Digital India
Power To Empower

E-Waste Awareness for RWAs & Localities

Manual for Training of Trainers

(2016)

Imprint

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The Project entitled "Awareness Programme on Environmental Hazards of Electronic Waste through Digital India Initiative" is funded by Ministry of Electronics and Information Technology (MeitY)/Government of India.

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Contents

1. About the Project

The Ministry of Electronics and Information Technology (MeitY) has initiated the project "Awareness Programme on Environmental Hazards of Electronic waste" on March 31, 2015. This project is under the 'Digital India' initiative of the Government of India. The project is expected to have far reaching and significant impact on the growth of the country as it focuses on reuse and recycling of e-waste, which has the potential to conserve natural resources. The project has three components viz., Content Development, Inventory Assessment and Awareness Generation amongst different stakeholders. The project will help in effective implementation of E-waste (Management) Rules, 2016.

The primary focus of the project is to create awareness among different stakeholders in order to reduce the adverse impact on environment and health due to improper disposal of e-waste. MeitY has played a key role in dissemination of knowledge on e-waste rules in the past and wishes to engage all key stakeholders during this exercise. During the project duration of 5 years, a city in each of the 10 identified states viz. Madhya Pradesh, Uttar Pradesh, Jharkhand, Orissa, Goa, Bihar, Pondicherry, West Bengal, Assam and Manipur will be covered. The activities will include organising awareness workshops for RWAs/Localities, Schools, Colleges, Bulk Consumers (including corporate & Govt. sectors), Informal Sector, Dealers, Refurbishers, Manufacturers, etc. so as to build capacities of the target groups to channelize e-waste in a manner that the rules are effectively implemented. Suitable course curriculum would also be framed for schools/colleges. Effort would be made to prepare the content in local language.

This project will also stress on adopting best practices for e-waste recycling available globally, so that the unorganised sector can generate jobs as well as viable business prospects thereby mitigating the impact of improper recycling on the environment. Recycling of e-waste will help in creating jobs and recovery of valuable components and materials through dismantling. The valuable metals recycled from old electronic items can also be used in manufacturing of new products. As a result, this will save energy, reduce pollution, mitigate greenhouse gas emissions, and reduce extraction of finite natural resources through mining. The project will also emphasize on the responsibilities of the producers and convey the message that they must inculcate the principle of Extended Producer Responsibility (EPR) and follow the mechanism for channelisation of e-waste from 'end of life' products to registered dismantlers or recyclers.

The tools and dissemination material for creating awareness are developed by MAIT to create awareness among various stakeholders in the value chain. The awareness workshops will help to present the current situation on e-waste disposal and practices thereby creating awareness on the issue; its recycling as well as the legal provisions and the responsibilities of the stakeholders.

The program also aims to enhance its reach to more cities across each state during the course of 5 years of its implementation. This will help to inculcate better disposal practices amongst all stakeholders thereby reducing the environmental impacts of improper handling and recycling of e-waste.

2. Framework of the Manual

The objectives of the manual are the following:

To act as a tool for enhancing the understanding of the trainers who would be involved in conducting the training in RWAs and localities on the subject of e-waste.

To serve as a ready reference for trainers to design and organize trainings on the subject of e-waste for citizens.

To serve as a compilation of information on the following issues related to the subject of e-waste:
• What is e-waste?
• What are the categories of e-waste?
• What is the generation of E-waste globally and in India?
• What are hazardous substances?
• What are the hazardous substances in E-waste?
• What are health impacts of unscientific processing of E-waste?
• What are the methods used at present by the informal sector for treating E-waste?
• What is the National Environment Policy of India?
• The E-waste (Management) Rules, 2016 and the challenges of implementing the Rules.
• Defining sustainable consumption and Lifestyles of Health and Sustainability (LOHAS)
• Guidelines for setting up of collection centres of e-waste.
• What is carbon footprint?
• How to measure carbon footprint?
• What are the strategies to reduce carbon footprint?

To serve as a guide for implementing initiatives by students that contribute to safe e-waste management in India.

Objectives of the training of trainers:

The training of trainers has been designed with the objective to enhance the understanding on the subject of e-waste amongst citizens. This will be achieved by a training of trainers on the subject of e-waste and providing them with adequate tools to organize trainings for residents of RWAs and localities.

The training of trainers will be followed by trainings for citizens so that they can contribute to effective handling and management of e-waste.

The training provided will increase knowledge amongst citizens about the generation of e-waste, hazardous substances in e-waste, present status of generation and disposal in India, regulation on management and handling of e-waste in India, role of citizens as consumers and efforts like setting up of e-waste collection centres that can be undertaken by them. In addition they will be introduced to concepts of secondary resources, sustainable consumption, LOHAS and carbon footprint.

The manual uses different methods to achieve the change objective including the Donna E. Walker's 'Learning Cycle' that has five steps including Mind Jog, Personal Connection, Information Exchange, Information Application and Real World Connection. This method

takes into account that different learners have different learning abilities and at least one of the steps of the cycle would be able to transfer the learning effectively.

In addition it uses Harvard case method that involves presenting a case to citizens where they associate themselves with a role as they read through the situation and identify the problem. The next step is to perform the necessary analysis to determine the cause and possible solutions to the problem. The manual provides essential information and situations that form cases that can be discussed with the citizens by the trainer.

How to use the manual:

This manual has 3 major components to it with of the objective of providing experiential learning to its users.

Component 1 is the Harvard case study which tries to rake the issue with the specific stakeholders as the key protagonist. This is done to help identify the present scenario with respect to the problem of e-waste and how it impacts the protagonist's daily life and future. The case study can be enacted in localities and RWAs to ensure that residents are able to learn through this experience and enable them to question on the subject to enhance understanding. Enhancement of understanding will lead to imbibing the learning into practice.

Component 2 is on the learning cycle which has been adopted from the finest techniques available for experiential learning today. The sessions help to unpack the subject at hand and enable to gain a better understanding of solutions in order to solve the problem. It also ensures that engagement is built with participants so that the training sessions are not just monologues from the trainer to the participants but allows the space for dialogue in order to enhance understanding of the subject of e-waste.

Component 3 includes references which have been extensively researched from material available through secondary sources. This includes work which has been done in India as well as around the world and has been published in renowned journals and publications. The links to the material have also been provided so that interested readers can enhance their understanding of the subject of e-waste.

In order to use the manual, the trainer has to go through the case study in order to relate to the problem and read in detail about the different issues that are discussed. For each session as elaborated, the trainers will discuss the subject at length in the time provided in order to ensure that their understanding is enhanced and they can pass the message to the relevant stakeholders during training workshops and activities that they are a part of during the course of the project.

3. Screenplay for a conversation between 2 gentlemen of a Resident Welfare Association about the ill-effects of e-waste.

This fictitious conversation is based in the city of Hopolabad. The city of Hopolabad is a business hub of the country and has thriving businesses in the manufacturing and service sectors. Mipolabad is a mining hub situated to the west of Hopolabad and Buradabad is a recycling hub which is located to its east. The city is surrounded on the northern and southern sides by agricultural farmland. Hopolabad has a domestic product of INR 72,000 crores annually and has a PPP of INR 7,20,000 (high income population). It has a population of 10 lakh people (big metropolis). The city is dotted with apartment complexes, malls and office buildings in the eastern and central areas. The western part of the city is a manufacturing hub for electronic items and vehicles.
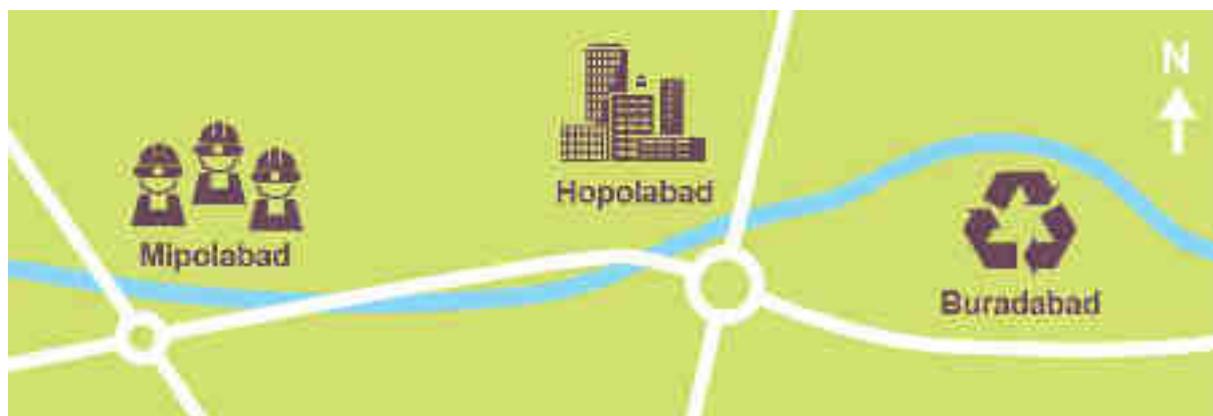
Buradabad, which is located to the east of Hopolabad, is a recycling hub and is dotted with formal recycling industries as well as informal (kabadis in local parlance) shops which extract material from waste. The Blue river flows from Buradabad through the city of Hopolabad and then into Mipolabad. Over the last 15 years, the river flow has almost stagnated which has caused floods in these 3 cities in the rainy season.

Introducing the actors:

Rajesh: A retired engineer from a mining company in Mipolabad. He now lives with his son in a colony in Hopolabad. He loves his morning walk and is active with the senior citizen group in the locality.

Damodar: The procurement head of the largest IT Company in Hopolabad, Classix Software. He has specific interests in environment and green procurement.

Ramesh: A retired government servant from Hopolabad. He was instrumental in setting the building blocks for the industrial policy in the country. He lives with his sons in a colony in Hopolabad.

About the conversation:

This conversation has 3 acts to it. ACT 1 is the conversation at a park in a colony in Hopolabad between Rajesh and Ramesh. Rajesh speaks to Ramesh about the purchase of a new TV in his grandson's room and both discuss the changes that have happened over their lifetime. The conversation switches to waste generation and both decide to consult Damodar who is Rajesh's son and an expert on the subject of e-waste.

The second part of the conversation, Rajesh and Ramesh speak to Damodar about the amount of e-waste that is being generated and seek advise on what the RWA can do in this regard to ensure that it can be managed in a proper manner. Damodar apprises them about the e-waste rules and advises them to set up a collection center in the colony.

The third part of the conversation, Ramesh and Rajesh conduct a meeting with other officials of the RWA and identify a place to set up a collection center or e-waste and plan to tie up with a recycler so that the same can be disposed in an environmentally sound manner.

ACT I

Ramesh and Rajesh sit down on a bench in the park after a brisk walk to 45 minutes. Both of them start chatting while sipping lemon water from their respective bottles.

It is 6.30 am and Ramesh and Rajesh finish their walk and take their seats on a bench in the park.

