Digital India
Power To Empower

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Ministry of Electronics
and Information Technology
Government of India

E-Waste Awareness for School Students

Manual for Training of Trainers

(2016)

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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 for students 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 students.

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 students. 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 students.

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

The training provided will increase knowledge amongst students 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 students 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 students 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 students 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 schools to ensure that students 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.

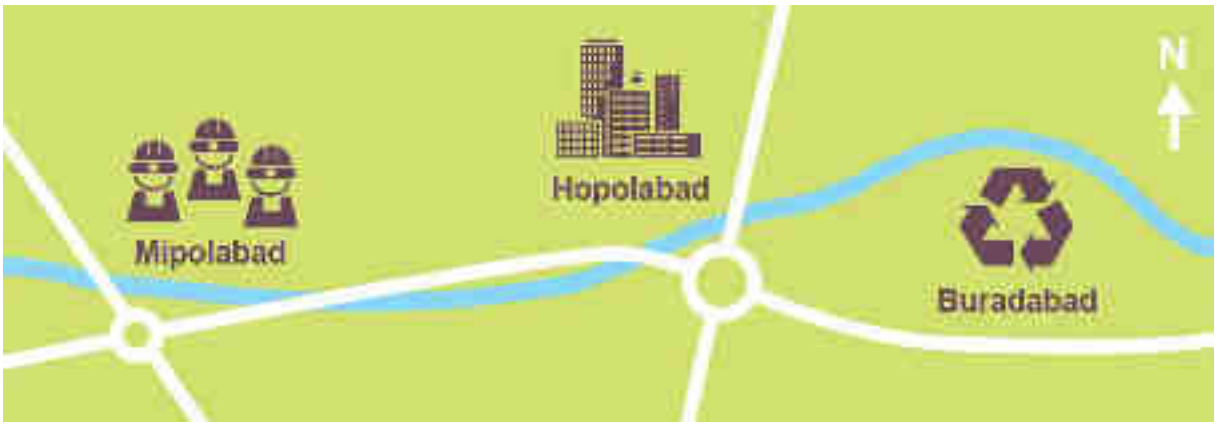
Component 2 is on the learning cycle which has been adopted from the finest techniques available for experiential learning today. The sessions help to unpack the subject at hand and enable to gain a better understanding of solutions in order to solve the problem. It also ensures that engagement is built 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 school students and their respective parents (fathers):

This fictitious conversation is based in the city of Hopolabad. The city of Hopolabad is a business hub and has thriving businesses in the manufacturing and service sectors. Hopolabad shares it borders with Buradabad in the east and Mipolabad on the west. Buradabad is a recycling hub and is dotted with formal recycling industries as well as informal (kabadis in local parlance) shops that extract material from waste. 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:

Dilip: A student of the 9th standard, he has particular interests in gaming and IT applications. He is also interested in acquiring remote operated electronic gadgets. His father has recently bought him a new TV. Dilip is also interested in sports and is a member of the school football team.
Shahid: A classmate of Dilip, Shahid is also interested in gaming. He is also a member of the green club in his school and has gone on day long visits to Mipolabad and Buradabad with the school.

Damodar: He is Dilip's father and is the executive engineer at a mining conglomerate, Prepanta, in Mipolabad. His company is now planning to establish an e-waste recycling facility in Buradabad and he has been tasked to set up the factory.
Iqbal: He is Shahid's father and is the executive engineer at a mining conglomerate, Prepanta, in Mipolabad. His company is now planning to establish an e-waste recycling facility in Buradabad and he has been tasked to set up the factory.

About the conversation:

This conversation has 3 parts to it. Part 1 is the conversation between the parents of 2 students of Hopolabad Community school. These students are the best of friends and keep visiting each others' households. Their fathers interact quite often since both are engineers and alumni from the Hopolabad Community Engineering college in Hopolabad. Iqbal went on to complete his management degree from Hopolabad Management school while Damodar went on to work in a mining company in the nearby town of Mipolabad.

