



# e-Waste Resposal: Project Report

Respose Waste Management and Research Pvt Ltd  
Hira Krishna, Rajaji Road, Cross Road No 1, Ramnagar,  
Dombivli East, Maharashtra, India - 421201

Tel : 022-30921797

Email : [info@resposeindia.com](mailto:info@resposeindia.com)

Website : <http://www.resposeindia.com>

Contacts :

DB Prabhu | [prabhu.db@resposeindia.com](mailto:prabhu.db@resposeindia.com) | +91 9820 431 378

Sujit Kochrekar | [sujit@resposeindia.com](mailto:sujit@resposeindia.com) | +91 9930 550 658





### **Rights to this document and its content :**

*The copyright to this document and its content, including explicit and implied meanings, is owned solely by Respose Waste Management and Research Pvt Ltd (referred to as Respose in short). As an owner of this document for all possible purposes, Respose confers upon those clients who download this document, the 'right to use' this document. 'Right to use' means the right to refer, infer, modify, edit, delete, print and distribute this document to personnel and entities associated with the client in various capacities such as, but not limited to, employees, consultants, contractors, shareholders, suppliers, etc. The Client may not use this document or its contents for direct commercial benefits by way of selling the information contained in this document. The Client may not indiscriminately distribute this document or part thereof through any medium of distribution/ communication to any party not connected with the Client.*

### **Disclaimer**

*The views and opinions expressed in this document are those of the authors and do not necessarily reflect any official policy or position. All analyses performed within this article are within the bounded rationality of the authors and based on the limited and dated resources available to them. Although every effort has been made to ensure that the information herein is correct we do not assume and hereby disclaim any liability to any party for any loss, damage, or disruption caused by errors or omissions, whether such errors or omissions result from negligence, accident, or any other cause. Hence all information contained herein should be utilized for any purposes only after due diligence from the applicable relevant perspective.*



## Index

Sr. No	Topic	Page
1	Introduction <ul style="list-style-type: none"><li>• Overview</li><li>• Business potential of e-waste</li></ul>	3
2	Fundamental Understanding of e-Waste and handling practices <ul style="list-style-type: none"><li>• What is e-Waste</li><li>• e-waste Categories and Classification</li><li>• Composition of e-Waste</li><li>• Current e-Waste Handling practices</li></ul>	5
3	Market Analysis for setting up an e-Waste management business <ul style="list-style-type: none"><li>• Buyers</li><li>• Suppliers</li><li>• Competition</li><li>• Opportunity</li></ul>	8
4	Overview of the process and plant layout	9
5	Financial Forecasts <ul style="list-style-type: none"><li>• Capex and Opex</li><li>• Projected Financial Statements</li></ul>	12
6	Recommendations	13
7	Appendix I and II	14



## Introduction

Green businesses are the key drivers of the economy in the current global business scenario. Of the various green initiatives, waste recycling creates the highest positive impact on the environment. Of all the different types of waste, electronic waste has the characteristics of

- a) the fastest growing segment of waste
- b) most valuable due to its basic composition
- c) very hazardous if not handled carefully.

However, the sector is very new with only a few corporate players in India and globally.

Most of the electronic waste management sector is currently handled by the unorganized / informal sector in India. However due to lack of skills, knowledge, awareness, etc., the sector has remained highly labour intensive, environmentally unfriendly and unhealthy. If done in the right way, and in an organized fashion, e-waste management can become a dominant economic sector.

The purpose of this document is to present a project report on electronic waste recycling as a financially rewarding business. We find that the e-waste business is highly profitable from the economic as well as environmental perspective. There are some established success stories around the world as well as a few in India. However, it is perceived that the unorganized sector has a cost advantage. Hence the organized waste management remains limited. We, at Respose, hold the opinion that the costs of the unorganized sector are not necessarily lower than the organized sector especially when we consider three major aspects :

- a) Rising cost of labour
- b) Limited efficiency of labour
- c) Low quality of the final output