Ramesh: *It is slowly getting warm and humid. I don't think we used to sweat like this last year.*
Rajesh: *Yeah true. This year the humidity has been higher than normal. I guess the weather is behaving in an abnormal manner.*
Ramesh: *I guess it is also got to do with the amount of pollution that is happening in and around our city.*
Rajesh: *That's true. The dust and smoke that is around every day is so damaging. Somedays it even becomes difficult to breathe in the afternoon.*
Ramesh: *So what else is happening Rajesh. Has the new TV arrived?*
Rajesh: *Yes Ramesh. Damodar got it yesterday.*
Ramesh: *You don't seem to be too happy about it.*
Rajesh: *No that's not the case. I was only contemplating about the time when we were young and not many of these distractions existed.*
Ramesh: *But times change my friend. And its for the better. Whereas we would depend upon a newspaper for all the news, here one is updated in almost no time. There are certain things which I have seen on TV for which I might have to travel the globe. Who can afford that? But I get to learn in my drawing room. So isn't that beneficial.*
Rajesh: *I agree. But then again, once you keep buying stuff, you should also remember that you keep creating a lot of stuff which you wont use anymore.*
Ramesh: *I don't understand.*

Rajesh: *You see we keep buying new stuff and replacing the old one. But what do we do with the old one which we are not using anymore?*

Ramesh: *Well it depends. Usually there is a lot of low value stuff which we give away to a kabadiwala. But then again there is some material which we go and sell to a proper shop to see if it can be repaired and can be used by us or maybe sold to someone for a nominal price.*

Rajesh: *I agree. But I am questioning the material which cant be used anymore and is irreparable.*

Ramesh: *That may again go to a kabadiwala I guess. But they extract a lot of material and it comes back in the system.*

Rajesh: *Yes I have seen them doing so. While passing Buradabad I saw a heap of wires being burnt and when I asked why the person was doing so, he informed that he was going to extract copper from the same.*

Ramesh: *But that would create so much pollution as well. Isn't it?*

Rajesh: *Yes. And that is what concerns me as well.*

Ramesh: *Then we should try and learn how exactly these items should be disposed so that none of this pollution creating activities can take place. If we don't do anything, then nothing will happen.*

Rajesh: *You know even Damodar keeps telling me of things that he is doing with his company. They are setting up an e-waste recycling facility in Buradabad. He keeps going there every week to see the progress in construction of the plant.*

Ramesh: *Then why don't we ask Damodar to spare some time and educate us on this important issue. Since he knows about it, he can tell us what to do. We can then seek help from fellow senior citizens and try and make a difference in our locality.*

Rajesh: *That's a great idea. Let me speak to Damodar and see if he can spare some time soon to advise us on this issue. Will let you know when we can sit over a cup of tea and discuss.*

Ramesh: *Yeah sure. Been some time when I had tea made by you. (chuckles)*

(ACT I completed)

ACT II

Ramesh comes over the Rajesh's house and they discuss the problem of disposal of non-working items with Damodar. Damodar advises them about setting up a collection center in the RWA and tying up with an authorised recycler so that old items can be given away to them.

Rajesh: *Hi Ramesh, welcome! I will call for Damodar right away.*

Ramesh: *Thanks Rajesh.*

Rajesh: *I have prepared some tea for you myself as promised. (Both share a hearty laugh)*

Ramesh: *Yeah that has been pending for some time.*

Damodar enters the room

Damodar: *Good evening uncle. I haven't seen you in a long time now. How are you doing?*

Ramesh: *I am doing fine. Rajesh keeps telling me how busy you are these days with the factory coming up in Buradabad.*

Damodar: *Yes. I hope all goes well and we are able to do some work which will really be helpful for the environment.*

Ramesh: *So what exactly is the factory going to do.*

Damodar: *It is a recycling unit for electronic waste.*
Ramesh: *What is electronic waste?*
Damodar: *All electronic and electrical items when they reach end of life are termed electronic waste*
Ramesh: *Ah. So there is a market for such goods as well.*
Damodar: *Yes uncle. And most importantly there are quite a few materials which are toxic in nature and are in these items. It is important to ensure that these are recycled properly which is why we are setting up this recycling plant.*
Ramesh: *But why Buradabad. It is such a dirty place.*
Damodar: *Buradabad is a hub for recycling uncle. It looks dirty because the recycling doesn't happen properly and people who work in this area are not conscious about the health and environmental hazards of improper recycling. Our plant will ensure that we are able to create that awareness amongst these people and overall amongst all citizens that we need to dispose off our waste in a proper manner.*
Ramesh: *Its quite noble. But will you be able to compete with these people as far as the business side of things is concerned. You know when I was in the ministry we always used to hear it from the large companies how small and medium enterprises would eat into their geographical markets.*
Damodar: *It makes business sense uncle but most importantly we are looking at ways and means to enhance environment protection through proper recycling.*
Ramesh: *When you say awareness, what is the kind of awareness that you would like to generate?*
Damodar: *You see uncle, there are a lot of electronic items we use today. it is important as well since it enhances our productivity and helps us stay connected. But all of these items have a life beyond which we cant use them. It is then important that the materials that are used in manufacturing these items are properly recycled back into the system once again.*
Ramesh: *You mean to say that instead of using material which is mined and is virgin, you ensure that the same material is recycled back into the industry and can be used again.*
Damodar: *Absolutely uncle. This will not only help to reduce the environmental impacts caused due to rampant mining, it will also ensure that whatever the earth has offered to us is not wasted and can be used again and again.*
Ramesh: *That's a noble thought which as I see makes business sense as well.*
Damodar: *Yes it surely does.*
Ramesh: *You see we were talking about this problem of disposal of items and recovery of material through burning the other day in the park. It was then that Rajesh invited me to come and speak to you to see if we as a RWA can do something about this to reduce the pollution that is taking place.*
Damodar: *Sure uncle, there are a lot of things that can be done.*
Ramesh: *Tell us of a few simple ones which we can action immediately.*
Damodar: *To start with, we can try and establish a collection center in the RWA where anyone can come and dispose off their waste materials. This will ensure that the material will not go to some kabadiwala who might burn it to extract some materials but can be sent across to an authorised recycler who can recycle using environment friendly techniques.*
Ramesh: *How will we store the material in the collection center?*
Damodar: *It is important that the material is inventorised in a manner that whatever item has toxic substances is stored separately so that we can dispose that to the proper recycler. I can train someone if required who can then manage this inventorisation.*
Ramesh: *Sure, we can have some members from the senior citizens take up this responsibility.*
Damodar: *Absolutely, there will be something new to learn as well and you will be able to create awareness in each and every household in the locality as well as other ones about the need to dispose electronic waste in a proper manner.*
Ramesh: *You have also been listening Rajesh. What do you propose?*

Rajesh: *I am gearing to go Ramesh. This will be a noble initiative as well and moreover we will get a chance to connect with our grand children as they are the ones using electronics in a major way.*

Ramesh: *Ok. Let us then call on a meeting of the senior citizens and discuss the items with them. Maybe, then Damodar, you can come and give us a brief and help us in setting the collection center.*

Damodar: *Sure uncle. I will be available anytime you guys are ready.*

Ramesh: *Thanks for this conversation Damodar and thanks for the tea Rajesh.*

Rajesh: *Thanks for coming Ramesh. Let us fix this meeting and go ahead as planned.*

Ramesh: *Yes sure.*

(ACT II completed)

ACT III

Rajesh and Ramesh can for a meeting of the senior citizens to discuss the issue of e-waste disposal and setting up of a collection center in the locality. Damodar addresses the group on the harmful effects of improper disposal and the steps that the citizens can take to reduce environment pollution through proper disposal.

Ramesh: *Friends, me and Rajesh have been discussing recently on the immense use and benefits of electronics in our day to day life. But like all other items, electronic appliances have a life as well and post that they are disposed. However, if disposed in an improper manner, these can cause environmental damage. I am sure a lot of you have seen how people burn copper wires to extract copper but the fumes cause air pollution which is harmful for all of us. We have invited Rajesh's son Damodar, who has been working in this area to advise us of steps that we can take in this regard to do our bit in saving the environment.*

Damodar: *Thank you uncle.*

(Damodar makes a 10 minute presentation on the effects of improper disposal of e-waste)

Damodar: *As you have seen in the presentation, these are the ill-effects of improper disposal of e-waste from our households and offices. Let me also apprise you that there is a law which has recently been revised by our government, which makes it mandatory for us to dispose off e-waste in a proper manner.*

Ramesh: *What are the steps that we can take in this regard.*

Damodar: *A RWA like us can take collective responsibility by ensuring that we make a collection center where we are able to collect e-waste emanating from households and then dispose it to an authorised recycler.*

Ramesh: *How big should be the collection center?*

Damodar: *We can allocate a space of around 1000 sq ft which should be enough to hold enough material so that when full a recycler can get a truck and take everything away.*

Ramesh: *How do we maintain this collection center?*

Damodar: *You see different electronic items are made up of different materials. There are some materials which are toxic in nature as well. it is important that these materials are stored in a proper manner and labelling and inventorisation is done properly so that the recycler can handle the material in a proper manner as required under the law.*

Rajesh: *What will the recycler do after he takes away the material from us?*

Damodar: *The recycler will use technology that has been approved to extract materials and metals from the e-waste and then sell it off in the market.*

Ramesh: *How do we get information about who is an authorised recycler?*

Damodar: *The information is available on the website of the pollution control board. I will also try and help identify a proper recycler for you until our recycling factory comes up in Buradabad.*

Rajesh: *How do we ensure that the material from households in our locality comes to this collection center?*

Damodar: *We need to create awareness amongst households on the subject of e-waste and the harmful effects of improper disposal of e-waste.*

Rajesh: *Do you think we should reduce the consumption of electronic items to reduce e-waste?*

Damodar: *No, I don't think so. It is however, important that we are able to follow lifestyles which are sustainable in nature. There is a limit to which we can extract resources so it is important that we consume in a manner that is sustainable and also dispose items which have reached end of life so that the materials can re-enter the system and be used to manufacture other items.*

Ramesh: *Thank you Damodar. This has been a really informative session for all of us. We will certainly discuss this with our families and try and inculcate better disposal practices not only for e-waste but for all other kinds of waste as well.*

Damodar: *Thank you for inviting me and please feel free to call on me as and when you feel my services would be required.*

(ACT III completed)

Senior citizens in the RWA have set up a collection center and have collected more than 200 kgs of e-waste. They have appointed an authorised recycler for recycling the same in an environment friendly manner.

4. References:

a) How can e-waste damage the environment and human health?

Composition of e-waste:

The composition of e-waste is very diverse and contains products across different categories. A typical electronic and electrical item consists of more than 1000 different substances which can fall under hazardous and non-hazardous categories. The major constituents are ferrous and non-ferrous metals, plastics, glass and plywood, printed circuit boards, concrete and ceramics, rubber and other items. Iron and steel constitutes about 50% of the WEEE followed by plastics (21%), non-ferrous metals (13%) and other constituents. Non-ferrous metals consist of metals like copper, aluminium and precious metals like silver, gold, platinum, palladium etc.

Pollutant/ Element	Occurrence
Arsenic	Semiconductors, diodes, microwaves, LEDs (light emitting diodes), solar cells
Barium	Electron tubes, filler for plastic and rubber, lubricant additives
Brominated flame –proofing agent	Casing, circuit boards (plastic), cables and PVC cables
Cadmium	Batteries, pigments solder, alloys, circuit boards, computer batteries, monitor cathode ray tubes (CRTs)
Chrome	Dyes/pigments, switches, solar
Cobalt	Insulators
Copper	Conducted in cables, copper ribbons, coils, circuitry, pigment
Lead	Lead rechargeable batteries, solar, transistors, lithium batteries PVC(polyvinyl chloride) Stabilizers, lasers, LEDs, thermoelectric elements, circuit boards
Liquid crystal	Displays
Lithium	Mobile telephones, photographic equipment, video equipment (batteries)
Mercury	Components in copper machines and steam irons; batteries in clocks and pocket calculators, switches, LCDs
Nickel	Alloys, batteries, relays, semiconductors, pigments
PCBs (Polychlorinated biphenyls)	Transformers, capacitors, softening agent for paint, glue plastic
Selenium	Photoelectric cells, pigments, photocopiers, fax machine
Silver	Capacitors, switches (contacts), batteries, resistors
Zinc	Steel, brass, alloys, disposable and rechargeable batteries, luminous substances.

