consumer to dispose their old electronic items only through three means viz, authorized collection centers, authorized recycler or through the manufacturer,” The law seeks to put the onus largely on the manufacturers, who are expected to pick up/ take back the e-waste. Non-compliance can entail imprisonment or a fine. A holistic approach is needed to address the challenges faced by India in e-waste management involving electronic goods manufacturers, consumers, recyclers and all concerned stakeholders. Hence, it is the right time to bring all stakeholders together under one platform for better understanding of the e-waste (Management and Handling) Rules 2011.

State of E-waste generation in India

The culture of consumerism has influenced Indians which has led to an increase in e-waste in the last two decades.

Growth rate in sale of computers in India is stated below in Table: 1

Table: 1
Total Computer Sales 2003 – 2009

Year	Units
2003 – 04	3,124,22
2004 – 05	3,809,724
2005 – 06	5,046,558
2006 – 07	6,341,451
2007 – 08	7,344,306
2008 – 09	6,796,107

Source: MAIT: IT Industry Performance Annual Review: 2008 – 09, Press Conference, New Delhi: 14 July 2009

The sale of television sets has risen from 88 lakh units in 2005 to about 118 lakh units in 2010. The telecommunication sector has also contributed to the increasing e-wastes generated in the country. The quality of electrical and electronic products produced in the country adds to the increased e-waste accumulation. The lifespan of mobile phone is very less and the changing models with improved features also add up to e-waste.

Table: 2
Quantity of WEEE (Waste Electrical and Electronic Equipment) generated in Indian States

Sl.No.	State / UT	E-waste (tonnes)
1.	Andaman & Nicobar Islands	92.2
2.	Andhra Pradesh	12780.3
3.	Arunachal Pradesh	131.7
4.	Assam	2176.7
5.	Bihar	3055.6
6.	Chandigarh	359.7
7.	Chhattisgarh	2149.9
8.	Dadra & Nagar Haveli	29.4
9.	Daman & Diu	40.8
10.	Delhi	9729.2
11.	Goa	427.4
12.	Gujarat	8994.3
13.	Haryana	4506.9
14.	Himachal Pradesh	1595.1
15.	Jammu & Kashmir	1521.5
16.	Jharkhand	2021.6
17.	Karnataka	9118.7
18.	Kerala	6171.8
19.	Lakshadweep	7.4
20.	Madhya Pradesh	7800.6
21.	Maharashtra	20270.6
22.	Manipur	231.7
23.	Meghalaya	211.6
24.	Mizoram	79.3
25.	Nagaland	145.1
26.	Orissa	2937.8
27.	Puducherry	284.2
28.	Punjab	6958.5
29.	Rajasthan	6326.9
30.	Sikkim	78.1
31.	Tamilnadu	13486.2
32.	Tripura	378.3
33.	Uttar Pradesh	10381.1
34.	Uttarakhand	1641.1
35.	West Bengal	10059.4
	Total	146180.7

Source: Country level WEEE assessment study by the International Resource Group Systems South Asia Pvt. Ltd. (IRGSSA), (M/s. IRG Systems South Asia Pvt. Ltd.), 2005.

❖ Pollutants in e-waste

Pollutants or toxins are concentrated in circuit boards, batteries, plastics and LCDs (liquid crystal displays). The table given below throws light on the pollutants occurring in the waste electrical and electronic equipments.

Table: 3
Pollutants and their occurrence in waste electrical and electronic equipment

S.No.	Pollutant	Occurrence
1.	Arsenic	Semiconductors, diodes, microwaves, LEDs (Light-emitting diodes), solar cells
2.	Barium	Electron tubes, filter for plastic and rubber, lubricant additives
3.	Brominated flame-proofing agent	Casing, circuit boards (plastic), cables and PVC cables
4.	Cadmium	Batteries, pigments, solder, alloys, circuit boards, computer batteries, monitor cathode ray tubes (CRTs)
5.	Chrome	Dyes / pigments, switches, solar
6.	Cobalt	Insulators
7.	Copper	Conducted in cables, copper ribbons, coils, circuitry, pigments
8.	Lead	Lead rechargeable batteries, solar, transistors, lithium batteries, PVC (polyvinyl chloride) stabilizers, lasers, LEDs, thermoelectric elements, circuit boards
9.	Liquid crystal	Displays

S.No.	Pollutant	Occurrence
10.	Lithium	Mobile telephones, photographic equipment, video equipment (batteries)
11.	Mercury	Components in copper machines and steam irons; batteries in clocks and pocket calculators, switches, LCDs
12.	Nickel	Alloys, batteries, relays, semiconductors, pigments
13.	PCBs (polychlorinated biphenyls)	Transformers, capacitors, softening agents for paint, glue, plastic
14.	Selenium	Photoelectric cells, pigments, photocopiers, fax machines
15.	Silver	Capacitors, switches (contacts), batteries, resistors
16.	Zinc	Steel, brass, alloys, disposable and rechargeable batteries, luminous substances

Source: Alexander Janz and Bernd Billitewski, 'Hazardous substances in waste electrical and electronic equipment' in Rakesh Johri, E-waste: Implications, regulations and management in India and current global best practices, TERI, New Delhi, 2008, p.93.