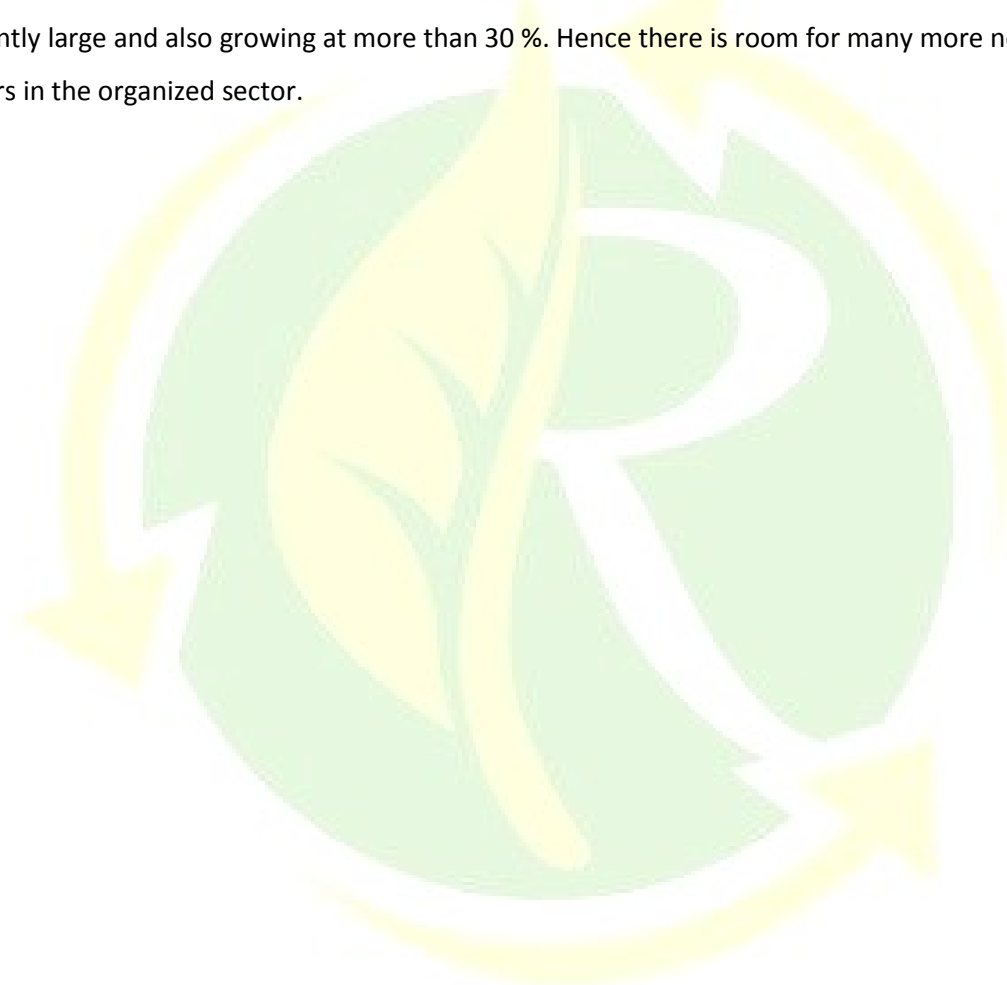
Automated or semi-automated large capacity plants require less labour, can consistently work at high efficiency and produce a much better quality of the final product. Therefore, they are extremely cost effective in the long run. Thus, even if there is competition of the unorganized sector, e-waste management can be an economically viable and a high returns business for the organized industry.



## The business potential of e-waste

As per various numbers published by various research agencies, about 20 to 50 million tonnes of e-waste are generated worldwide every year. E-waste comprises of more than 5 % of all solid waste generated and the volume is expected to increase at a rate of 300% per annum in developing countries.

In India, the total e-waste generated is expected to cross 800,000 tons in 2012. This figure is expected to grow at a rate of 30 – 50 % year on year. Of this, the currently installed and functioning capacity in the organized sector is only about 100,000 tons. The current market size itself is sufficiently large and also growing at more than 30 %. Hence there is room for many more new recyclers in the organized sector.





# Fundamental Understanding of e-Waste and Handling Practices

## What is e-Waste?

Old electronic equipment that have outlived their useful life are categorized as e-waste.