The second part of the conversation is between Iqbal and Shahid while they are returning home after the visit to Dilip's home. This conversation revolves around what Iqbal has learnt about sustainable consumption from Damodar and how he tries to explain the same to Shahid with the perspective of a TV purchase.

The third part of the conversation takes place in the school next day when Shahid and Dilip interact with each other over purchase of the new TV. The conversation is about sustainable lifestyles and how both friends would like to start a collection center in school for e-waste so that it can be recycled properly.

ACT I

Shahid accompanied by his father Iqbal visit his friend Dilip's house in the neighborhood. While discussing how the day had gone by, Damodar and Iqbal, discuss the intense use of resources and effects of mining. Damodar informs Iqbal how their company is slowly moving towards recycling so that they can extract materials from used products rather than using virgin metals which have to mined and extracted from minerals. The conversation last 10 minutes and the scene ends when Shahid and Iqbal prepare to leave for home.

It is 8 pm and the bell rings. Shahid, accompanied by his father Iqbal walk in and are greeted by Dilip.

Dilip: *Good evening, Uncle! How are you doing?*
Iqbal: *I am fine,…how are you doing? Is Daddy back from work?*
Dilip: *Yes Uncle, he's back. I will tell him you are here. Shahid, let's go to my room, while Uncle and Daddy chat.*
Shahid: *Yeah sure. I would anyways like to see your new TV.*

Dilip and Shahid walk out and as they are doing so, Damodar walks into the room.

Damodar: *Hi Iqbal! How are you doing? Long day at work?*

Iqbal: *Yeah, sort of. How about you?*
Damodar: *Its fine, apart from the environment permissions that we are waiting for to start production at a new mine. If we get these clearances soon, then it will be 'Sone pe Suhaaga' moment for us.*
Iqbal*: Is this new mine being commissioned in Mipolabad?*
Damodar: *Yes, it is.*
Iqbal*: Good to know that your company is growing. What kind of ore will you extract from this mine?*
Damodar: *Iron ore primarily. There are also some mica deposits which have been discovered in the geological survey. Apparently there are huge deposits and once the mine starts operating at full capacity, we should see double digit growth of the company for the next 10 years.*
Iqbal: *Ah! Business is booming which means. Calls for a celebration in that case.*
Damodar*: Yeah we will, but I am just keeping my fingers crossed on the environment clearances as I mentioned.*
Iqbal: *Procedural hassles huh. But tell me, where does all this ore get used up?*
Damodar: Oh, there is a huge demand for minerals in our country. Any item which is manufactured needs raw materials.
Iqbal*: So that would mean that the more products we demand, we are contributing to the growth of your company (chuckles)*
Damodar*: Yes, of course. But on the other hand you are also consuming more resources.*
Iqbal*: What would that mean and how does it matter?*
Damodar: *You see all the resources that we mine are ultimately finite. These will end some day. What will we do then? We might not finish everything in our lifetime but then how much we will leave for our children should matter to us as well. Don't you think so?*
Iqbal: *Yes I agree. Hadn't thought of it in that manner. But then again whatever we buy is basis our needs. So should we stop buying things completely?*
Damodar: *Of course not. We would then go out of business (chuckles). But on a serious note, a lot of the things that we buy are lifestyle purchases.*
Iqbal*: What do you mean by lifestyle purchases?*
Damodar*: I will give you an example. You see all these flat screen TV's these days. Just 10 years ago, we used to watch TV on a CRT monitor. But slowly as the flat screen LCD, LED and Plasma screen TVs came around we switched to them.*
Iqbal: *Yes we did. But then the picture quality of these TVs is far better than the CRT TVs. Isn't it?*
Damodar: *Agreed. You see what I am trying to say is that if the CRT would have gone bust and then one would purchase a new one, then it would be termed as a need. But just replacing a working TV with something which offers better technology is something which I would refer to as a lifestyle purchase.*