❖ **Composition of e-waste**

Waste from electrical and electronic wastes include several toxins like cadmium, lead in circuit boards, lead oxide and cadmium in cathode ray tubes (CRTs), mercury in switches and flat monitors, etc. These substances are carcinogenic in nature. The table given below indicates the harmful elements present in the compositions of e-waste that are hazardous to human health and the environment.

Table: 4
Harmful elements in the composition of electrical and electronic appliances hazardous to health and environment

S. No.	Metal	Danger
1.	Lead	A neurotoxin that affects the kidneys and the reproductive system. High quantities can be fatal. It affects mental development in children. Mechanical breaking of CRTs (cathode ray tubes) and removing solder from microchips release lead as powder and fumes
2.	Plastics	Found in circuit boards, cabinets and cables, they contain carcinogens. BFRs or brominated flame retardants give out carcinogenic brominated dioxins and furans. Dioxins can harm reproductive and immune systems. Burning PVC, a component of plastics, also produces dioxins. BFR can leach into landfills. Even the dust on computer cabinets contains BFR.
3.	Chromium	Used to protect metal housings and plates in a computer from corrosion. Inhaling hexavalent chromium or chromium 6 can damage the liver and kidneys and cause bronchial maladies including asthmatic bronchitis and lung cancer.

S. No.	Metal	Danger
4.	Mercury	Affects the central nervous system, kidneys and immune system. It impairs foetus growth and harms infants through mother's milk. It is released while breaking and burning of circuit boards and switches. Mercury in water bodies can form methylated mercury through microbial activity. Methylated mercury is toxic and can enter the human food chain through the aquatic channel.
5.	Beryllium	Found in switch boards and printed circuit boards. It is carcinogenic and causes lung diseases.
6.	Cadmium	A carcinogen. Long-term exposure causes <i>Itai itai</i> disease, which causes severe pain in the joints and spine. It affects the kidneys and softens bones. Cadmium is released into the environment as powder while crushing and milling of plastics, CRTs and circuit boards.
7.	Acid	Sulphuric and hydrochloric acids are used to separate metals from circuit board. Fumes contain chlorine and sulphur dioxide, which cause respiratory problems. They are corrosive to the eye and skin.

Source: 'IT's underbelly' – *Down to Earth*, vol.19, no.1, May 16 – 31, 2010.

The recoverable quantity of elements in Personal Computer (PC) is given below:

Elements	Content (% of total weight)	Content (kg)	Recycling efficiency (%)	Recoverable (%)weight of element (kg)
Plastics	23	6.25	20%	1.25069408
Lead	6	1.71	5%	0.08566368
Aluminum	14	3.85	80%	3.08389248
Germanium	0.0016	0.00	0%	0
Gallium	0.0013	0.00	0%	0
Iron	20	5.57	80%	4.45453312
Tin	1	0.27	70%	0.19188512
Copper	7	1.88	90%	1.69614576
Barium	0.0315	0.01	0%	0
Nickel	0.8503	0.23	0%	0
Zinc	2	0.60	60%	0.35979072
Tantalum	0.0157	0.00	0%	0
Indium	0.0016	0.00	60%	0.00026112
Vanadium	0.0002	0.00	0%	0
Terbium	0	0.00	0%	0
Beryllium	0.0157	0.00	0%	0
Gold	0.0016	0.00	99%	0.000430848
Europium	0.0002	0.00	0%	0
Tritium	0.0157	0.00	0%	0
Ruthenium	0.0016	0.00	80%	0.00034816
Cobalt	0.0157	0.00	85%	0.00362984
Palladium	0.0003	0.00	95%	0.00007752
Manganese	0.0315	0.01	0%	0
Silver	0.0189	0.01	98%	0.005037984
Antimony	0.0094	0.00	0%	0
Bismuth	0.0063	0.00	0%	0
Chromium	0.0063	0.00	0%	0
Cadmium	0.0094	0.00	0%	0
Selenium	0.0016	0.00	70%	0.00030464
Niobium	0.0002	0.00	0%	0
Yttrium	0.0002	0.00	0%	0
Rhodium	0	0.00	50%	0
Mercury	0.0022	0.00	0%	0
Arsenic	0.0013	0.00	0%	0
Silica	24.8803	6.77	0%	0

Source: Guidelines for Environmentally Sound Management of e-waste, published by the Ministry of Environment and Forests and the Central Pollution Control Board, March 2008, p. 72.