Table 1: Pollutants and their occurrence in e-waste
Source:
Rajya Sabha Secretariat, 2011

Table 2: Possible Hazardous substances in e-waste components (CPCB, 2008)

Hazardous Substance	Danger
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 form microchips release lead as powder and fumes.
Plastic	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.
Chromium	Used to protect metal housings and plates in a computer from corrosion, inhaling Hexavalent chromium or chromium 6 can damage liver and kidney and cause bronchial maladies including asthmatic bronchitis and lung cancer.
Mercury	Affect 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 aquatic.
Beryllium	Found in switch boards and printed circuit boards. It is carcinogenic and causes lung diseases.
Cadmium	A carcinogen. Long-term exposure causes Itai-Itai 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. Cadmium may be released with dust, entering surface water and groundwater.
Acid	Sulphuric and hydrochloric acids are used to separate metals from circuit board's furnes contain chlorine and sulphur dioxide, which cause respiratory problems. They are corrosive to the eye and skin.
PBB	Polyhalogenated derivatives which can cause pre and post natal complications and can lead girls to menarche at an early age. They can also cause acne.
PBDE	Leads to restriction in development of kids between the age of 1 and 6 years.

E-Waste Source	E-Waste Component	Environmental Hazard	Effects on Human
CRTs (used in TVs, Monitors, ATM, Video Camera, etc), Batteries, PVC cables, Paints	Lead, barium & other heavy metals	These metals leaching g into the ground water and release of toxic phosphor	Anemia, Renal Toxicity, Insominia
Batteries, Housing & Medical equipment	Mercury	Air emissions as well as discharge into rivers of glass dust	Renal Toxicity, Muscle Tumors, Mental retardation cerebral palsy
Plastics from	Plasticizer	Chlorinated plastic	Risk in developing

printers, keyboards, monitors etc	bisephenol-A(or BPA) as well DEHP and DBP Plastic compound known as phthalates	release harmful chemicals into the surrounding soil, which seep into ground water or other surrounding water sources which cause serious harm to the species that drink this water.	heart problems, obesity reproductive disease
PVC & Polymer, Paints, Printing inks, electrical transformers & Capacitors	Polychlorinated Biphenyls (PCBs)	Include extreme pollution from production, toxic chemical exposure during use, hazards form fires	Suppression of immune system damage to the liver nervous and reproductive systems

Table 3: Possible hazardous substances in WEEE/E-waste components

Table 4:Component and possible hazardous content

Component	Possible Hazardous Content
Metal	
Motor/compressor	
Cooling	Ozone Depleting Substances (ODS)
Plastic	Phthalate plasticize, BFR
Insulation	Insulation ODS in foam, Asbestos, refractory ceramic fiber
Glass	
CRT	Lead, antimony, mercury, phosphors
LCD	Mercury
Rubber	Phthalate plasticizer, BFR
Winning/electrical	Phthalate plasticizer, lead , BFR
Concrete	
Transformer	
Circuit Board	Lead Beryllium , antimony, BFR
Fluorescent Lamp	Mercury, Phosphorus, Flame retardants
Incandescent Lamp	
Healing element	
Thermostat	Mercury
BFR – containing plastic	BFRs
Batteries	Lead, lithium, Cadmium, Mercury
CFC, HCFC , HFC , HC	Ozone depleting substances
External electric cables	BFRs, plasticizers
Electrolyte capacitors (over L/D 25mm)	Glycol, other unknown substances
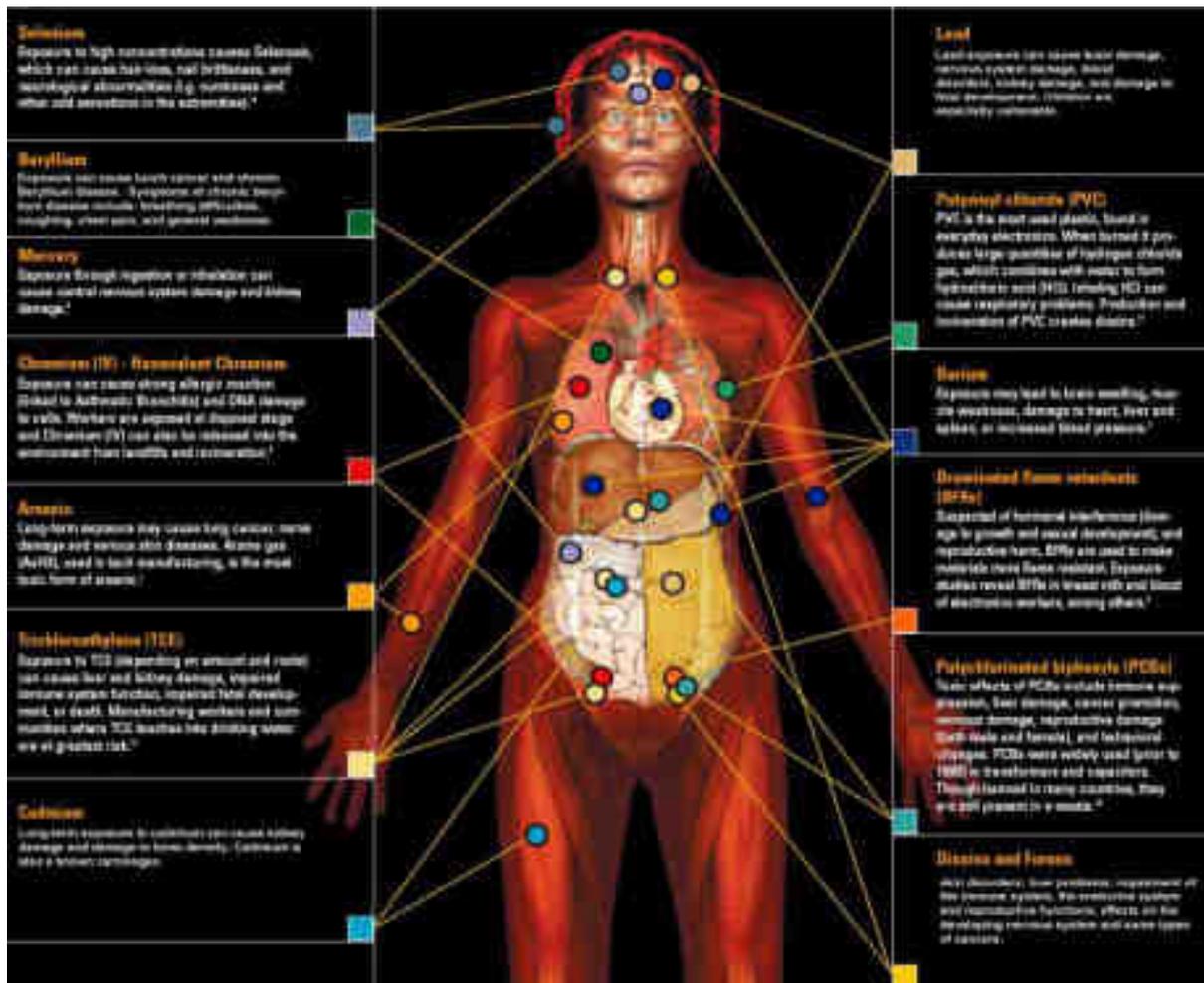
Figure 1: Adverse Impact of e-waste

Source:
http://www.capeewaste.co.za/why_recycle_ewaste.html

Exposure to e-waste may lead to changes in thyroid function, changes in cellular expression and function, adverse neonatal outcomes, changes in temperament and behaviour, and decreased lung function. Boys aged 8–9 years living in an e-waste recycling town had a lower forced vital capacity than did those living in a control town. Significant negative correlations between blood chromium concentrations and forced vital capacity in children aged 11 and 13 years were also reported. Findings from most studies showed increases in spontaneous abortions, stillbirths, and premature births, and reduced birthweights and birth lengths associated with exposure to e-waste. People living in e-waste recycling towns or working in e-waste recycling had evidence of greater DNA damage than did those living in control towns.

b) What are the benefits from environmentally sound management of e-waste

E-waste releases pollutants in air, water and soil that have very adverse impacts on environment and health. For instance, heavy metals are released through dust generated during mechanical treatment, for example, the dismantling and crushing of e-waste. In

addition metals are released during vaporization wherein metals are released from compounds in an acid bath. Dioxins and furans are released in flue gases during thermal treatment like incineration. The combustion of cable insulation containing PVC in order to recycle copper wiring and the incineration of epoxy resin containing flame retardant from circuit boards in order to recycle the metal they contain also released dioxins and furans. Acids are released in the form of vapour when metals are released from compounds. Acids may also get distributed throughout the surrounding area in the following ways factory air and dust being blown into the vicinity, leaching through waste water and seepage and release of flue gas into the atmosphere as a result of open incineration of furnace combustion. Therefore, environmentally sound management of e-waste can have several benefits for health of human beings as well as improve the environmental quality in cities where informal recycling takes place.

c) What is e-waste

Electronic waste or e-waste:

'e-waste' means waste electrical and electronic equipment whole or in part or rejects from their manufacturing, refurbishment and repair process which are intended to be discarded as waste.

Source:
Indian Ministry of Environment and Forests & Climate Change 2015. E-waste (Management) Rules, 2015.
http://www.indiaenvironmentportal.org.in/files/file/notified%20ewaste%20rule%202015.pdf
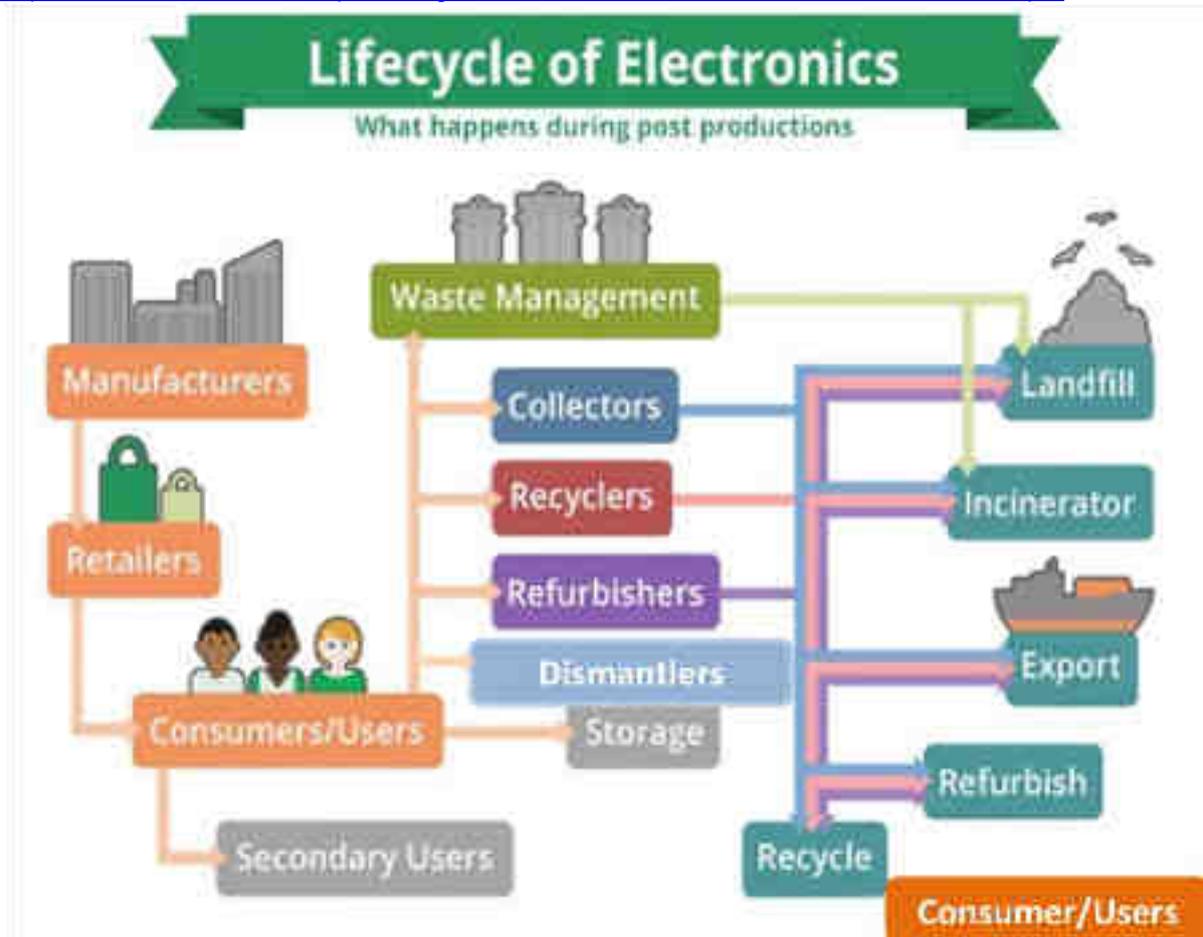
Figure 2: Lifecycle of electronics