Iqbal*: Ok I get your point. But one gets value for an old TV as well and that is watched by someone who purchases it second hand. Isn't it?*
Damodar: *Agreed. But you see every product has a lifecycle, especially electronic products. Some electronic products have a higher life cycle, like a TV, refrigerator or airconditioner, while some have a smaller one like mobile phones, laptops and computers. But it is important to bear in mind that all of these are made up of resources which are finite. Hence we must always try and use these products responsibly.*
Iqbal*: This is very interesting Damodar. I never thought about such things in this way. But how did you come across this information.*
Damodar*: You see my company realised that there is amazing potential in sourcing metals from products which have reached their end of use. We planned about a year ago on setting up a recycling factory which will try and recover as much material as possible from electronic products which have been discarded by their respective owners and extract metals from them.*
Iqbal*: So when and where is this factory coming up?*

Damodar: *You see in our neighbourhood, Buradabad has huge potential for recycling. We planned to set the factory there. It should come up by the end of this year.*
Iqbal*: What are the kinds of metals that you can recover from electronics? All I can think of are plastics and some aluminium and steel.*
Damodar: *You will be amazed to know that a computer contains precious metals like gold and silver. There are also some rare metals in electronic items which are scarce and hence command a really high price like platinum and molybdenum.*
Iqbal: *I am amazed to know that. This has been a really informative conversation Damodar. I think its time we head home. Can you call for Shahid please?*

Damodar calls for Dilip and Shahid and they walk into the room.

Iqbal: *Come Shahid, lets leave. Its time to go home and have dinner.*
Damodar: *Thank you for dropping in and we shall catch up again soon.*
Dilip: *Bye Shahid! Bye uncle! We shall catch up in school tomorrow.*

(ACT I completed)

ACT II

The next conversation takes place in the car between Iqbal and Shahid. Shahid has seen the new TV that has been purchased by Dilip and is very impressed. He tells Iqbal about the same and Iqbal brings up the thought of purchasing a new TV for their home as well. Shahid tries to convince him otherwise and talks about things he has learnt from Damodar and Dilip. Shahid then shares with Iqbal that he and Dilip are planning to set up a collection center for e-waste in school and will be making a presentation on the same next week to the Green club which they are a part of. The conversation ends with Iqbal congratulating Shahid.

Its 8.30 pm when Iqbal and Shahid leave from Damodar and Dilip's house. Shahid sits in the passenger seat with Iqbal on the driving seat when they get chatting.

Iqbal: *So what were you and Dilip discussing*
Shahid: *Dilip has just purchased a new flat screen TV for his room. It has HD picture. We were just watching a movie and the picture quality was so very good Dad.*
Iqbal: *Yeah I have heard about these new TVs as well which have HD picture quality. I was planning to get one for our drawing room as well.*
Shahid*: But the present TV is working fine dad. Why would we want a new one?*
Iqbal*: Hmmn. That just reminds me of the conversation that I had with Damodar a short while ago.*
Shahid*: Were you guys discussing about buying a new TV dad?*
Iqbal*: No, it was about electronic waste and what happens after we dispose off our old electronic products.*
*Shahid**: Yeah me and Dilip have learnt a lot from uncle on this subject.*
Iqbal: Wow. You never told me anything about that son.
Shahid*: Hardly get to spend time with you dad other than our maths sessions every weekend.*
Iqbal: *Yeah true. So what are you doing with what you have learnt*
Shahid*: As part of the Green club, of which I am a member, me and Dilip are preparing a presentation*

Iqbal: *On e-waste?*
Shahid: *Yes dad, and how we should try and dispose off our e-waste.*
Iqbal: *How to dispose off e-waste? Is it so important that one needs to learn to dispose off something which is waste?*
Shahid: *Yes dad. E-waste has a lot of hazardous substances which are a health hazard for humans as well as cause grave pollution to the environment. It is very important that it is disposed off in a proper manner so that these risks can be mitigated.*
Iqbal: *But how does it become a health hazard son. I still don't understand.*
Shahid: *You see dad, in Buradabad, there are a lot of people who work with waste. They take all the material and try to extract metals from e-waste by using acid baths which cause a great deal of pollution. This is a health hazard for them as well and causes environmental pollution.*
Iqbal: *Oh, that's such a bad thing to do. But why do they do this?*
Shahid: *It is their livelihood dad, which is why they do it. Also they have a lot of access to material since they collect door to door and we as citizens are not aware of proper disposal practices.*