The recoverable quantity of elements in a television set (TV) is given below:

Elements	%	PPM	Recoverable weight of element (kg)
Aluminum	1.2	-	0.4344
Copper	3.4	-	1.2308
Lead	0.2	-	0.0724
Zinc	0.3	-	0.1086
Nickel	0.038	-	0.013756
Iron	12	-	4.344
Plastic	26	-	9.412
Glass	53	-	19.186
Silver	-	20	0.000724
Gold	-	10	0.000362

Source: *Guidelines for Environmentally Sound Management of e-waste, published by the Ministry of Environment and Forests and the Central Pollution Control Board, March 2008, p. 73.*

The various materials recovered from a refrigerator are given below:

Material Type	%
CFCs	0.20
Oil	0.32
Ferrous Metals	46.61
Non-ferrous Metals	4.97
Plastics	13.84
Compressors	23.80
Cables / Plugs	0.55
Spent Purfoam	7.60
Glass	0.81
Mixed waste	1.30
Total	100.00

Source: *Guidelines for Environmentally Sound Management of e-waste, published by the Ministry of Environment and Forests and the Central Pollution Control Board, March 2008, p. 74.*

Government assistance for Treatment, Storage and Disposal facilities (TSDFs)

The Government of India has taken several measures to address waste management. It has encouraged the setting up of integrated Treatment, Storage and Disposal facilities (TSDFs) for hazardous waste management in the Public Private Partnership (PPP) mode in clusters of hazardous waste generating industries. So far 28 TSDFs have been set up.

The Ministry of Urban Development is implementing the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) for providing financial assistance to the State Government / Urban Local Bodies for various projects including solid waste management.

Based on the proposals received from the states, the Centre has provided financial assistance to the State Pollution Control Boards for setting up integrated TSDFs. The financial assistance provided to the states is given below:

Year	State	Amount (Rs. in lakhs)
2007 - 2008	Tamil Nadu	80.00
2007 - 2008	Andhra Pradesh	80.00
2007 - 2008	Maharashtra	96.64
2008 - 2009	Maharashtra	160.00
2009 - 2010	Maharashtra	240.00
2009 - 2010	Uttar Pradesh	80.00
2009 - 2010	Kerala	80.00

Source: 'Assistance to States for Disposal of Wastes', Lok Sabha Unstarred Question No. 6519, dated 05.05.2010.

In order to ensure the proper usage of funds, a Memorandum of Understanding (MOU) is entered into between the Ministry of Environment and Forests, State Pollution Control Board and the entrepreneur before releasing the funds. A Monitoring Committee is also constituted to monitor the progress of the facility.

Conclusion

All types of waste – imported and generated in India, hazardous industrial waste, municipal solid waste and e-waste pose a threat to human health and local environment. The quantum of e-waste generated in a month has increased manifold in the country posing a serious threat to the environment and people's health. The Central Pollution Control Board (CPCB) has identified about 88 critically polluted industrial zones in the country which has polluted the adjacent water bodies, rivers and ground water. A report by the Toxics Link reveals that India has over 1.38 million obsolete computers with an additional 1,050 tonnes of electronic scrap added by manufacturers every year.

The state of Tamilnadu is the first state to form a policy of collection of electronic waste by Community Based Organizations (CBOs). The Ministry of Environment and Forests, Government of India provides funding to conduct awareness programmes, meetings, conferences to Central Pollution Control Board (CPCB), State Pollution Control Boards (SPCB) and other reputed institutions.

As per the saying 'prevention is better than cure', reducing waste at source will clearly promote economic and industrial competitiveness. Nearly 94% of the

materials used for manufacturing durable electrical and electronic goods become waste even before the end product is ready for use. Reducing wastes at source would even reduce the financial incentives that drive the illegal trade in the country. The ultimate solution is to minimize the generation of hazardous waste rather than recycle them. The Ministry of Environment and Forests is promoting the 3R Concept of Reduce, Reuse and Recycle for hazardous waste management.

Even though it is evident that the IT industry is the leading contributor to our country's growing economy, one must not forget that it is the same IT industry that is contributing to the growing e-waste menace.

The future has in store both challenges and opportunities with regard to minimizing requirements, developing cleaner and more sustainable products and effective e-waste management. It is also suggested that the Government of India may impose a cess on Electrical & Electronic products to set up common e-waste recycling units either in the government sector or private sector with government assistance. It has also been proposed by the Ministry of Environment and Forests in the draft Plastic Waste (Management & Handling) Rules, 2010 to entrust the Municipalities or Civic Agencies in assigning the overall responsibility for setting up processing units, operation and coordinating effective e-waste management.