Source:
http://greatforest.com/sustainability101/uncategorized/e-waste-recycled-video/)

Around 1.7 million tonnes of e-waste is generated in India per year (Baldé, (2015)).The main sources of electronic waste in India are the government, public and private (industrial) sectors, which account for almost 70 per cent of total waste generation. The contribution of individual households is relatively small at about 15 per cent; the rest being contributed by manufacturers. Though individual households are not large contributors to waste generated by computers, they consume large quantities of consumer durables and are, therefore, potential creators of waste. An Indian market Research Bureau (IMRB) survey of 'E-waste generation at Source' in 2009 found that out of the total e-waste volume in India, televisions and desktops including servers comprised 68 per cent and 27 per cent respectively. Imports and mobile phones comprised of 2 per cent and 1 per cent respectively (Rajya Sabha Secretariat 2011). In countries like China and India, though annual generation per capita is less than 1 kg, it is growing at an exponential pace. The increasing "market penetration" in developing countries, "replacement market" in developed countries and "high obsolescence rate" make WEEE/E-waste one of the fastest waste streams. Main contributors of e-waste includes It includes computer and its accessories, monitors, printers, keyboards, central processing units; typewriters, mobile phones and chargers, remotes, compact discs, headphones, batteries, LCD/Plasma TVs, air conditioners, refrigerators and other household appliances (Rajya Sabha Secretariat 2011).

Source:

Baldé, C.P., Wang, F., Kuehr, R., Huisman, J. (2015), The global e-waste monitor – 2014, United Nations University, IAS – SCYCLE, Bonn, Germany, http://i.unu.edu/media/ias.unu.edu-en/news/7916/Global-E-waste-Monitor-2014-small.pdf

WEEE Recycle & CSE. E-Waste Training Course for Policymakers and Regulators – Facilitator's Manual, http://www.igep.in/live/hrdpmp/hrdpmaster/igep/content/e54413/e54441/e62968/WEEERecycleCSEmanual.pdf

Rajya Sabha Secretariat 2011: E-waste in India. New Delhi. http://rajyasabha.nic.in/rsnew/publication_electronic/E-Waste_in_india.pdf

Amount of e-waste and recycling

The increased use of electrical and electronic equipment (EEE) and their high rate of obsolescence is leading to around 41.8 million tons of e-waste generation globally that is growing at an annual growth rate of 4 to 5 per cent per year (Baldé, (2015):24-25). From the developed countries around 75% to 80% of e-waste is shipped to countries in Asia and Africa for "recycling" and disposal where majority of imported e-waste is managed through informal unsafe recycling channels (Perkins et al., (2014): 287).

Around 1.7 million tonnes of e-waste is generated in India (Baldé, (2015):42)). According to Central Pollution Control Board (CPCB) (2015) list of registered e-waste dismantler/recycler in the country as on 27-11-2014 the total recycling capacity is 349154.6 MTA, this is only 20% of the estimated e-waste generation in India and therefore non-compliance to the rules is expected.

For example, around 170,000 tons of electronic waste is generated from scrapped television alone in India every year. If each ton has a value of INR 10,000 then the recycling industry

turnover would be INR 170 Crores. The total market is worth INR 1700 Crores despite considering a conservative value of e-waste.
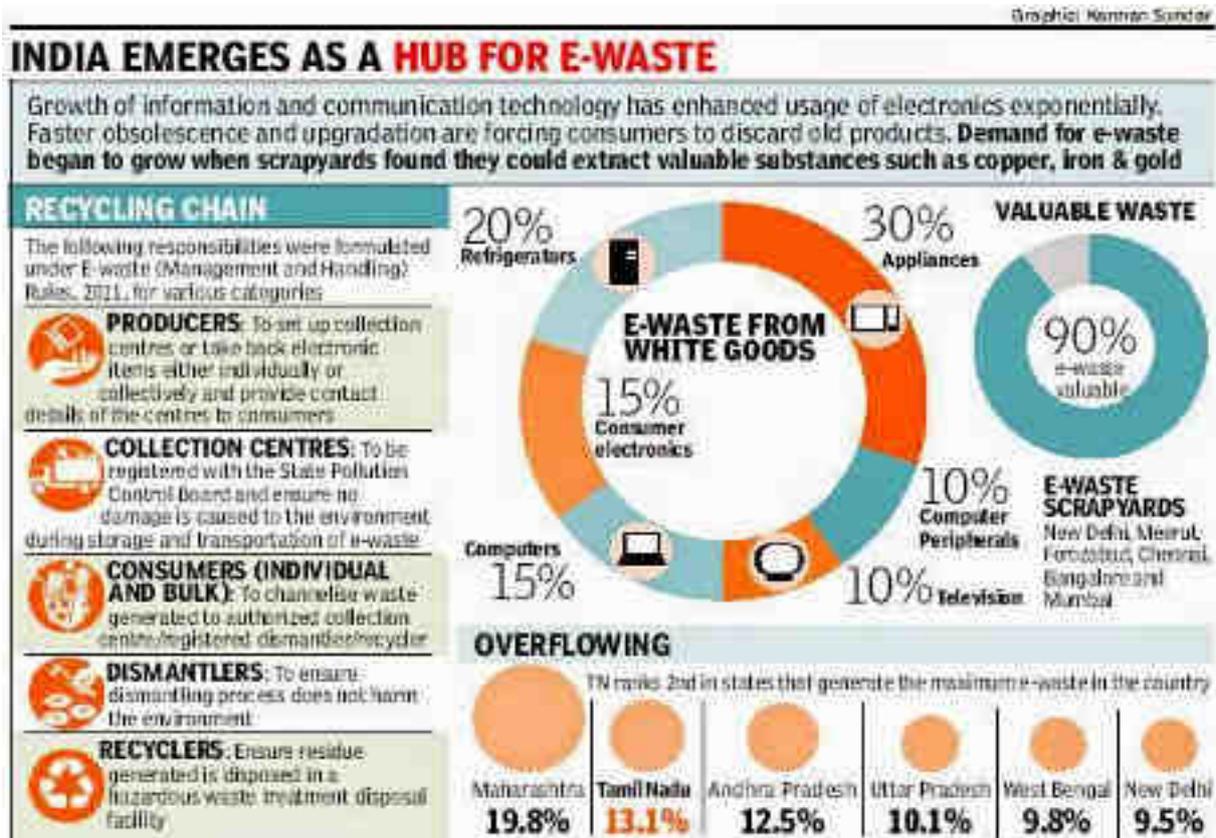

Figure 3: e-waste generation in India

The e-waste recycling sector revenue in 2015 was estimated at Euro 2.5 billion and is expected to grow to 3.5 billion by 2020 (Cucchiella et al., (2015)).

Source:
Central Pollution Control Board (CPCB) (2015), List of e-waste recyclers in India,
http://cpcb.nic.in/Ewaste_Registration_List.pdf

Cucchiella, Federica, D'Adamo, Idiano, Koh, S.C. Lenny, Rosa, Paolo, (2015), Recycling of WEEEs: An economic assessment of present and future e-waste streams, Renewable and Sustainable Energy Reviews, Volume 51, November 2015, Pages. 263-272.
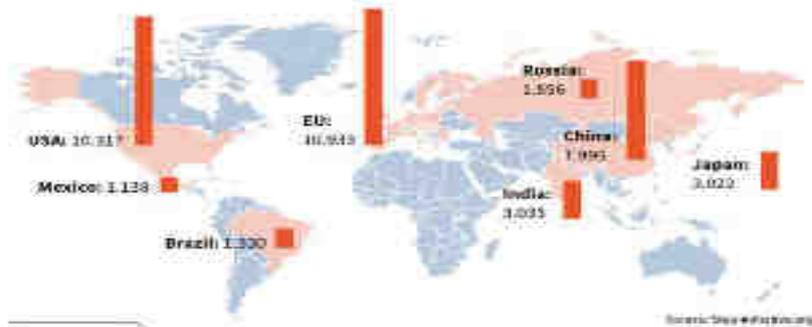
Figure 4: e-waste generation across the world

d) What are the resources embedded in e-waste

Resources embedded in e-waste:

The composition of e-waste is very diverse and contains products across different categories. A typical electronic and electrical item consists of more than 1000 different substances which can fall under hazardous and non-hazardous categories. The major constituents are ferrous and non-ferrous metals, plastics, glass and plywood, printed circuit boards, concrete and ceramics, rubber and other items. Iron and steel constitutes about 50% of the WEEE followed by plastics (21%), non-ferrous metals (13%) and other constituents. Non-ferrous metals consist of metals like copper, aluminium and precious metals like silver, gold, platinum, palladium etc.

e) How can you organize a collection drive for e-waste in your RWA/ locality? Which agencies can support you in organizing such a collection and awareness drive?

A collection drive for e-waste can be organized by contacting manufacturer or dealers who would then refer to the authorized collector, dismantler and recycler of e-waste. A record of each item collected in the drive should be maintained and provided to the collector, dismantler and recycler. The local pollution control board officer can be informed about the drive and the e-waste collected during the drive so that they can audit if safe recycling of the collected e-waste has been conducted.

All manufacturers, dealers and government's environment department could support collection and awareness drive. In addition national, international and local environmental NGOs can be partners for such a drive.

f) What is a carbon footprint?

Carbon Footprint

The total amount of greenhouse gases produced to directly and indirectly support human activities, usually expressed in equivalent tons of carbon dioxide (CO_2). In other words: When you drive a car, the engine burns fuel which creates a certain amount of CO_2, depending on its fuel consumption and the driving distance. (CO_2 is the chemical symbol for carbon dioxide). When you heat your house with oil, gas or coal, then you also generate CO_2. Even if you heat your house with electricity, the generation of the electrical power may also have emitted a certain amount of CO_2. When you buy food and goods, the production of the food and goods also emitted some quantities of CO_2 (TFC (2016)).

Source:

Time for Change (TFC), (2016), Definition of Carbon Footprint,
http://timeforchange.org/what-is-a-carbon-footprint-definition

Fee Online Tool to calculate Carbon Footprint:
http://www.nature.org/greenliving/carboncalculator/

g) What are the policies for e-waste management in our country?

As per the E-Waste (Management) Rules 2016 all e-waste should be recycled by authorized recyclers and dismantlers. In line with the principle of 'Extended Producer Responsibility' (EPR) the producers have to set up a scheme for collection of used/waste Electrical and Electronic Equipment from the Electrical and Electronic Equipment placed on the market earlier through dealers. In addition collection centres, Producer Responsibility Organisation, buy-back arrangement, exchange scheme, Deposit Refund Scheme, etc. should be implemented whether directly or through any authorised agency for channelising the items so collected to authorised recyclers. Consumers or bulk consumers of electrical and electronic equipment listed in Schedule I of the E-waste rules 2016[1] shall ensure that e-waste generated by them is channelised through collection centre or dealer of authorised producer or dismantler or recycler or through the designated take back service provider of the producer to authorised dismantler or recycler; (2) bulk consumers of electrical and electronic equipment listed in Schedule I shall maintain records of e-waste generated by them in Form-2 and make such records available for scrutiny by the concerned State Pollution Control Board; As responsible consumers we are expected to deposit the e-waste at authorized collection centres.