Iqbal: *I am very happy you are working on such an important subject. When is the presentation?*
Shahid: *Its next week dad.*
Iqbal: *And who are you presenting it to?*
Shahid: *Well to start with it would be to the Green club members and some teachers and the principal as well.*
Iqbal: *That's good. And what do you guys want to present.*
Shahid: *We are trying to pitch for setting up of an e-waste collection center in our school.*
Iqbal: *Wow. That would be great. But the target group would be students.*
Shahid: *Yes dad, which is why we are also planning to make it interesting for them. Me and Dilip are travelling with Damodar uncle on the weekend to Buradabad. We will be making a short video on how people are working with e-waste and when we present to the group, we would like to take them through the video as well.*
Iqbal: *Once you shoot that video, show it to me as well. Let me see if I can take the RWA members through the same too.*
Shahid: *Yeah dad I will.*
Iqbal: *Home's here. Lets go and enjoy our dinner.*

(ACT II completed)

ACT III

In ACT III Dilip and Shahid meet at school and discuss the idea of the presentation where they want to talk about setting up a collection center in school.

Its 11 am the next day and time for a short recess in school. Dilip and Shahid get chatting with other members of the Green club to discuss the details of the presentation.

Dilip: *Good morning! (The room echoes with a good morning)*
Shahid: *Friends, we have come up with the presentation on electronic waste and it effects and why we need to set up a collection center in school for e-waste.*
Dilip: *We will also be going across to Buradabad with my dad over the weekend to shoot a small video which we will then show in the assembly next week.*

Shahid*: So coming back to the presentation, we have first introduced what is electronic waste for those who would have very little idea about the subject. Then we move on to hazardous substances in electronic waste and finally we come to setting up the collection center for e-waste.*
Dilip: *But before we come to that, we will be showing the video that we shoot so that students and teachers are aware of the environmental issues surrounding e-waste.*
Shahid: *Yeah and the final bit would be about the carbon footprint that we leave when we consume resources so that we become responsible towards whatever we purchase and whenever we dispose off such items.*
Dilip: *So how does everyone feel about this structure?*
All: *We think its fine, lets take this step and I am sure many people around us will learn from this as well.*
Shahid: *We also have plans to organise essay competitions, quiz shows and drawing and painting competitions amongst students.*
All*: That would be so good.*
Dilip: *Yeah, the idea is that we should all be able to take back these learnings and talk to our parents as well.*
Shahid*: Yeah, that's the idea.*
Dilip: *In fact, I think we should also try and train our teachers so that they are able to talk about this subject to our fellow students in the EWS class.*
All: *Yeah that would be fantastic and will help everyone learn about the same.*
Shahid: *Thank you everyone for the encouragement. The bells rung and its time to run back to class. (Everyone leaves)*

(ACT III completed)

Dilip and Shahid have now set up a collection center in school with the help of their friends from the Green club and the blessings of the school principal. Dilip and Shahid have conducted a training for teachers on what they need to speak to students about while disposing e-waste and the hazards of improper recycling of e-waste. The school has managed to collect about 300 kgs of e-waste in the first month itself. Kudos to Dilip and Shahid on this beginning to save the environment and our planet.

4. References:

a) Resource consumption

It is an umbrella term for the many different ways and rate at which 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. Non-renewable resources are those that cannot be replenished or made again in a short duration and may take billions of years to be made again for example fossil fuels that provide energy, metal ores used to manufacture cars and computers etc (FOE, 2005).