The fundamental principles of accountability, transparency and sustainability need to be integrated in any policy or regulation on e-waste to ensure its proper and effective implementation.

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Annexure – I
LIST OF E-WASTE RECYCLERS IN INDIA

S. No.	State / UT	Name and address of recyclers
1.	Andaman & Nicobar Islands	Nil
2.	Andhra Pradesh	<p>M/s. Earth Sense Recycle Private Limited, Plot No. 37, APIIC Industrial Park, Mankhal, Maheshwaram Mandal, Rangareddy District</p> <p>M/s. Ramky E-Waste Recycling Facility, (Ramky Enviro Engineers Ltd.) Plot No. 25 A, Hardware Park, K. Raviryal (V), Maheswaram (M), Rangareddy District</p> <p>M/s. Project Salvage, APEL I.E, Kushaiguda, Kesara (M), Rangareddy District</p> <p>M/s. Z Industries, 106 & 107, Pulimamidi (Village), Kandukur (M), Rangareddy District</p> <p>M/s. R. R. Ewaste Solution Pvt. Ltd. Plot No. 113. Phase -III, IDA Cherlapally, Rangareddy Dt.</p> <p>M/s. Indian Recycling Co., C-12/B, Industrial Estate, Sanathnagar, Hyderabad</p>

3.	Arunachal Pradesh	Nil
4.	Assam	Nil
5.	Bihar	Nil
6.	Chandigarh	Nil
7.	Chhattisgarh	M/s. Navrachna Recycling Pvt. Ltd., Plot no. 1B, Somni Industrial Area, Distt.- Rajnandgaon – 491 441
8.	Dadra & Nagar Haveli	Nil
9.	Daman & Diu	Nil
10.	Delhi	Nil
11.	Goa	Nil
12.	Gujarat	M/s. Jhagadia Copper Ltd., 747, GIDC Industrial Estate, Jhagadia, Dist-Bharuch - 393 110
		M/s. ECS Environment Ltd., ECS House, 11-12 Garden View, Opp. Auda Garden, Sindhu Bhawan road, Off SG Highway-Pakwan Circle, Bodakdev, Ahmedabad 380 054

M/s. E-coli Waste
Management P. Ltd.,
Plot No. 90 TO 92, Sabar
Industrial Park P. Ltd.,
Village : Asal Ta-Bhiloda,
District Sabarkantha,
Himmatnagar

M/s. E-Process House,
Plot No. 136/F-1. 2nd Phase,
GIDC, District Valsad,
Vapi 396 195

M/s. Pruthvi E-Recycle Pvt.
Ltd.,
Plot No.- 31/32 Golden
Industries Area, Near Rolex
Industries, Village – Kothariya,
District - Rajkot

13. Haryana

M/s. 3R Recyclers,
Plot No. 266, Sector-8, IMT
Manesar, Gurgaon

M/s. Earth Sense Recycle Pvt.
Ltd., Plot No. 225, Sector – VI,
IMT Manesar, Gurgaon –
122 051

M/s. Green World
International,
Vill. Kherkhi, Danla Sihi,
Sikanderpur Road, Delhi
Jaipur Highway, Gurgaon

M/s. Green Vortex Waste
Management (P), Ltd.,
P. No. 177/7, IMT Manesar,
Gurgaon

14. Himachal Pradesh Nil

15. Jammu & Kashmir Nil

16. Jharkhand Nil

17. Karnataka M/s. Ash Recyclers,
UNIT – 1, No-94, Thimmiah
Road, Bengaluru – 560 051

M/s. Ash Recyclers,
UNIT-II, Shed No. – B-3,
KSSIDC Industrial Estate,
Hoskote, Bengaluru – 562 114

M/s. E- Parisara Pvt Ltd.,
Plot No. 30-P3, KIADB
Industrial Area, Dabaspeta,
Nelamangala Taluk, Bangalore
Rural District- 562 111

M/s. New Port Computer
Services (India) Private
Limited.,
Shed No. B-29, KSSIDC
Industrial Estate,
Bommasandra, Bengaluru –
560 099

M/s. EWARD & Co.,
No. 6/1B, 14th Cross Hosur
Main Road, Bommanahalli,
Bengaluru – 560 068

M/s. Nishanth Technologies,
Shed No. B-121/A, ITI
Dyavasandra Industrial
Estate, Whitefield Road,
Bengaluru

M/s. K. G. Nandani
Enterprises,
#46/4, 46/5,
Billakempanahalli Village,
Bidadi Hobli, Ramanagar
(Taluk & District) – 562 109
M/s. Electronics City
Industries Association,
No. B-102, Block I, KSSIDC
Complex, Electronic City,
Hosur Road, Bengaluru