On an average, in India, in case of mobile phones the useful life goes upto 2 years. In case of PCs, it may go upto 5 years. The life of these equipment is extended due to reasons such as upgrade, repair and reuse, donation to charity, etc.

## E-Waste Categories and Classification

E-Waste is categorized by the government of India under the broad class of hazardous waste. Within e-Waste, there are several categories such as Large and small household appliances, electrical and electronic toys and sporting equipment, tools, computers and related equipment etc. A detail categorization as adopted by the Central Pollution Control Board of India is given in Appendix I.

## Composition of e-waste

Electrical and Electronic equipment contains metallic and non metallic elements, alloys and compounds such as Copper, Aluminium, Gold, Silver, Palladium, Platinum, Nickel, Tin, Lead, Iron, Sulphur, Phosphorous, Arsenic etc. If discarded in the open, these metals can cause a severe environmental and health hazard.

**Table 1 : e-Waste components and its health hazards if done manually in an uncontrolled and informal method.**

	Metals	Toxic effects
1	Antimony	Irritation of the eyes, Skin, Lungs, Heart.
2	Bismuth	Inhalation problems, Skin reactions, Sleeplessness, Depression, Rheumatic pain.
3	Cadmium	Damage the lungs. Bone fracture, Damage to central nervous system, Possibly DNA damage, Cancer.
4	Chromium	Allergic reactions, Lung cancer Nose irritations and nosebleeds. Upset stomachs and ulcers, Kidney and liver damage Cause of Death.
5	Cobalt	Lung effects, Hair loss, Vomiting and nausea, Vision problems, Heart problems, Thyroid damage, cause of Asthma & Pneumonia
6	Gallium	Cause throat irritation, Difficulty breathing, Chest pain, Partial paralysis.
7	Germanium	Harmful for Skin, Eyes & Blood
8	Molybdenum	Joint pains in the knees, hands, feet



		It is Highly toxic
9	Nickel	Lung cancer, Nose cancer, Larynx cancer and Prostate cancer, Heart disorders
10	Selenium	Collection of fluid in the lungs, Abdominal pain, Fever, Heart and muscle problems, Bronchial asthma, Diarrhoea, Enlarged liver, Burning, Bronchitis, Sore throat, Cause of death
11	Silver	Kidney, Eye, Lung, Liver, Brain damage, Anaemia
12	Lead	Rise in blood pressure, Kidney damage, Miscarriages and subtle abortions, Brain damage, Effects fertility of men through sperm damage, Diminished learning abilities of children
13	Tin	Eye and skin irritations, Headaches, Stomachaches, Sickness and dizziness, Breathlessness, Urination problems
14	Iron	risk of lung cancer
15	Yttrium	Threat to the liver, Cause of cancer
16	Zinc	Decreased sense of taste and smell,, Birth defects, Vomiting, Skin irritations, Stomach cramps

It is difficult to identify the level of content of each metal. For each category of electronic equipment, each manufacturer, each model may have different composition. However based on various studies and experiments, we can establish average benchmarks for some products.

**Table 2 : Average Composition of WEEE**

<b>PCB and active electronics</b>	<b>20% by weight</b>	<b>Casing, castings, Non EE parts *</b>	<b>80% by weight</b>
Copper	16%	Plastic	30%
Gold	0.03%	Ferrous Metal	20%
Silver	0.1%	Aluminium	15%
Palladium	0.01	Glass	20%
Lead	2 %	Copper	15%
Aluminium	5 %	<b>Total</b>	<b>100%</b>
Iron	5 %		
Nickel	1 %	*Estimated	
Solder	0.66 %		
Epoxy	58 %		
Other	12.2 %		
<b>Total</b>	<b>100%</b>		

In reality, all metals cannot be recovered due to technology limitations and commercial viability. In real world, the major metals recovered are Gold, Platinum, Paladium, Nickel, Copper, Silver, Zinc, Iron, Aluminium. Major non metals recovered are Lead, Phosphorous. Other items are plastic and glass. It may make economic sense to focus on only a few items and dispose the remaining.