Due to the finite nature of fossil fuels and metals it is likely that we will run out of these resources in future as highlighted in the chart below:

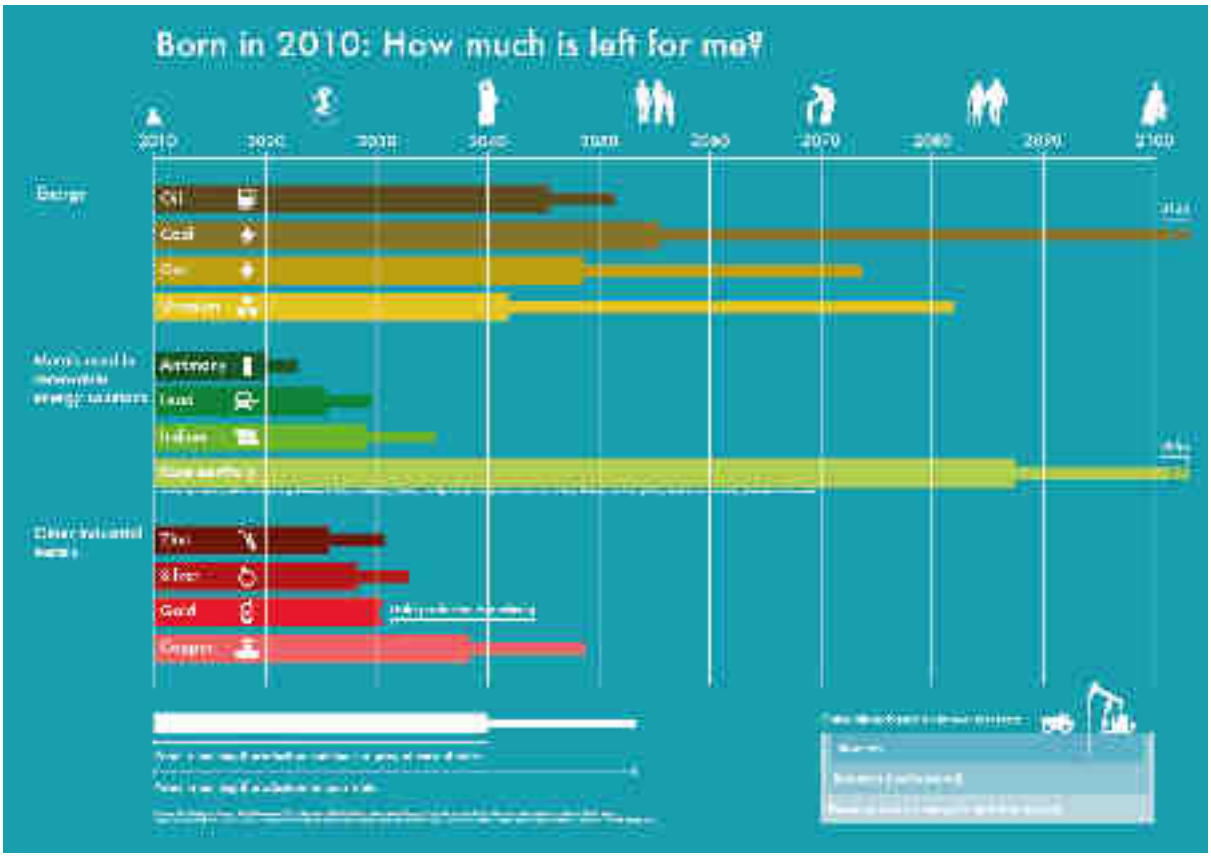


Figure 1: Resource consumption over the years

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

Figure 2: 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_Resource.pdf

Over consumption: 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/

b) LOHAS and how to draw a personal action plan of LOHAS:

LOHAS:

LOHAS is an 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 homeware, domestic rainwater tanks, sustainable timber, 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 their 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 known, 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 costs more than the computer with high percentage of harmful materials and no use of recycled plastics.

For tackling the 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 processes 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

c) 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 3: 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 the first computer made with plastics from recycled old electronics.