M/s. ECO- BIRDD Recycling
Company, Pvt. Ltd.,
No185, Azeez Sait Industrial
Area, Nayandahalli, Mysore
Road, Bengaluru – 560 039

M/s. F.A. Enterprises,
B-8, Tamaka, Kaida, Industrial
Area, Kolar 563 101

M/s. Ameena Enterprises,
C-199, KSSIDC Industrial
Estate, Hebbal Mysore –
570 017

M/s. E-R3 Solutions Pvt. Ltd.,
C – 430, 1st Cross, Behind
Peenya Police Station, 1st
Stage Peenya Industrial Area,
Peenya, Bengaluru –
560 058

M/s. Trishyirya Recycling
India Pvt. Ltd.,
No. 315, 4th Phase, Peenya
Industrial Estate, Bengaluru –
560 058

M/s. Tech Logic,
Unit-2, Shed No. 36, 2nd
Main, Ranganathapura,
Bengaluru – 560 044
M/s. E Friendly & Waste
Recycler,
Off. #. 19, Stephen's Enclave,
Stephens Road, Frazer Town,
Bengaluru – 560 005

M/s. Terra Firma
Biotechnologies Ltd,
Sy No. 22, Srinivasapura
Village, Katenahalli, Kolalu
Hobli, Koratagere Taluk,
Tumkur

M/s. Samarthanam Trust for
the Disabled,
No. 66. 6th Main, 3rd Phase,
Peenya Industrial Area,
Bengaluru – 560 058

M/s. E-Sparsh,
No. 134/1, 2nd B Main Road,
2nd Stage, Peenya Industrial
Area, Bengaluru – 560 058

M/s. Green Globe
Enterprises,
No. 108/7, 5th Cross,
Singasandra Industrial Area,
Hosur Road, Bommanahalli,
Bengaluru – 560 068

M/s. Tech Logic,
No. 41, 1st A main,
Kalyannagar, Shakthi Garden,
Mudalapalya, Vijayanagar,
Bengaluru – 560 072

M/s. Sai Recyclers,
No. 20, KSSIDC Industrial
Estate, Bhashettihalli,
Versandara Post,
Doddaballapura Town & Taluk,
Bangalore Rural District.

M/s. Nobel Technology,
No. 46, 14th Cross, 4th Phase,
Peenya Industrial Area,
Bengaluru – 560 058

M/s. KGN Enterprises,
Plot No. 110 (P)/1, 111/1,
Humnabad Industrial Area,
Bidar – 585 330

M/s. Amara Metals
Enterprises,
No. V20/1, 4th Main, 2nd
Stage, Peenya Industrial Area,
Bengaluru – 560 058

M/s. Cerebra Integrated
Technologies Ltd.,
Plot No. 422/2, 11th Cross,
4th Phase, 2nd Stage, Peenya
industrial Area, Bengaluru –
560 058

M/s. N. V. Trading Company,
Plot No. 19 D, Bidadi
Industrial Area, 2nd Phase, 1st
Sector, Ramangara Taluk &
District

M/s. Just-e-Care,
No. C-14, Industrial Estate,
Station Back Road, Bijapur –
586 101

M/s. Eco E-waste Recyclers
India Pvt. Ltd.,
Shed No.26, No.41/1,42/2,
2nd Cross, Mutachari
Industrial Estate, Mysore
Road, Bengaluru – 560 099

M/s. MKK E-waste
Enterprises,
Shed No.292, Belur Industrial
Area, Dharwad

M/s. Ecovision Recycling,
No.D-65, Veerasandra
Industrial Area, Hosur Road,
Bengaluru – 560 034

M/s. Lubetech Petro
Chemicals,
Plot No.8-A, Bidadi Industrial
Area, 2nd Phase, Sector-1,
Bidadi, Ramangara District

M/s. Royal Touch,
No.3/2, Ezekiel Industrial
Estate, Ward No.94, K.G. Halli,
AC Post, Nagavara Main
Road, Bengaluru – 560 045

M/s. Arrow Systems,
No.SM 3, 4th Phase,
3rd Stage,Peenya Industrial
Area, Bengaluru – 560 058

M/s. Retone E-waste
Management,
Plot No.95B & 96A, Belagola
Industrial Area, Mysore –
570 017

M/s. Trackon E-waste
Recyclers Pvt. Ltd.,
No.28, Gerupalya, 2nd Phase,
Kumbalgodu Industrial Area,
Bengaluru – 560 074

M/s. Digicomp Complete
Solutions Ltd.,
No.86, Ground Floor, 3rd
Cross, New Timber Yard
Layout, Mysore Road,
Bengaluru – 560 026

M/s. Afeefa Spectro Alloys,
Sy.No.289/1, Nagaragere
Village, Gauribidnur Taluk,
Chikkaballapura District

M/s. e-Scrappy Recyclers,
No.106, Andrahalli Main Road,
Byreshwara Industrial Area,
Peenya 2nd Stage, Bengaluru –
560 058

M/s. HMG Eco care Recyclers
Pvt. Ltd,
No.C-22, 3rd cross,
KSSIDC Industrial Estate,
Kumbalgodu, Mysore Road,
Bengaluru – 560 074.