### **Current e-Waste handling practices**



E-waste is generated in households and corporates (including private and government companies). As per one study 68% of WEEE is stockpiled in USA (HP, 2005). In India, the number is likely to be much higher.

The collection of this waste happens in different ways. The chains start from ragpickers, and move up to local scrap dealers, area aggregators and finally recyclers. Corporate business houses sell their old EEE to second-hand buyers through various means such as auction, scrap sale or open bidding.

Once e-waste is collected from its generators, it is resold or rented or donated or dismantled for parts or sold on basis of weight to scrap dealers. Most of the recycling community works in the informal sector. The aggregate WEEE is taken by a larger scrap dealer who sorts the material as per his own convenience. The non usable equipment is dismantled manually. The easily separable parts such as plastics, glass, metal cabinets etc are directly sold in various markets. The more complicated parts such as mother boards, assemblies, fused parts etc are usually sold to an informal recycler. These metals are sold to smelters. In most cases, the extraction techniques are so crude that the output is also contaminated. Also the efficiency of such techniques is only about 30%.

From the usable part of the collected WEEE, some is sold directly in second hand sale, some is refurbished and sold as a refurbished product, some is donated to charity and some is rented.





## Market Overview

**Buyers :** Main buyers are smelters, plastic recyclers, glass recyclers, metal traders, metal buyers, metal exchanges etc.

**Suppliers:** As discussed earlier, the suppliers could be both household and corporate entities. It is possible to sign contracts with business houses for collection. Apart from business houses, the household WEEE can be collected through a network of scrap dealers, retail outlets etc..

**Competition:** The informal sector forms the biggest competitor. However, it has several systemic weaknesses. As of today with WEEE regulations becoming more effective and overall awareness increasing, collection is becoming a problem for the unorganized sector.

Within the organized sector, the competition is still limited to just about 10 recyclers in India.

### Opportunity

Based on various research studies, the total e-waste production in India was about 400,000 Tons in 2009 and is likely to reach 800,000 tons in 2012. Only about 19,000 tons was recycled officially in 2009.

Various other research papers and data points on the internet highlight the following facts :

- Given the size of our population any fraction of any demographic unit is a large chunk in itself.
- PC penetration in India is estimated to be 40 per 1000 as compared to 995 in the US. This shows the immense potential for refurbished PC market.
- High technology penetration in Urban areas (>70%). This means that the highest source of e-waste is here.
- Moderate penetration in semi urban areas but a high growth rate(~100%).
- Very low rural penetration and medium growth rate, but accelerating very fast.
- Large companies refresh PCs every 4 years(avg).
- E-waste was a US\$2 B worldwide business in FY2009 (only partially tapped)
- In India, organized e-Waste recycling is a nascent industry.