Environmentally sound E-waste treatment technologies are used at three levels as described below:
● 1st level treatment
● 2nd level treatment
● 3rd level treatment

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[1] 'bulk consumer' means bulk users of electrical and electronic equipment such as Central Government or State Government Departments, public sector undertakings, banks, educational institutions, multinational organisations, international agencies, partnership and public or private companies that are registered under the Factories Act, 1948 (63 of 1948) and the Companies Act, 2013 (18 of 2013) and health care facilities which have turnover of more than one crore or have more than twenty employees;

All the three levels of e-waste treatment are based on material flow. Each level treatment consists of unit operations, where e-waste is treated and output of 1st level treatment serves as input to 2nd level treatment. After the third level treatment, the residues are disposed of either in TSDF (Treatment, Storage, and Disposal Facility) or incinerated. The efficiency of operations at first and second level determines the quantity of residues going to TSDF or incineration. The simplified version of all the three treatments is shown below.

For non CRT E-waste, the major e-waste treatment facilities in India use the following technologies.

1. Dismantling 2. Pulverization/ Hammering 3. Shredding 4. Density separation using water
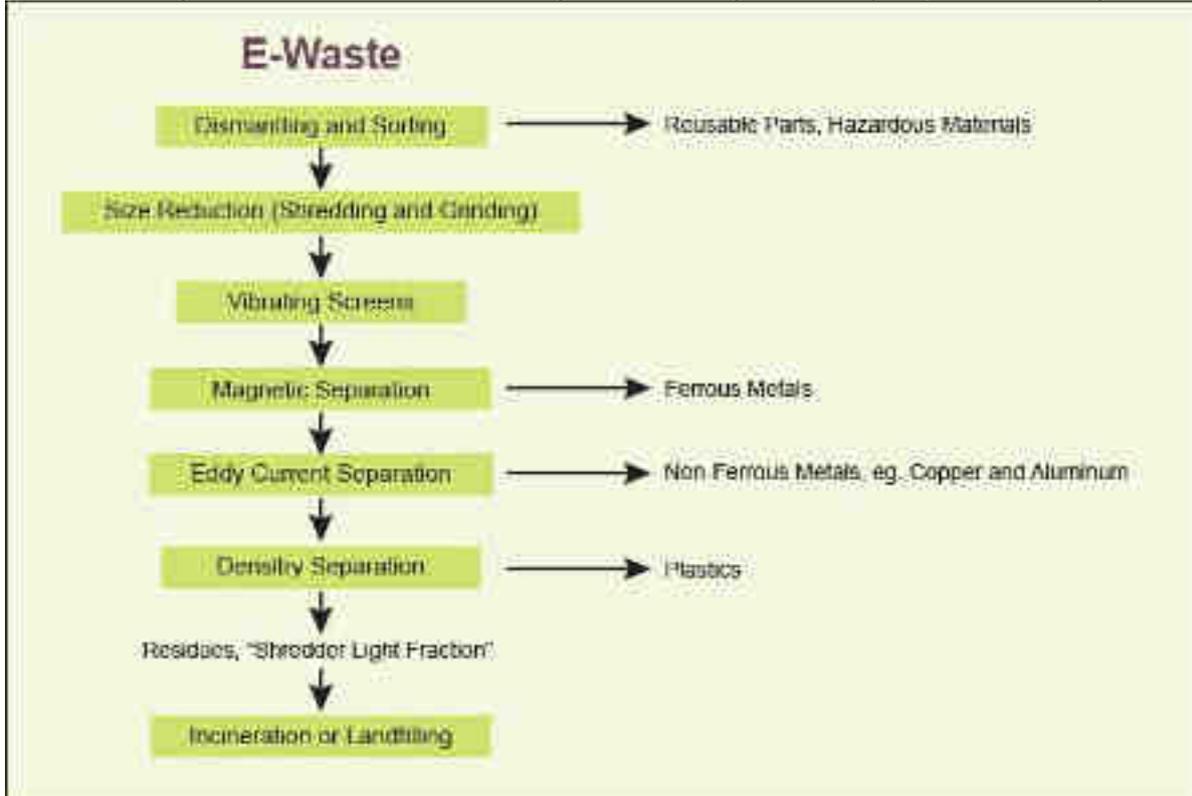
Figure 5: Treatment of e-waste

Source:
WEEE Recycle & CSE. E-Waste Training Course for Policymakers and Regulators – Facilitator's Manual
http://www.igep.in/live/hrdpmp/hrdpmaster/igep/content/e54413/e54441/e62968/WEEERecycleCSEmanual.pdf

Indian Ministry of Environment and Forests & Climate Change 2016. E-waste (Management) Rules, 2016.
http://www.moef.gov.in/sites/default/files/EWM%20Rules%202016%20english%2023.03.2016.pdf

E-waste Management Rules and its requirement for e-waste disposal and recycling

The E-waste Management Rules ask for 'environmentally sound management of e-waste' that means taking all steps required to ensure that e-waste is managed in a manner which shall protect health and environment against any adverse effects, which may result from

hazardous substances contained in such waste. The rules are applicable on producers, manufacturers, dealers, consumer, bulk-consumer, refurbishers and recyclers. It includes the following provisions to help ensure proper recycling and disposal of e-waste:

Implementation of Extended Producer Responsibility' (EPR) that puts responsibility on any producer of electrical or electronic equipment, for their products beyond manufacturing until environmentally sound management of their end-of-life products. 'Extended Producer Responsibility' means responsibility of any producer of electrical or electronic equipment, for channelisation of e-waste to ensure environmentally sound management of such waste. Extended Producer Responsibility may comprise of implementing take back system or setting up of collection centres or both and having agreed arrangements with authorised dismantler or recycler either individually or collectively through a Producer Responsibility Organisation recognised by producer or producers in their Extended Producer Responsibility - Authorisation;

Setting up 'Producer Responsibility Organisation' has been mandated that is a professional organisation authorised or financed collectively or individually by producers, which can take the responsibility for collection and channelisation of e-waste generated from the 'end-of-life' of their products to ensure environmentally sound management of such e-waste;

Implementation of Deposit Refund Scheme whereby the producer charges an additional amount as a deposit at the time of sale of the electrical and electronic equipment and returns it to the consumer along with interest when the end-of life electrical and electronic equipment is returned;

Every producer of electrical and electronic equipment and their components or consumables or parts or spares shall ensure that, new Electrical and Electronic Equipment and their components or consumables or parts or spares do not contain Lead, Mercury, Cadmium, Hexavalent Chromium, polybrominated biphenyls and polybrominated diphenyl ethers beyond a maximum concentration value of 0.1% by weight in homogenous materials for lead, mercury, hexavalent chromium, polybrominated biphenyls and polybrominated diphenyl ethers and of 0.01% by weight in homogenous materials for cadmium.

Overall the rules ask for record keeping by all stakeholders except individual consumers who are expected to ensure that e-waste generated by them is channelized through safe recycling and disposal system as set up according to the rules.

Source:

Indian Ministry of Environment and Forests & Climate Change 2016. E-waste (Management) Rules, 2016.
http://www.moef.gov.in/sites/default/files/EWM%20Rules%202016%20english%2023.03.2016.pdf

h) Who can support the setting up of collection points for low-value e-waste?

Setting up a collection center for e-waste:

As per the e-waste management rules to set up a collection center there is a need to apply for authorization from the State Pollution Control Board or Pollution Control Committee as per FORM – 1(a). There is a need to have agreements with producers who are willing to get the e-waste covered under their EPR collected at your center as well as with dismantlers

and recyclers who will be taking the e-waste from the collection center for further processing. It should be ensured that systems for record keeping and training for safe handling and storage of e-waste is provided to the people who will be managing the collection center.
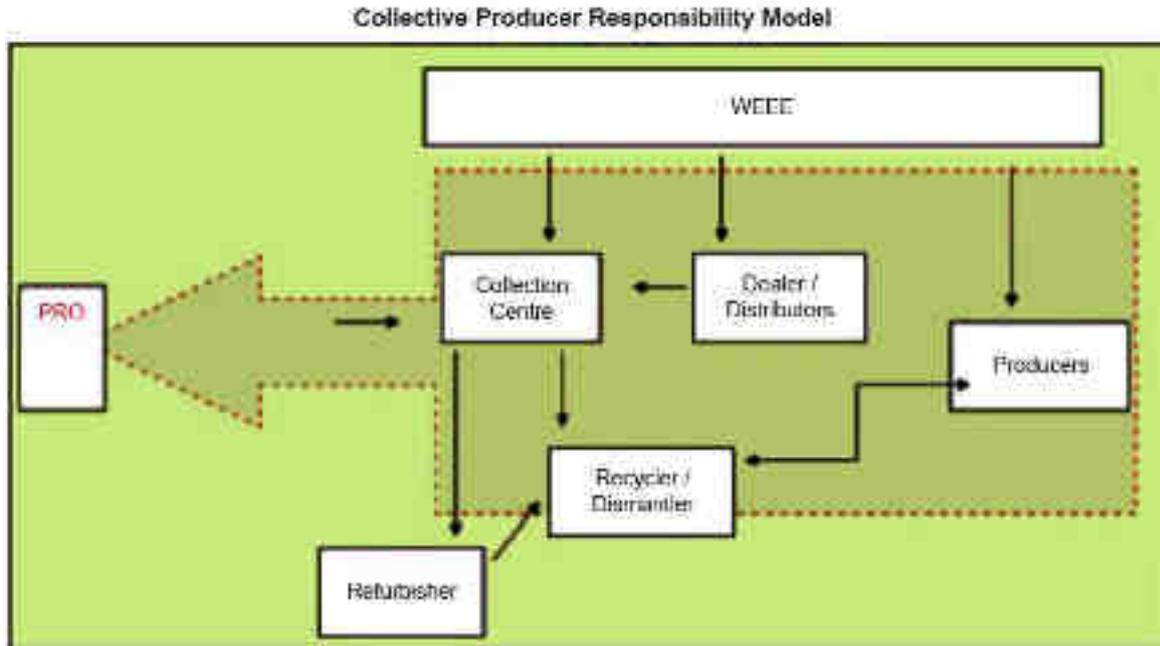
Figure 6: Collective Producer Responsibility Model representation with role of collection center

Responsibilities of Collection Centers include:

(1) Ensure that the facilities are in accordance with the standards or guidelines prescribed by the Central Pollution Control Board from time to time;

(2) The e-waste collected by them is stored in a secured manner till it is sent to registered dismantler or recycler as the case may be;

(3) Ensure that no damage is caused to the environment during storage and transportation of e-waste;

(4) Maintain records of the e-waste handled in Form 2 and make such records available for scrutiny by the State Pollution Control Board or the Pollution Control Committee concerned.

Precautions for setting up and managing such collection points

As precaution for setting up and managing collection points it is crucial to have Personal Protective Equipment (PPE) and Standard Operating Procedures (SOPs) for people handling e-waste. Record of the type of waste collected and time of collection should be maintained as per the E-waste management rules. Contract with recyclers and manufacturers should be in place to ensure that e-waste is managed safely after reaching the collection point.

How and where can you get information on the locally available collection services for e-waste

All manufacturers, producers and dealers should provide information about locally available collection, dismantling and recycling services through their web platforms, outlets. The information should also be available at the SPCB web platforms. Regular awareness campaigns and advertisements should be organized for providing information about locally available collection, dismantling and recycling services.

i) Resource consumption and Lifestyles of Health and Sustainability (LOHAS)

Resource Consumption:

It is an umbrella term for the many different ways and rates that humans consume the products of the natural world. Some resources are finite, meaning that once they are used there are none left, such as fossil fuels and land. Other resources are renewable, such as wind and solar energy.

Resource can be categorized into renewable and non-renewable, Renewable materials are not finite in availability as they can be replenished in a short duration for example agricultural products, livestock etc. While non-renewable resources are those that cannot be replenished or made again in short duration and may take billions of years to be made again for example fossil fuels that provide energy, metal ores used in the manufacture of cars and computers etc (FOE, 2005).