M/s. Surface Chem Finishers,
B-41/1, 3rd Stage, Peenya
Industrial Estate Bengaluru –
560 058

18. Kerala Nil

19. Lakshadweep Nil

20. Madhya Pradesh Nil

21. Maharashtra M/s. Earth Sense
Recycle Pvt. Ltd.,
A-7, Gala no: 1,2&3, Ground
Floor, Prena Complex, Anjur
Phata, Vill: Val, Tal: Bhiwandi
Dist: Thane

M/s. Eco Friend Industries,
A-205, TTC Industrial Area,
Pawane Village, Thane Belapur
Road, Navi Mumbai –
400 710

M/s. Just Dispose Recycling
Pvt. Ltd.,
A 103,104,110,119, Arvind
Industrial Estate, Navghar,
Tal: Vasai, Dist: Thane

M/s. Mercury Metal
Industries,
Plot no. D-48, MIDC Mahad,
Tal: Mahad, Dist: - Raigad

M/s. Sabbir Traders,
Plot No.999 (7), Kiravali
Narayan Kutir Udyog Mandal,
Village Adivali, Tal. Panval,
Dist. Raigad

M/s. Eco Recycling Limited,
Eco House, Near Top Glass
Enclave, Bhoipada Vasai
(East), Dist. Thane

M/s. Hi- Tech Recycling India
(P) Ltd.,
S No. - 571/572, Near Silver
Court Hotel, A/P: Bhigaon,
Tal: Mulshi, Dist: Pune

M/s. E-Recon Recycling,
Gate no:94, Chitegaon,
Tal:Paithan, Dist:
Aurangabad

M/s. Green World Recycling,
Vill: Val, Pritesh Complex,
Building no; B-12, Gala No:
7,8 Anjur Phata,Village: Val,
Tal: Bhiwandi, Dist: Thane

- | | |
|---------------|-----|
| 22. Manipur | Nil |
| 23. Meghalaya | Nil |
| 24. Mizoram | Nil |
| 25. Nagaland | Nil |

26. Orissa Nil
27. Puducherry Nil
28. Punjab Nil
29. Rajasthan M/s. Greenscape
Eco Management Pvt. Ltd.,
H-1-472, Alwar, Rajasthan
- M/s. K.G. Metalloys,
F— 37-38, RIICO Industrial
Area, Ondela Road, Dholpur,
Rajasthan – 328 001
- M/s. Deshwal E-waste
Recycler,
G-147A, IID, Khuskhera,
Tehsil Tijara, Distt. Alwar
30. Sikkim Nil
31. Tamilnadu M/s. AER Worldwide (India)
Pvt. Ltd.,131/2, Madhavaram
Village,Ambattur Taluk,
Thiruvallur District
- M/s. INAA Enterprises,
Plot No.AC31/24, SIDCO
Industrial Estate,
Thirumudivakkam,
Sriperumpudur Taluk,
Chennai 600 044

M/s. TES AMM Private
Limited,
SF No. 3894/19, Tondiarpet
Village Fort – Tondiarpet
Taluk, Chennai
M/s. Trishyiraya Recycling
India Pvt. Ltd.,
Plot No.A-7, Phase-I, MEPZ-
SEZ, Tambaram,
Chennai-600 045

M/s. Ultrust Solution India (P)
Ltd.,
Plot No. 101, SIDCO Industrial
Estate,Ambattur,
Chennai 600 098

M/s. SVP Recycling P Ltd.,
Unit 31, Vyasarpadi Industrial
Estate,EH Road, Chennai

M/s. Auto Mac Systems,
S.F. No. 60,Pt. Errahalli
Village, Krishnagiri District

M/s. Salisons,
13-4/5, SIDCO Industrial
Estate,Chengalpet
Taluk,Kancheepuram District

M/s. TES – AMM Private
Limited,
Plot No.A-18, SIPCOT
Industrial Growth Centre,
Oragadam, Panruti 'A' Village,
Sriperumpudur, Kanchipuram
District

M/s. Global E-waste
Management and Services
(GEMS), R.S.No.222/3, Plot
No.147/A, Neervallur-Village,
Kancheepuram Taluk,
Kancheepuram

M/s. SEZ Recyclers,
TP – 7th Avenue, Mahindra
World City Developers
Ltd., Industrial Park,
Thenmelpakkam,
Kancheepuram District