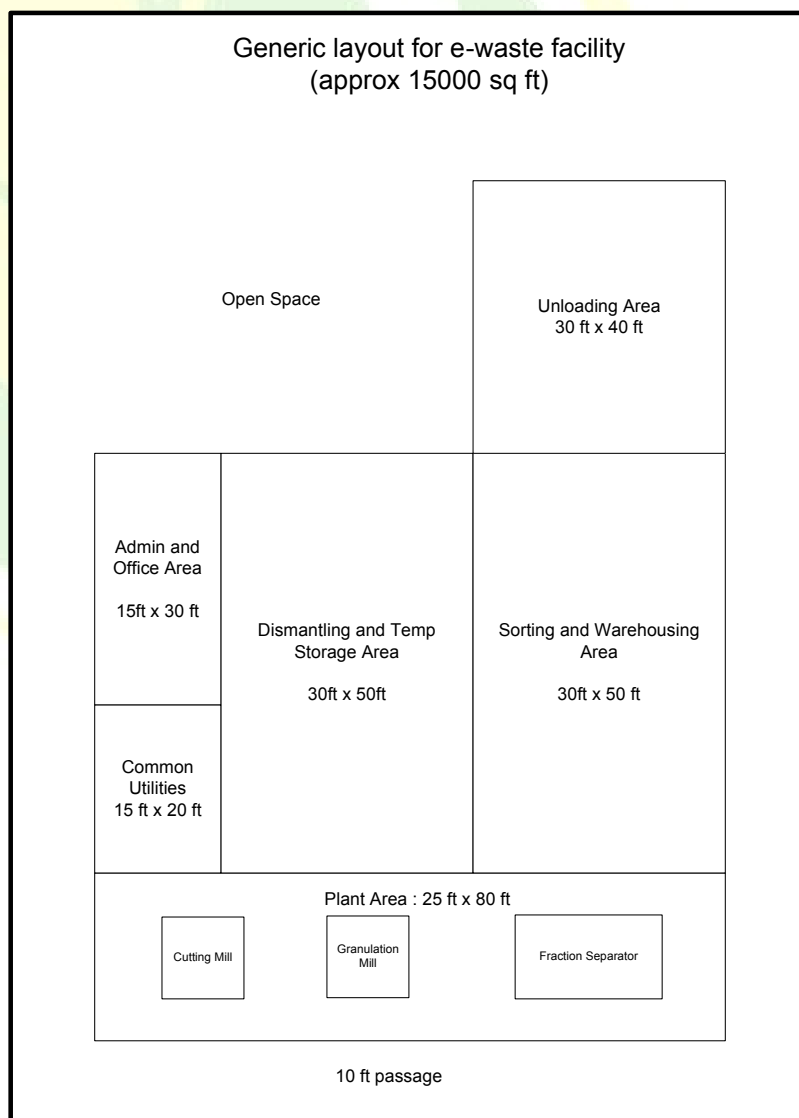
## Overview of the Process and Plant layout

The process steps are as under :

1. Collection
2. Aggregation
3. Classification
4. Processing of different types of classes : Batteries, CRT tvs, monitors, etc are not to be recycled or dismantled in this premises. Such types of WEEE will be offloaded to other registered recyclers who have the facility of handling the same.
5. Dismantling
6. Classification of dismantled parts
7. The process inside the plant includes size reduction, granulation, ferrous metal separation, non ferrous mixed metal separation and non metals separation.

The separation process does not generate any effluents. It is a completely mechanical process.

The entire process is a mix of manual and automated tasks so that the activity remains economically viable. Manual tasks are all hazard free and all standard safety precautions are taken. Automated tasks are conducted in sealed chambers wherever required for safety purposes. For such a facility approximately 15000 sq ft of land is provisioned. The generic plant layout is as shown.





## **Respose e-Waste processing technology.**

The Respose e-Waste processing plant consists of :

- a. Respose Cutting Mill for electronic circuit boards, wires and small parts
- b. Respose Granulation Mill for e-waste with primary separation
- c. Respose Vibratory Feeder Assembly for Granulation Mill
- d. Respose Enhanced Air Purification System
- e. Respose Conveyor Belt (10 ft)
- f. Respose Magnetic Separator
- g. Respose Fraction Separator
- h. Respose Feeder Assembly for Fraction Separator)
- i. Electrical control panel

WEEE is manually dismantled and separated into electronic circuit boards, wires and external cabinets and casings. The cutting mill is used for reducing the size of the assorted electronic circuit boards, wires, small components, small equipment etc.

A magnetic separator separates ferrous components. The non ferrous fraction is passed over a conveyor belt to the granulation mill by a vibratory feeder.

The granulated fraction passes through a primary separator. The granulated material is fed to a fraction separator through a feeding assembly.