Due to the finite nature of fossil fuels and metals it is likely that we will runout of these resources in future as highlighted in the chart below:
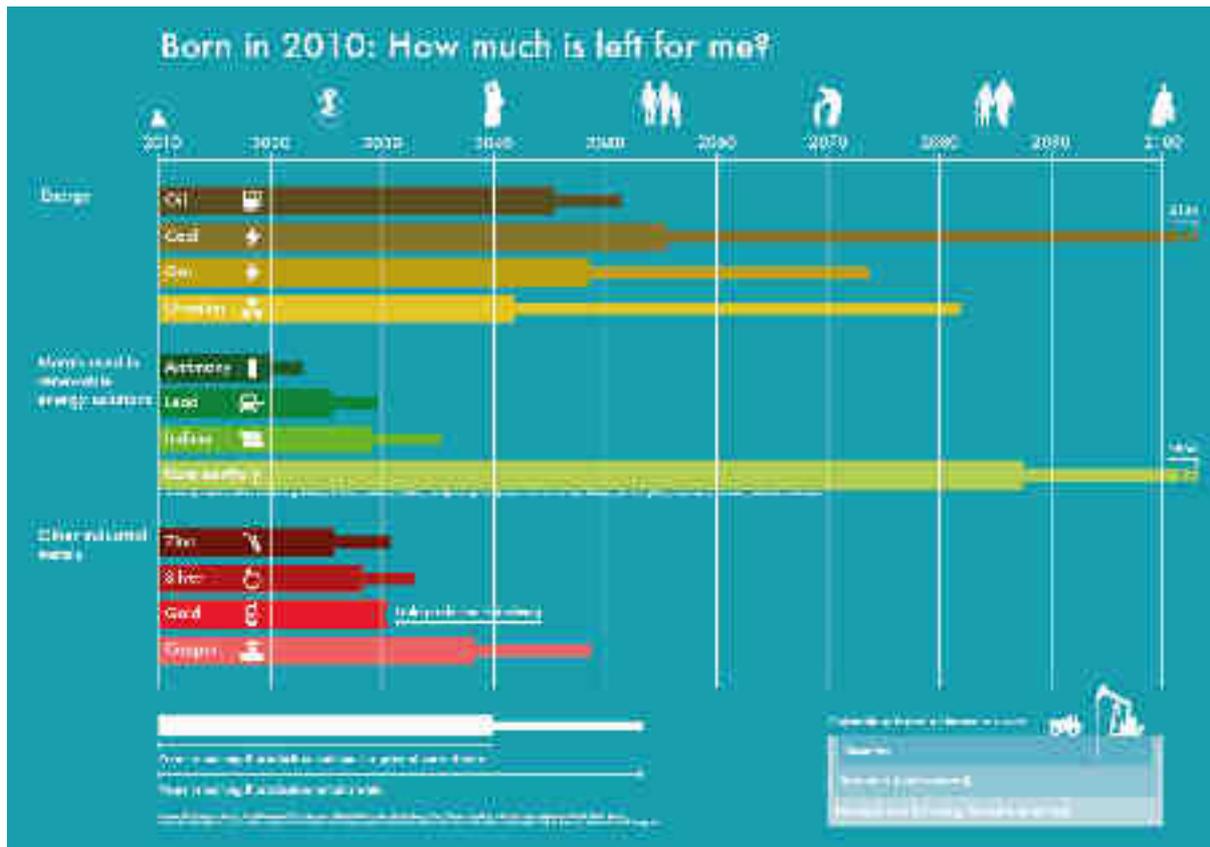
Figure 7: Resource consumption over the years

Overconsumption due to lifestyle changes, higher income levels and increased rate of obsolesce of electrical and electronics goods is leading to overconsumption of resources. Therefore it is necessary to reduce overconsumption and recycle so that we don't run out of resources.

Figure 8: Resource consumption across the ages

Source:

Govt. of Australia, (20011), Background Paper: Resource Consumption, Draft Planning Strategy.
http://www.planning.act.gov.au/__data/assets/pdf_file/0007/25684/Planning_Background11_Resourc
e.pdf

Overconsumption: Our use of the world's natural resources.
https://www.foe.co.uk/sites/default/files/downloads/overconsumption.pdf

Forecast when we will run out of each metal
http://www.visualcapitalist.com/forecast-when-well-run-out-of-each-metal/

Secondary resources:

A secondary resource is something created by the process or consumer of products at their
end-of-life for further processing, obviously if it is economically viable to do so. It really is the
economic value of secondary resources that drives the recycling system, and the basis of
the circular economy. Thus treating secondary resources is principally a matter of
considering the economic value that it contains and also the form in which this value is
present i.e. the mineralogy, the combinations of materials, linkages etc. The figure below
gives a succinct overview of a circular economy

Source:
EC Brussels, 2.7.2014 COM(2014)
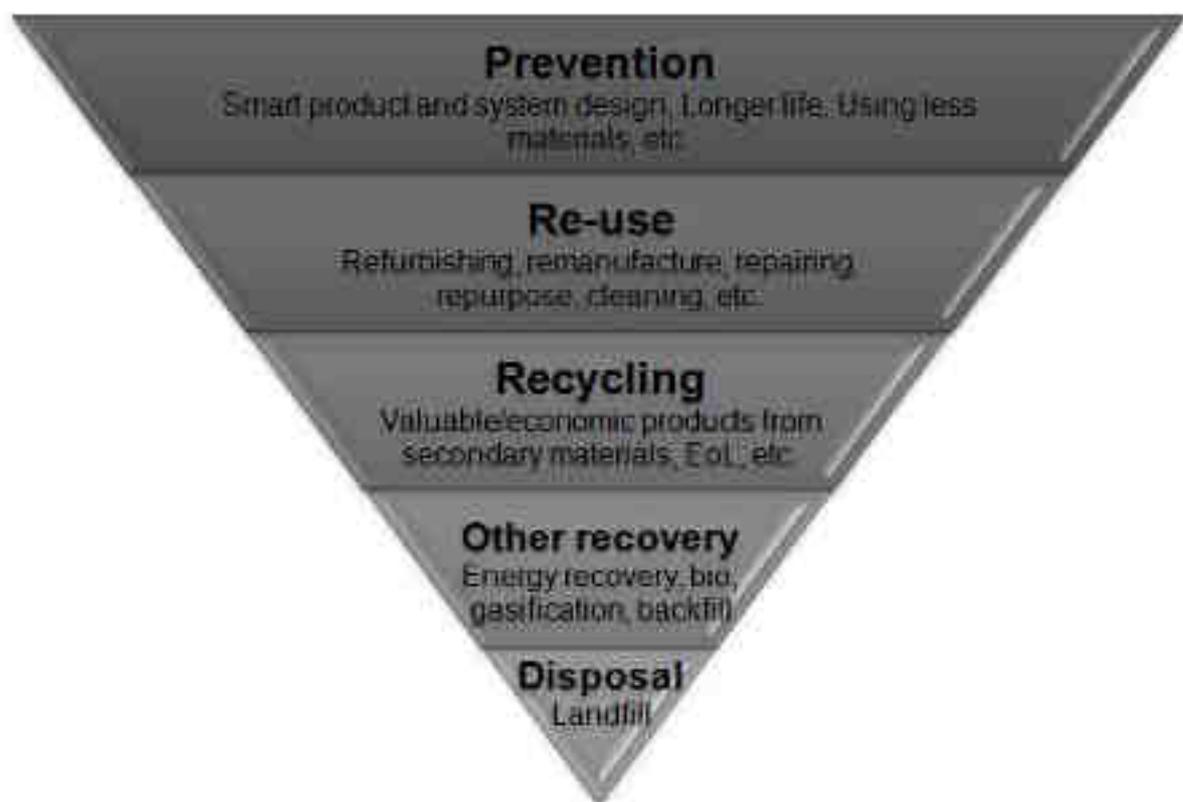
Figure 9: Steps towards a circular economy

The figure very clearly highlights through the "Raw Materials" and "Recycling" sections that process metallurgy is a key aspect in the realization of a closed-loop society. It really is the economic value of secondary resources that drives the recycling system, and the basis of the circular economy.

On the other hand primary resources are mostly extracted through mining operations leading to high economic, social and environmental costs. Use of secondary resources that use waste as a source of materials for building useful products leads to reduction in mining and prevents harmful environmental and social impacts.

Companies have already begun to transform themselves as participants of circular economy by design products that can more readily be recycled and reused. For example, Dell has introduced first computer made with plastics from recycled old electronics.

Figure 10: Closed loop recycling process

Source:

USING SECONDARY RESOURCES – TOWARDS SYSTEM INTEGRATED METAL PRODUCTION
(SIMP), 30/01/2015, by: Markus Reuter

http://www.outotec.com/en/About-us/Blogs/Experts-thinking-ahead/Metal-and-material-recycling/Dates/2015/1/Using-secondary-resources--towards-System-Integrated-Metal-Production-SIMP/

Dell, (2014), Dell has introduced first computer made with plastics from recycled old electronics. http://www.electronicstakeback.com/2014/06/12/dell-introduces-first-computer-made-with-plastics-from-recycled-electronics/

LOHAS:

LOHAS is acronym for Lifestyles of Health and Sustainability and is based on the work of US sociologist Paul H. Ray. LOHAS consumers' lifestyle and purchasing decisions are informed by their values regarding personal, family and community health, environmental sustainability and social justice. These values and attitudes are driving the markets for products as diverse as renewable energy, solar hot water, organic foods, recycled and sustainable homewares, domestic rainwater tanks, sustainable timbers, natural cleaning products, alternative medicine, yoga and eco-tourism.

Source:
LOHAS, (2016), Introduction,
http://www.lohas.com.au/what-lohas

Personal Action Plan of LOHAS:

According to the Ellen Macarthur Foundation, today's linear 'take, make, dispose' economic model is reaching its physical limits or is unsustainable. Therefore there is a need to adopt a circular economy that is an attractive and viable alternative as it is restorative and regenerative by design, and aims to keep products, components, and materials at their highest utility and value at all times. As envisioned by the originators, a circular economy is a continuous positive development cycle that preserves and enhances natural capital, optimises resource yields, and minimises system risks by managing finite stocks and renewable flows. It works effectively at every scale.

LOHAS contributes to the concept of circular economy by ensuring that products are used keeping in mind the aim of reducing the adverse environmental and social impacts. LOHAS aims at moving consumers from being purchasers to participants for making a difference in terms of environmental and social impact of the product.

Personal action plan should start with finding and knowing more about the environmental and social impact of the product during manufacturing, use and end of life. For example if we use a television we can find what all metals, minerals and other substances were used to manufacture it and what was the environmental and social impact of the product.

LOHAS consumers actively seek green and sustainable products, support the principle of reduce, reuse and recycle in their day to day life and purchase decisions. Therefore, after the product's impact is know the person should compare the impact of this product with that of similar products available in the market. He or she should actively ask questions about the environmental management system and recycling program of the company. After comparison the consumer adopting LOHAS should opt for the most eco-friendly and recyclable product even if it costs slightly higher. For example, given a choice that you can buy a computer with 50% less harmful materials and made out of recycled plastic, you should buy it even if it is costing more than the computer with high percentage of harmful material and on use of recycled plastics.

For tackling e-waste challenge LOHAS consumers should demand from manufacturers that products should be made with minimum amount of harmful substances and they should ensure that e-waste is collected and managed in an environmentally and socially responsible manner. This will motivate the companies to change their manufacturing process to more sustainable options and implement recycling programs.