M/s. Comtech Exports Ltd.,
Mambakkam, Sriperumbudur,
Kanchipuram District

M/s. Enviro Metals Waste
Management India Pvt. Ltd.,
Sriperumbudur Taluk,
Kanchipuram District

M/s. Ultrust Solutions (India)
Pvt. Ltd.,
S.F.No.297/1B,
Pappankuppam Village
Gummidipoondi Taluk,
Thiruvallur District

M/s. Green India Recyclers,
Ellaikudy, Thiruverumbur
Panchayat Union

M/s. Shri Raaam Recycling,
SIDCO Industrial Estate,
Gummidipoondi, Thiruvallur
Taluk & District

M/s. Victory Recovery &
Recycle Technologies India
Pvt.Ltd.,
672/2, Doubal Dragon
Industrial Park, Kannur
Village & Post Kottaiyur,
Thiruvallur 602 108

M/s. AER Worldwide (India)
Pvt. Ltd.,
774, Elandhancheri,
Sadaiyankuppam
Village. Manali New Town,
Thiruvallur District

M/s. Trittech Systems,
Porur Village, Ambattur
Taluk,Thiruvallur District

M/s. Abishek Enterprises,
No.2G/2NP, SIDCO Industrial
Estate, Ambattur, Thiruvallur
District

M/s. Green R2 ReProcessors
Pvt. Ltd.,
Plot No. 19, TASS Industrial
Estate, Ambattur, Chennai
600 098

M/s. Renaissance Recycling
Pvt. Ltd.,
S.F. No. 206/1, 206/2,
Kizhacheri Village,Thiruvallur
Taluk & District

M/s. B.V. Enterprises,
S.F. NO. 41/2, Thandalam
Village, Sriperumbudur
Taluk, Kancheepuram District

M/s. Tropical Recyclers,
S.F. No. 427/2, Vellanur
Village, Ambattur Taluk,
Thiruvallur District

32. Tripura

Nil

33. Uttar Pradesh

M/s. Khan Traders,
B-5, Site No. 4, Panki
Industrial Area, Kanpur

M/s. TIC Group India Pvt.Ltd.,
J-2 & J-6, SDF Block J, Noida
Special Economic Zone (NSEZ),
Noida Dadri Road, Phase – II,
Noida – 201 305

M/s. J.V.N. Metals,
30/41/1A, Rakabganj Road,
Chhipitola, Agra
(Godown - Khasara No. 1003,
Post- Kakua, Gwalior Road,
Agra

34. Uttarakhand

M/s. Attero Recycling Pvt.Ltd.,
173, Village Bhagwanpur,
Raipur Industrial Area,
Roorkee, Dist. Haridwar

35. West Bengal

M/s. J.S. Pigments Pvt. Ltd.,
Vill & P.O.: Jarua, P.S.: Polba,
Delhi Road, Pin-712 138

Source:

1. Central Pollution Control Board, Government of India
2. Tamilnadu Pollution Control Board
3. Maharashtra Pollution Control Board
4. Odisha State Pollution Control Board
5. Karnataka State Pollution Control Board
6. Andhra Pradesh Pollution Control Board
7. West Bengal State Pollution Control Board

Annexure – II

LIST OF E-WASTE DISMANTLERS IN KARNATAKA & MAHARASHTRA

S. No.	State / UT	Name and address of Dismantlers
1.	Karnataka	<p>M/s. Sriram Eco Raksha ComputerServices Pvt. Ltd., No. B-29,KSSIDC Industrial Estate, Bommasandra, Hosur Road, Anekal Taluk, Bengaluru – 560 099</p> <p>M/s. FA Enterprises, No. B-08,KIADB Industrial Area, Tamaka,Kolar Distirct.</p> <p>M/s. E-R3 Solutions Pvt. Ltd., No. C-430, 1st Cross, 1st Stage Peenya Industrial Area, Bengaluru – 560 058.</p> <p>M/s. Trishyirya Recycling India Pvt. Ltd, No.315, 4th Phase, Peenya Industrial Estate, Bengaluru – 560 058.</p> <p>M/s. Tech Logic, Unit-2, Shed No.36, 2nd Main, Ranganathapura,Bengaluru – 560 044</p>

M/s. Sai Recyclers,
No. 20, KSSIDC Industrial
Estate, Bhashettihalli,
Versandara Post, Doddaballpura
Town & Taluk, Bangalore Rural
District.

M/s. Nobel Technology,
No.46, 14th Cross, 4th Phase,
Peenya Industrial Area,
Bengaluru – 596 058.

M/s. Cerebra Integrated
Technologies Ltd.,
Plot No. 422/2, 11th Cross,
4th Phase, 2nd Stage, Peenya
Industrial Area, Bengaluru -
560 058.