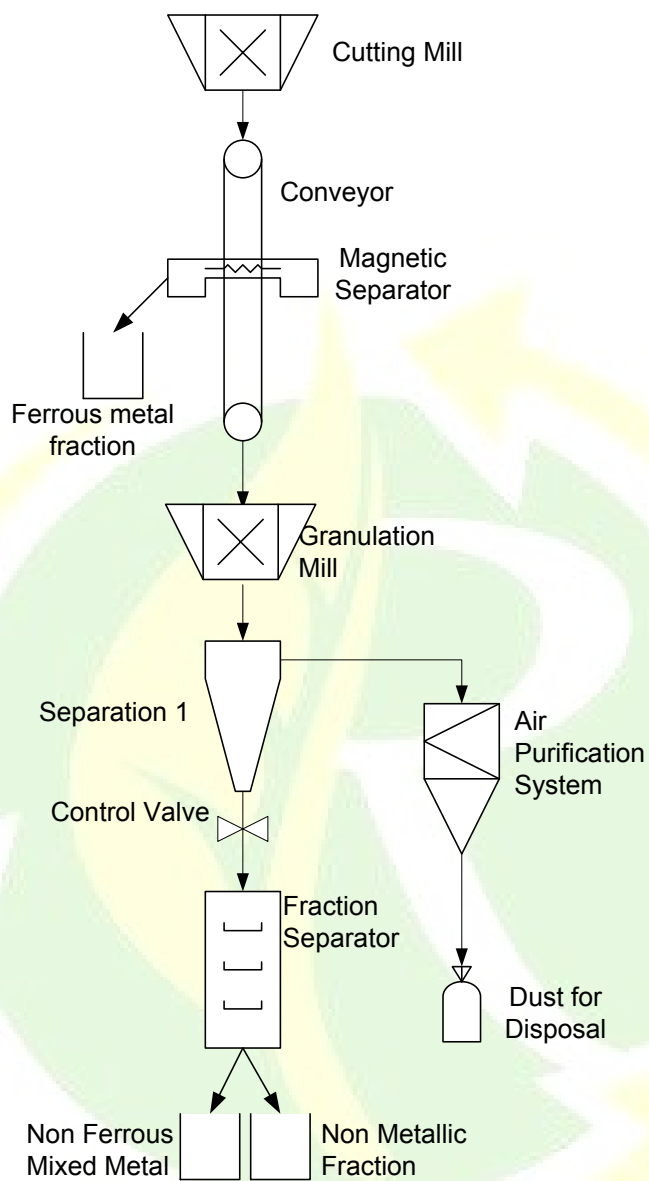
The dust from the granulating mill and the primary separator is fed to an air purification system. The air purification system separates the dust and minute particles from air and releases clean air in the environment.

The fraction separator separates the granulated material into non metallic and non ferrous mixed metal fraction.

Throughout the entire process, manual handling of material is avoided to a maximum. Material is handled only at input of the cutting mill, handling of separated fraction bins and manual picking of oversized parts after first level size reduction.

The entire process is completely mechanical. No chemicals are used at any stage. Water used in the process is completely recycled and not released as effluent / spent water. Dust generated in the process is collected in proper bags and packed for safe disposal.

The entire operation is free from any kind of polluting processes.





## Financial Viability

### Capital Expenses

1. Land : 20000 sq ft to start with.
2. Factory Building with furniture, fixtures, workbenches, shopfloor, tech equipment, etc.
3. Plant and Machinery

### Operational Expenses

The Operational Expenses in this model are

- a. Salaries.
- b. Cost of scrap
- c. Utilities expenses such as electricity and water.
- d. Logistics expenses
- e. Marketing expenses
- f. Spares and consumables
- g. Contingency expenses

**Table 3** : The e-Waste Collection targets

Target Collection	Tons
Year 1	1200
Year 2	1440
Year 3	1728
Year 4	2074
Year 5	2488

The Financial projection is as follows :

	Year 1	Year 2	Year 3
<b>Revenue from Sales</b>	<b>597.82</b>	<b>786.99</b>	<b>1036.27</b>
<b>Operating Expenses</b>			
Salaries	31.80	36.04	42.44
Rent	10	11	12.1
Raw Material	480.00	633.60	836.35
Utilities	17.00	18.70	20.57
Transportation	24.00	31.68	41.82
Spares and consumables	0	5	5.5
Others and Contingency	18	5	5
<b>Total</b>	<b>580.80</b>	<b>741.02</b>	<b>963.78</b>
<b>Operating PBIDT</b>	<b>17.02</b>	<b>45.97</b>	<b>72.50</b>



## Recommendations

Based on the above discussion, Respose Team registers its conclusions and makes its recommendations as under :

1. E-Waste management is a financially viable and rewarding business.
2. The key to success is a continuous flow of WEEE.
3. The costs and revenues are fluctuating according to market conditions.
4. We also recommend that initially a Recycler may go for a dry process and not consider the refining of the metals. Once the critical mass is built up, the Recycler may evaluate setting up refining and smelting units.
5. Carbon Credits is another revenue source, which may be evaluated.
6. Extended Producer Responsibility law has already been adopted in India and it is only a matter of time till it gets properly enforced. This will also ensure a much robust supply chain and a lower cost of collection.