Source:

Natural Marketing Institute, (2007), Understand the LOHAS Consumer.
http://www.lohas.se/wp-content/uploads/2015/07/Understanding-the-LOHAS-Consumer-11_LOHAS_Whole_Foods_Version.pdf

Ellen Macarthur Foundation, (2015), Concept of circular economy,
http://www.ellenmacarthurfoundation.org/circular-economy/overview/concept

Occupational Health and Safety (OHS) issues around improper handling of e-waste

e-waste contains a wide range of hazardous compounds that may be released during improper handling thereby becoming a threat to humans and the environment. In addition, in some processes used, new hazardous compounds, such as dioxins, may be formed as the original e-waste components are degraded. Most risks arise during the uncontrolled e-waste recycling activities using rudimentary methods. These include manual disassembly and sorting; heating and acid leaching of printed circuit boards (PC-boards); shredding, melting and extrusion of plastics; open burning of plastic coated wires and other components; and sweeping and collection of toners from toner cartridges. These activities are mostly carried out directly on the ground in open air or in poorly ventilated workshops, and involve minimal emission control systems and personal protection for the workers.

Humans and the environment in the areas where this is carried out may therefore be highly exposed to the emissions generated. The recycling workers and the local residents are particularly exposed via dust generated during dismantling and shredding processes, and fumes and smoke generated during acid digestion processes and various high temperature processes, such as open burning and heating, melting, and extrusion processes. The environment is mainly contaminated from the open burning processes and through leakage from dumped residue of various recycling activities, e.g. stripped cathode ray tubes (CRTs) and PC-boards, spent acids from the digestion processes and residual ashes. On the whole, lead seems to be particularly problematic among the metals, and dioxins (chlorinated and brominated) and polybrominated diphenyl ethers (PBDEs) among the organic compounds. These compounds are all very toxic and may potentially be emitted in large amounts during rudimentary e-waste recycling activities. Lead and PBDEs because they both are highly abundant in e-waste, and dioxins because the formation conditions many times are ideal in the processes used. As a consequence, extremely high levels (in some cases the highest ever measured) of these compounds have been measured in environmental as well as human samples collected in areas where uncontrolled e-waste recycling is taking place. Risks also arise when e-waste is treated as general municipal solid waste. During incineration, a wide variety of hazardous compounds may be emitted to the atmosphere via the smoke and exhaust gases, both in gaseous form and bound to particles.

The compounds emitted may be those that were present in the original waste, but probably more important are those compounds that may be formed during the incineration processes,

e.g. PCDD/Fs and PBDD/Fs. This is because the e-waste, being a complex fuel, may function as precursors for many different compounds in thermal processes. In fact, the conditions for dioxin formation are many times ideal when e-waste is incinerated, which is partly due to the presence of PVC-plastics and BFRs as dioxin precursors and partly due to the presence of copper and antimony as very potent catalysts in the transformation reactions. In modern incineration facilities the emission of these and other compounds may be minimized by process optimization and flue gas treatment systems. However during landfilling, hazardous compounds may leak to the surrounding environments, including nearby surface water and groundwater reservoirs, and also evaporate to the atmosphere. Leakage may occur for most compounds in the waste due to the long time span involved, but of particular concern are the leakage of lead and various other metals, as well as PBDEs and phthalate plasticizers. Evaporation mainly occurs for volatile compounds, of which mercury and its methylated derivatives are of most concern. The extent of leakage and evaporation from a landfill depends on the properties of the contaminants in question, but also on the design of the landfill (i.e. if it is open or sealed), the properties of the material being stored (e.g. type of waste, if it has been pre-treated in some way etc.), and on various environmental factors such as the ambient temperature and pH and humic content in the infiltrating water (SEPA, (2011)).

Source:
Swedish Environmental Protection Agency, (2011), Recycling and disposal of electronic waste Health hazards and environmental impacts, Report 6417.

5. Session Plans:

E-Waste Curriculum: Training of Trainers

This curriculum has used Donna E. Walker's 'Learning Cycle' to design each of the sessions. Each step of the Walker's cycle serves a specific purpose thus ensuring that the learning effectiveness is maximized. The details of the five steps of the Walker's Cycle are explained below:

1. Mind Jog: This step helps to start the session on a positive note and arouse curiosity about the issue the session relates to. Mind jogs need to be short and crisp, and lead into the topic.

2. Personal Connection: This step helps to bring out the 'what's in it for me' connection and prepares the participants for absorbing new knowledge. The exercises used at this stage try to make the session relevant to learner's real world 'as is'.

3. Information Exchange: The focus of this stage is to build new knowledge, facilitate exchange of information between and among the participants and deduce some key concepts through discussion and presentation to supplement participants' information. In this stage, the facilitators allow the participants to come up with concepts instead of downloading it for them and allow extensive peer discussion and learning. The facilitators here need to concentrate on refining and building on participants' inputs.

4. Information Application: The purpose of this stage is to build confidence in the participants about new knowledge, support them to apply the key concepts learnt to realistic scenarios (thereby reconfirming the learning of the previous stages), and to facilitate a multi-perspective view. This stage also seeks to add fresh insights into the concepts and apply the skills to real life situations without taking real risks. For this curriculum, we have tried to ensure that the activities are drawn from the participants' background and experiences and enough complexity has been built into it in order to get a variety of responses.

5. Real World Connection: The activities in this stage seek to elicit personal learning and satisfy the participants that new knowledge will lead to a better performance. The design of this stage enables participants to connect personal learning to learning from the session, as the facilitator helps them set up clear performance oriented goals, which are also specific, measurable and realistic. This way both the facilitators and the participants get a chance to informally assess how effective the participants' learning has been.

Session 1: What is E-Waste?

Purpose

The primary function of this session is to introduce the participants to the methodology that would be used in transacting the curriculum. The session also aims to build an understanding of participants around the concept of E-waste and problems associated with E-waste.

Session Objectives

At the end of the session participants will be able to:

- Explain what E-waste is composed of, where e-waste is produced and in what quantities
- Identify the problems associated with E-waste Management

Flow Step	Key Idea/Description	Methodology/ Tools	Duration
Mind Jog	**Familiarizing with the concept of E-waste** How many of you have heard of the word e-waste; show of hands; get responses from few participants.	Group activity	15 minutes
Personal Connect	**Connecting personal experiences with E-Waste** One thing which I am doing, through which I am augmenting e-waste in the environment (think individually and then share in small groups). • Individually reflect and write (10 minutes) • In small groups, share. (20 minutes)	Individual reflection and Group Work	30 minutes
Information Exchange	**Defining the concept of E-waste** Case study: Read aloud the case study with participants reading the part of different characters + individual recording after each section. If the group is a mixed Hindi/English group, run in one Hindi group and one English group. It is a good idea to give the case study as a pre-work so that the participants have at least read it before they come and this is only a refresher.	Group study and Discussion Case study	1 hour
Information Application	**Learning about the themes of the E-waste curriculum** Group processing of the case study to identify the major themes of curriculum • Make 4 small groups • Participants share individual written thoughts in small groups	Discussion	1 hour

	• As a group discuss the case study and bring out the core themes which the case study is focusing on • Each group presents to the larger group the themes which they have been able to identify from the case study . • The facilitator sums up the discussion by introducing the curriculum themes and how each theme will be treated as a session which the participants will undergo over the course of next 4 days . • Theme 1 – Introduction to E-waste • Theme 2 –Harmful effects of E-waste on human health and environment • Theme 3 Disposing e-waste in an environmentally sound manner and setting up collection points		
Real World Connect	**Reflecting on one's understanding wrt E-waste themes** Self-assessment on E-waste themes	Individual reflection	15 minutes

MIND JOG **Slide – What is E-Waste?**	*INSTRUCT* Make a circle How many of you have heard of the word e-waste? Please raise your hands if you have heard and if you have not please don't ; get responses from few participants. **EXPLAIN:** All of us have some idea about E-Waste. In the course of next 3 hours , we will be engaging more deeply with the subject and get to build a more informed understanding on the issue.
PERSONAL CONNECT	**SAY:** Take a minute to reflect on "One thing which you are doing, through which you are augmenting e-waste in the environment" and write down for yourself on a card. *(Give participants 5 minutes for this)* **SAY:** Now, let's get into three groups. Within your groups, take a look at your reflections and as a group capture the actions which are adding to e-waste in the environment. **INSTRUCT** Will one person from each group share their groups' chart with the larger group? As the groups are sharing, capture what they are saying on a chart or white board **EXPLAIN** Each one of us is responsible for creating e-waste some more some less. Its important that first we accept that we are contributing to e-waste and take necessary actions to mitigate e-waste within our

	schools, family and community
INFORMATION EXCHANGE Handout1.1 What is E-waste? Handout1.2 What are the 10 categories of e-waste? Handout 1.3 Generation of E-waste globally Handout 1.4 Generation of E-waste in India	**INSTRUCT** Read the case study in small groups with participants reading the part of different characters **Damodar:** *Good evening uncle. I haven't seen you in a long time now. How are you doing?* **Ramesh:** *I am doing good. Rajesh keeps telling me how busy you are these days with the factory coming up in Buradabad.* **Damodar:** *Yes. I hope all goes well and we are able to do some work which will really be helpful for the environment.* **Ramesh:** *So what exactly is the factory going to do.* **Damodar:** *It is a recycling unit for electronic waste.* **Ramesh:** *What is electronic waste?* **Damodar:** *All electronic and electrical items when they reach end of life are termed electronic waste* **Ramesh:** *Ah. So there is a market for such goods as well.* **ASK** How was it? What have you learnt?
INFORMATION APPLICATION	**INSTRUCT:** Get into your groups again . Now discuss the case study in your small groups and respond to the following questions -What is the case study about ? -Why do you think we are studying this case study? -Who are the different characters and what roles are they playing ? - Which character has fascinated you the most and why? - What is your learning from the case study ? -How would you like to use this learning in your life ? - What are the different themes which the case study brings out? **EXPLAIN** • The case study brings out the different themes which an E-Waste facilitator needs to understand to facilitate sessions with adolescent groups . During the course of the next 4 days of this TOT we will be referring to the case study to highlight different themes: • Each group presents to the larger group the themes which they have been able to identify from the case study . • The facilitator sums up the discussion by introducing the curriculum themes and how each theme will be treated as a session which the participants will undergo over the course of next 4 days . • Theme 1 – Introduction to E-waste • Theme 2 –Harmful effects of E-waste on human health and environment • Theme 3 Disposing e-waste in an environmentally sound manner • Theme 4 Setting up collection points
REAL WORLD CONNECT	**ASK:** Each one of you need to fill –up this questionnaire. You have ½ hour to fill this and your time starts now …….. **ASK:**

	• How was your experience? • Why did it work /not work well? **EXPLAIN:** Our understanding of E-waste is at different levels . For us to be a credible E-waste facilitator its important for us to have the right information . The questionnaire clearly indicates your current understanding of the subject and also brings out the learning gap.

Session 1 and Session 2
Transition Note:

In the last session, we discussed about the concept of E-waste through a case study . In this session we will dive deeper into the issue and understand the harmful effects of E-waste on environment and human health and also learn about actions which can help us prevent the hazards resulting from these substances.

Session 2: Harmful effects of e-waste on the environment and human health

Purpose

This session explains the harmful effects of E-waste. The focus will be on understanding the harmful effects of e-waste on human health and environment.