M/s. Ecovision Recycling,
No.D-65,Veerasandra Industrial
Area, Hosur Road, Bengaluru –
560 034.

M/s. Arrow Systems,
No.SM 3, 4th Phase, 3rd stage,
Peenya Industrial Area,
Bengaluru – 560 058.

M/s. Digicomp Complete
Solutions Ltd,
No.86, Ground floor,
3rd Cross, New Timber Yard
Layout, Mysore Road, Bengaluru
– 560 026

M/s. Eco-Ewaste Recyclers India
Pvt. Ltd.,
Shed No.26, No.41/1, 42/2, 19 &
20, 2nd Cross, Mutachari
Industrial Estate,
Hanumanthappa Layout,
Mysore Road, Bengaluru –
560 039

M/s. Epragathi (A Division of
Integrated System Soft),
Shed No. M, #405, 1st & 2nd
Floor, 7th & 8th Cross, 1st Stage,
Peenya, Bengaluru – 560 058

M/s. Hindustan Computers,
No.V3 & V4, KIADB Industrial
Area, Tamaka, Kolar.

M/s Rashi E-waste,
No.52/170 & 171, 6th Cross,
Aziz Sait Industrial Town,
Nayandahlli Post, Bengaluru –
560 039.

2. Maharashtra

M/s. Earth Sense Recycle Pvt.
Ltd.,
A-7 , Gala no: 1,2&3,
Ground Floor, Prerna Complex,
Anjur Phata, Vill: Val, Tal:
Bhiwandi Dist: Thane

M/s. Eco Friend Industries,
A-205, TTC Industrial Area,
Pawane Village, Thane Belapur
Road, Navi Mumbai –
400 710.

M/s. Just Dispose Recycling Pvt.
Ltd.,
A-103,104,110,119, Arvind
Industrial Estate, Navghar, Tal:
Vasai, Dist: Thane

M/s. Mercury Metal Industries,
Plot no. D-48, MIDC Mahad, Tal:
Mahad, Dist:- Raigad,

M/s. Shabbir Traders.
Plot No.999 (7), Kiravali Narayan
Kutir Udyog Mandal, Village
Adivali, Tal. Panvel, Dist.
Raigad

M/s. Hi-Tech Recycling India
Pvt. Ltd.,
S.No: 571/572, Near Silver Court
Hotel, A/P: Bhugaon, Tal:
Mulshi, Dist: Pune

M/s. Green World Recycling.
Vill: Val, Pritesh
Complex, Buliding no; B-12,
Gala No: 7,8 Anjur Phata,
Village: ValTal: Bhiwandi, Dist:
Thane

M/s. E-Recon Recycling,
Gat no:94, Chitegaon, Tal:
PaithanDist: Aurangabad

Source:

1. Maharashtra Pollution Control Board
2. Karnataka State Pollution Control Board

Annexure – III

LIST OF E-WASTE COLLECTION CENTRES IN MAHARASHTRA & ODISHA

S. No.	State	Name and address of Collection Centres
1.	Maharashtra	<p>M/s. ZTronics Infratel Pvt. Ltd., Sr. No: 103, Gala No: 538, 539, At: Pimpri, Tal: Thane, Dist: Thane</p> <p>M/s. Poona E-waste Solutions, Ubale Nagar, 1/1009, Gat no: 2334/4, Wagholi, Pune 412 207</p> <p>M/s. V. Chiranjiv & Co., Plot no: 829, Road no: 8, Kalmboli Steel Complex, Kalamboli, Navi Mumbai</p>
2.	Odisha	<p>M/s. GreenneX India Resources Pvt. Ltd., Plot No. N4/180, IRC Village, Nayapalli, Bhubaneswar, Odisha 751 015</p> <p>Works: IDCO Plot No-1, Anlapatna Industrial Area, Chandaka, Khurda</p> <p>M/s. Sani Clean Pvt. Ltd., 401, N4-42 F, IRC Village, Bhubaneswar 751 015</p>

Works Office:

Plot No. 654/960, Tangiapada,
Khurda

M/s. Green Vortex Waste
Management Pvt. Ltd.,
Plot No. 155, Mancheswar
Industrial Estate, Bhubaneswar
751 010

M/s. Green Circle
Environment Private Ltd.,
Socrates, D-2/7, Industrial
Estate, Rasulgarh,
Bhubaneswar 751 010

M/s. Pollution Control &
Management System,
Plot No. N5/305, Nayapalli,
Bhubaneswar 751, 015

Work Office:

Plot No. 579/3392,
Mouza – Mukundprasad,
Khurda

Source:

1. Maharashtra Pollution Control Board
2. Odisha State Pollution Control Board