Considering all the above points, we hold the opinion that WEEE recycling is a highly profitable business. Precious metals are in restricted quantities and therefore to ensure maximum recovery, the process of separating metals must be such that there is minimal contamination and a minimum loss. Use of technology ensures this and pays off in the long run as compared to the unorganized sector which uses manual labour and in the process, stays with a very low efficiency, low quality of yield and therefore with a much lower profitability.



# Appendix 1

## Classification of e-Waste as per Government of India norms

CAT- A1	Large household appliances	<ul style="list-style-type: none"><li>- Refrigerators and Freezers, Other appliances used for refrigeration, conservation and storage of food , Washing machines, Clothes dryers, Dish washing machines,</li><li>- Cooking ranges/stoves Electric hot plates, Microwaves, Other appliances used for cooking and other processing of food,</li><li>- Electric heating appliances, Electric radiators, Other fanning, exhaust ventilation and conditioning equipment.</li></ul>
CAT - A2	Small household appliances	<ul style="list-style-type: none"><li>- Vacuum cleaners, Carpet sweepers, Other appliances used for cleaning,</li><li>- Appliances used for sewing, knitting, weaving and other processing for textiles, Iron and other appliances used for ironing and other care of clothing,</li><li>- Toasters, Fryers, Grinders, coffee machines and equipment for opening or sealing containers or packages,</li><li>- Electric knives, Appliances for hair-cutting, hair drying, tooth brushing, shaving, massage and other body care appliances,</li><li>- Digital clocks, watches and equipment for measuring indicating or registering time Scales</li></ul>
CAT – A3	Toys, leisure and sports equipment	<ul style="list-style-type: none"><li>- Electric trains or car racing sets, Hand-held video game consoles, Video games, -</li><li>- Computers for biking, diving, running, rowing, etc.,</li><li>- Sports equipment with electric or electronic components,</li><li>- Coin slot machines</li></ul>
CAT – A4	Electrical and electronic tools (except large-scale stationary industrial tools)	<ul style="list-style-type: none"><li>- Drills, Saws, Sewing machines, Equipment for turning, milling, sanding, grinding, sawing, cutting, shearing, drilling, making holes, punching, folding, bending or similar processing of wood, metal and other materials,</li><li>- Tools for riveting, nailing or screwing or removing rivets, nails, screws or similar uses,</li><li>- Tools for welding, soldering or similar use,</li><li>- Equipment for spraying, spreading, dispersing or other treatment of liquid or gaseous substances by other means,</li><li>- Tools for mowing or other gardening activities</li></ul>
CAT – A5	Medical devices (except implanted and infected products)	<ul style="list-style-type: none"><li>- Radiotherapy equipment,</li><li>- Cardiology, Dialysis, Pulmonary ventilators, Nuclear medicine</li></ul>