Session Objectives

Upon completion of this topic, participants will be able to…

- Explain the hazardous substances found in e-waste
- Describe the risks associated with hazardous substances
- Explain the actions on how to prevent the hazards resulting from these substances

Summary session plan:

Flow Step	Description Key Idea	Methodology/Tools	Duration
Mind Jog	**Linking personal associations of E-waste with the session** Photo language (photos depicting the harmful effects of e-waste on health and environment).	Photo language Set of 30 photographs depicting impact of e-waste (To be sourced) The activity can be done either ways - with photo prints or soft copies if all participants have laptops.	10 minutes
Personal Connect	**Reflecting on personal experiences wrt E-waste** Why have you selected this particular photograph? What story does this photograph tell you?	Individual Reflections + Group work	30 minutes
Information Exchange	**Defining E-waste impact** Case study: read aloud the RELEVANT SECTION of case study with participants reading the part of different characters + individual recording after each section. If the group is a mixed Hindi/English group,	Case study	1 hour

	run in one Hindi group and one English group. It is a good idea to give the case study as a pre-work so they have at least read it before they come and this is only a refresher.		
Information Application	**Understanding types of E–waste impact** Group processing of the case study to identify the impacts of E-waste • Make 4 small groups • Participants share individual written thoughts in small groups • As a group discuss the case study and bring out the harmful effects of E-waste • Each group presents to the larger group the harmful effects of E-waste based on the case study . • The facilitator sums up the discussion by sharing the effects with the participants Post the discussions, participants are asked to prepare a poster/other IEC material in their small groups on E-waste and its harmful effects .	Group work	1 hour
Real World Connect	**Identifying personal learning gap** Participants are asked to create a personal learning plan for themselves to address the learning gaps from the last session on E-waste and this session on Impact of E-waste . This will help the participants to keep a track of their learning throughout the training workshop. The plan will be reviewed again on the last day of the training workshop.	Creating a personal action plan	20 minutes

MIND JOG Slide with instructions and questions	Spread 25-30 photographs depicting the harmful effects of e-waste on health and environment *INSTRUCT* **This activity has to be done individually .Please pick up one photograph keeping 2 questions in mind** Why have you selected this photo? What story does this photo tell you?
PERSONAL CONNECT	**ASK -Keep the photo with you and get into 3 small groups for a group activity .Each member has to share his /her response to the above 2 questions in the group**

	EXPLAIN: Each one of us is an E-Waste facilitator and all of us have stories to share from the field and from our personal experiences about the harmful effects of e-waste on humans and environment. **In this session we'll look at the harmful effects of e-waste on humans and environment more deeply……**
INFORMATION EXCHANGE Handout 2.1 Hazardous substance in E-waste Handout 2.2 Health impacts of E-waste Handout 2.3 Methods of treating E-waste	**INSTRUCT** Case study: read aloud the RELEVANT SECTION from the case study with participants reading the part of different characters + individual recording after each section. If the group is a mixed Hindi/English group, run in one Hindi group and one English group. It is a good idea to give the case study as a pre-work so they have at least read it before they come and this is only a refresher. **Rajesh:** *You see we keep buying new stuff and replacing the old one. But what do we do with the old one which we are not using anymore?* **Ramesh:** *Well it depends. Usually there is a lot of low value stuff which we give away to a kabadiwala. But then again there is some material which we go and sell to a proper shop to see if it can be repaired and can be used by us or maybe sold to someone for a nominal price.* **Rajesh:** *I agree. But I am questioning the material which cant be used anymore and is irreparable.* **Ramesh:** *That may again go to a kabadiwala I guess. But they extract a lot of material and it comes back in the system.* **Rajesh:** *Yes I have seen them doing so. While passing Buradabad I saw a heap of wires being burnt and when I asked why the person was doing so, he informed that he was going to extract copper from the same.* **Ramesh:** *But that would create so much pollution as well. Isn't it?* **Rajesh:** *Yes. And that is what concerns me as well.* **Ramesh:** *Then we should try and learn how exactly these items should be disposed so that none of this pollution creating activities can take place. If we don't do anything, then nothing will happen.*
INFORMATION APPLICATION	**INSTRUCT** • Make 4 small groups • Participants share individual written thoughts in small groups • As a group discuss the case study and bring out the harmful effects of E-waste • Each group presents to the larger group the harmful effects of E-waste based on the case study . • The facilitator sums up the discussion by sharing the effects with the participants Post the discussions, participants are asked to prepare a poster/other IEC material in their small groups inorder to generate a discussion with participants on E-waste and its harmful effects . **EXPLAIN** As E-waste facilitators it is important for you to not just have the right information but also the right resources and the methodology to make the target group understand the concepts in a fun way so that maximum learning can happen.

REAL WORLD CONNECT	INSTRUCT
	Create a learning plan for self to address the learning gaps which has been identified through the self-assessment tool. Request you to keep a track of your learning throughout the training workshop. We will review it again on the last day of the training workshop. **EXPLAIN** Its important as a facilitator to keep an eye on your own learning and unlearning because it will help you not only transfer the concepts better but also help you to respond to the questions of the participants

Session 2 and Session 3
Transition Note:

In the previous session, we discussed the harmful effects of E-waste on health and environment .   In this session , we will talk about disposing E-waste in an environmentally sound manner

Session 3: Disposing E-waste in an environmentally sound manner

Purpose

This session seeks to give an introduction about E-Waste disposal in an environmentally sound manner.

Session Objectives

Upon completion of this topic, participants will be able to…
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- List down the locally available collection services for e-waste
- List down the questions regarding e-waste while buying a new product or disposing off an old one
- Explain the process of organizing a collection drive for e-waste
- List down the information on who can support the setting up of collection points for low-value e-waste?
- Articulate the precautions for setting up and managing such collection points

Summary Session Plan

Flow Step	Description	Methodology/ Tools	Duration
Mind Jog	**Connecting with the session objective** A film on E-waste disposal (To be developed)		20 minutes
Personal Connect	**Linking personal experiences with E-waste disposal** One electronic product which you have disposed -off in the last month and what did you do with it?	Reflection and Group work	30 mins
Information Exchange	**Explaining the importance of setting up of the E-waste collection centers** Case study: read aloud the RELEVANT SECTION of the case study with participants reading the part of different characters + individual recording after each section. If the	Group Work	1 hour

	group is a mixed Hindi/English group, run in one Hindi group and one English group. It is a good idea to give the case study as a pre-work so they have at least read it before they come and this is only a refresher. We will have practitioners one from formal and the other from the informal sector to talk about the polices and rules ; responsibility of different stakeholders and the challenges in the implementation of the policy		
Information Application	**Processing of learning from the activity** Group processing of the case study to identify the disposing of E-waste in an environmentally sustainable manner • Make 4 small groups • Participants share individual written thoughts in small groups • As a group discuss the case study and bring out ways of disposing of E-waste • Each group presents to the larger group the ways of disposing E-waste based on the case study . • The facilitator sums up the discussion by sharing the mechanisms of E-waste disposal with the participants Exposure to a collection facility to understand the setting up and implementation of the collection centre	Individual work on project and self	1 hour
Real World Connect	**Exploring the importance of collection centres** Design a collection drive to be set-up and rolled in the neighbourhood		20 mins

MIND JOG ?	**ASK:** Participants to place their watches/ phones/calcs in the centre) – INSTRUCT Now there are so many gadgets lying in front of you , you are requested to pick up your favorite gadget and share the reason for choosing the same. Explain We choose things because of appearance, brand, popularity, price OR alternate activity Inform the participants that they are going to play a game called gadget . Share that as you clap your hands , they will have to start walking in the circle and when you specify a pose and call out gadget , they will have to strike the pose of that gadget Begin the game by clapping out the following: Phone Computer/laptop Watch

	Television
PERSONAL CONNECT	Ask each participant to write down the purpose of their favourite gadget and how it eases their life
INFORMATION EXCHANGE Handout 5.1List of dos and don'ts for setting up of the collection centres Handout 5.2 Managing a collection centre Handout 5.3 List of agencies which can support you in organizing such a collection and awareness drive Handout 5.4 List of E-waste collection centres in your city	Case study: read aloud the RELEVANT SECTION of the case study with participants reading the part of different characters + individual recording after each section. If the group is a mixed Hindi/English group, run in one Hindi group and one English group. It is a good idea to give the case study as a pre-work so they have at least read it before they come and this is only a refresher. **Ramesh:** *When you say awareness, what is the kind of awareness that you would like to generate?* **Damodar:** *You see uncle, there are a lot of electronic items we use today. it is important as well since it enhances our productivity and helps us stay connected. But all of these items have a life beyond which we cant use them. It is then important that the materials that are used in manufacturing these items are properly recycled back into the system once again.* **Ramesh:** *You mean to say that instead of using material which is mined and is virgin, you ensure that the same material is recycled back into the industry and can be used again.* **Damodar:** *Absolutely uncle. This will not only help to reduce the environmental impacts caused due to rampant mining, it will also ensure that whatever the earth has offered to us is not wasted and can be used again and again.* **Ramesh:** *That's a noble thought which as I see makes business sense as well.* **Damodar:** *Yes it surely does.*
INFORMATION APPLICATION	**SAY:** Group processing of the case study to identify the disposing of E-waste in an environmentally sustainable manner • Make 4 small groups • Participants share individual written thoughts in small groups • As a group discuss the case study and bring out ways of disposing of E-waste • Each group presents to the larger group the ways of disposing E-waste based on the case study . • The facilitator sums up the discussion by sharing the mechanisms of E-waste disposal with the participants Exposure to a collection facility to understand the setting up and implementation of the collection centre . Design and implement a collection drive in the neighbourhood .
REAL WORLD APPLICATION	Plan for a collection centre in the locality and identify the challenges which will come in the implementation of the centre

45

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List of Tables

Table 1: Pollutants and their occurrence in e-waste

Table 2: Possible Hazardous substances in e-waste components

Table 3: Possible hazardous substances in WEEE/E-waste components

Table 4:Component and possible hazardous content

List of Figures

List of Abbreviations

MeitY: Ministry of Electronics and Information Technology
MAIT: Manufacturers Association for Information Technology
LOHAS: Lifestyles for Health and Sustainability
e-waste: Electronic Waste
RWAs: Resident Welfare Associations
EPR: Extended Producer Responsibility
PPP: Purchasing Power Parity
TV: Television
CRT: Cathode Ray Tube
LCD: Liquid Crystal Display
LED: Light Emitting Diode
CPCB: Central Pollution Control Board
PVC: Polyvinyl Chloride
PCBs: Polychlorinated Biphenyls
TSDF: Treatment, Storage and Disposal Facility
BFR: Brominated Flame Retardants
PBB: Polybrominated Biphenyls
PBDE: Polybrominated Diphenyl Ethers
ATM: Automated Teller Machine
WEEE: Waste Electrical and Electronic Equipment
CFC: Chlorofluorocarbon
HCFC: Hydrochlorofluorocarbons
HFC: Hydroflourocarbon
HC: Hydrocarbon
UNEP: United Nations Environment Programme
DRS: Deposit Refund Scheme
PRO: Producer Responsibility Organisation
OHS: Occupational Health and Safety
PCDD/Fs: Polychlorinated dibenzo-p-dioxins
PBDD/Fs: Polybrominated dibenzo-p-dioxins
CO_2: Carbon Dioxide
IEC: Information, Education and Communication

About this Manual

Under the Digital India Mission, the Ministry of Electronics and Information Technology (MeitY) has initiated a project "*Awareness Programme on Environmental Hazards of Electronic waste*". The programme aims to enhance awareness on the growing challenges and opportunities provided by e-waste.

This manual, for RWAs and Localities, is a part of a series of training materials prepared for all the relevant stakeholders involved in e-waste management in India. Through this programme and by publication of awareness materials, MeitY aims to develop standardized content for reaching out to the relevant stakeholders.

The focus group of this particular manual are residents of RWAs and localities, a critical and vibrant community of change agents in society. This manual intends to present the subject of e-waste and its multiple facets in a manner that engages citizens in experiential learning about e-waste. The manual uses state of the art methodological approaches such as Harvard Case Methodology and Walker Learning Cycle to enable residents of RWAs and Localities not only learn but also act – as responsible consumers and communicators for environmental change.

The manual uses different methods to achieve the change objective including the Donna E. Walker's 'Learning Cycle' that has five steps including Mind Jog, Personal Connection, Information Exchange, Information Application and Real World Connection. This method takes into account that different learners have different learning abilities and at least one of the steps of the cycle would be able to transfer the learning effectively.

In addition it uses Harvard case method that involves presenting a case to citizens where they associate themselves with a role as they read through the situation and identify the problem. The next step is to perform the necessary analysis to determine the cause and possible solutions to the problem. The manual provides essential information and situations that form cases that can be discussed with the citizens by the trainer.