		<ul style="list-style-type: none"> <li>- Laboratory equipment for in-vitro diagnosis</li> <li>- Analysers, Freezers, Fertilization tests, Other appliances for detecting, preventing, monitoring, treating, alleviating illness, injury or disability</li> </ul>
CAT – A6	Monitoring and control instruments	<ul style="list-style-type: none"> <li>- Smoke detector</li> <li>- Heating regulators</li> <li>- Thermostats</li> <li>- Measuring, weighing or adjusting appliances for household or as laboratory equipment</li> <li>- Other monitoring and control instruments used in industrial installations (e.g. in control panels)</li> </ul>
CAT – A7	Automatic dispensers	<ul style="list-style-type: none"> <li>- Automatic dispensers for beverages</li> <li>- Automatic dispensers for hot or cold bottles or cans</li> <li>- Automatic dispensers for solid products</li> <li>- Automatic dispensers for money</li> <li>- All appliances which deliver automatically all kind of products</li> </ul>
CAT – B1	IT and telecommunication equipments	<ul style="list-style-type: none"> <li>- Centralised data processing: Mainframes, Minicomputers,</li> <li>- Personal computing: Personal Computers (CPU with input and output devices), Laptop (CPU with input and output devices), Notebook, Notepad etc.,</li> <li>- Printers</li> <li>- Copying equipment, Electrical and electronic typewriters</li> <li>- Pocket and desk calculators</li> <li>- Other products and equipment for the collection, storage, processing, presentation or communication of information by electronic means</li> <li>- User terminals and systems</li> <li>- Facsimile, Telex, Telephones, Pay telephones, Cordless telephones, Cellular telephones, Answering systems, And other products or equipment of transmitting sound, images or other information by Telecommunications</li> </ul>
CAT – B2	Consumer electronics	<ul style="list-style-type: none"> <li>- Radio sets, Television sets, Video cameras, Video recorders, Digital cameras, Hi-fi recorders, Audio amplifiers, Musical instruments, And other products or equipment for the, purpose of recording or reproducing sound or image, including signals or other technologies for the distribution of sound and image than by telecommunications</li> </ul>





## Appendix II

### Electronic Waste Technology Players (Partial List)

Company	Products	Head Office
<b>Respose India,</b>  Respose Waste management and Research Pvt Ltd.	Plant for e-waste recycling Cutting Mill Granulating Mill Air purification unit Fraction Separator Cable recycling machine Consulting Services	Hira Krishna, Rajaji Road, Cross lane 1, Ramnagar, Dombivli East, India Tel : 022 31921797 Email : <a href="mailto:info@resposeindia.com">info@resposeindia.com</a>
<b>BHS Sonthofen GmbH</b>	Shredders, Centrifugal Crushers, Complete Recycling plant assembly	An der Eisenschmelze 47 87527 Sonthofen / Germany Tel: +49 83216099-0 E-mail: <a href="mailto:info@bhs-sonthofen.de">info@bhs-sonthofen.de</a>
<b>Erdwich Zerkleinerungssysteme GmbH</b>	Shredders, Granulators,	Kolpingstrasse 8 - D-86916 Kaufering Phone: +49 0 81 91 / 96 52 - 0 - Fax: +49 0 81 91 / 96 52 - 16 eMail: <a href="mailto:info@erdwich.de">info@erdwich.de</a>
<b>Green Machine Sales LLC</b>	Monitor processing, Shredders, Grinders, Scrap Baling, WEEE product destruction and reclaim systems	5 Gigante Dr., Hampstead, NH 03841 USA Phone: 603-329-7337 Toll-Free: 877-448- 4443 FAX: 603-329-7458 E-Mail: <a href="mailto:sales@greenmachinesales.com">sales@greenmachinesales.com</a>
<b>Hamos GmbH</b>	Electrostatic separators for mixed plastics and metals, Electronic waste recycling,	Recycling- und Separationstechnik Im Thal 17 82377 Penzberg Germany Tel.: +49 8856 9261-0 Fax: +49 8856 9261-99 E-mail: <a href="mailto:hamos@hamos.com">hamos@hamos.com</a>
<b>MEWA</b>	Complete WEEE processing plant, Rotary Shear, Granulators, Cutting mills etc.	Gültlinger Strasse 3 D-75391 Gechingen GERMANY - EUROPE Tel. +49 7056 925-0 Fax +49 7056 925-169 <a href="mailto:info@mewa-recycling.de">info@mewa-recycling.de</a>
<b>Shredtech</b>	Shredders, Delaminators	Shred-Tech® 295 Pinebush Rd. Cambridge, Ontario Canada N1T 1B2
<b>S+S Separation and Sorting Technology GmbH</b>	Magnetic Separators, Metal detectors and separators, Glass separators, etc.	Regener Strasse 130 D94513 – Schonberg Germany Tel : +49 8554 3080
<b>Swiss Rtec</b>	WEEE recycling plants, delamination mills, Vertical Shredders etc.	Reutistrasse 17a CH-8280 Kreuzlingen Switzerland