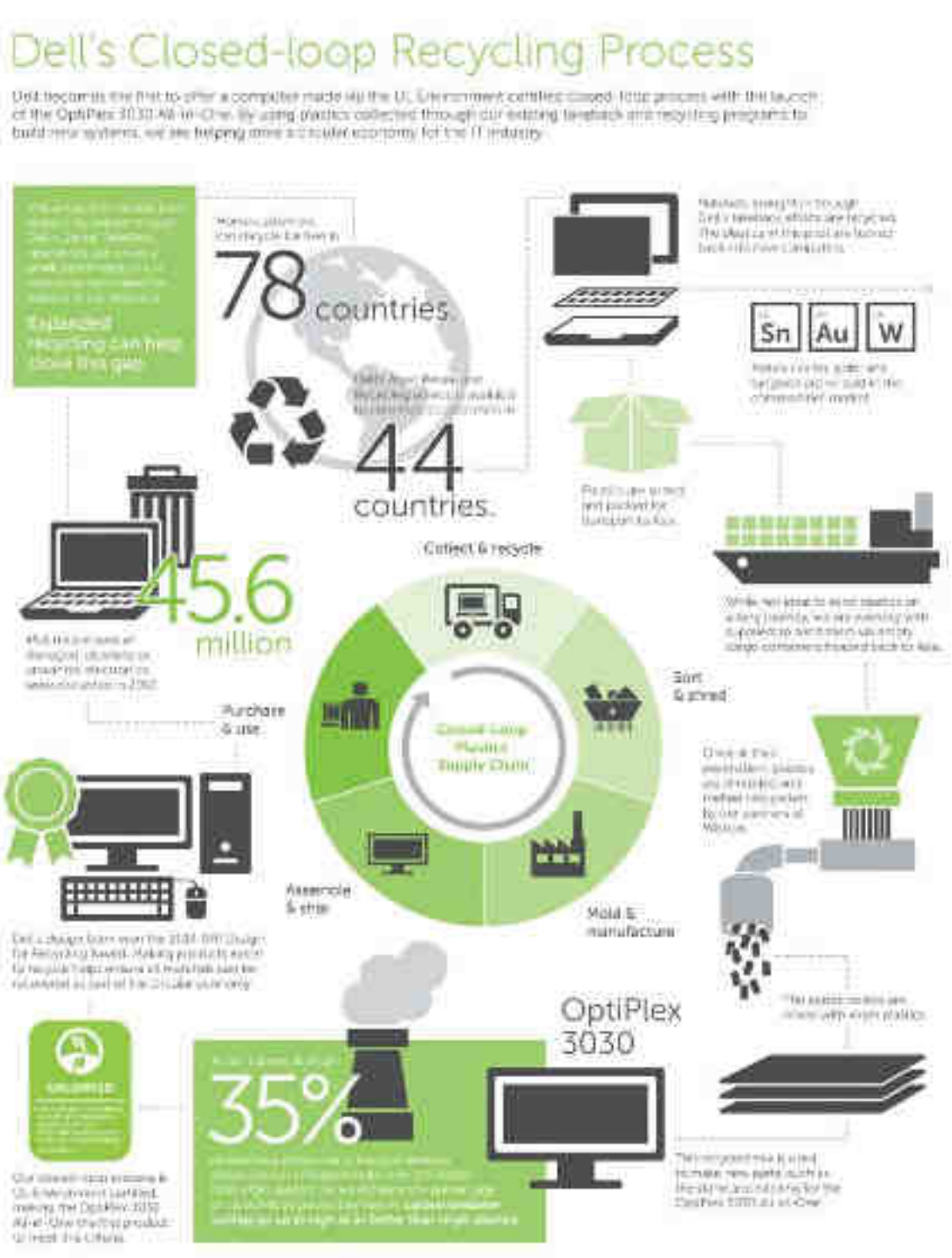


Figure 4: Closed loop recycling process

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/

d) Electronic waste or e-waste and related information:

Electronic waste

'e-waste' means electrical and electronic equipment, whole or in part discarded as waste by the consumer or bulk consumer as well as rejects from manufacturing, refurbishment and repair processes;

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

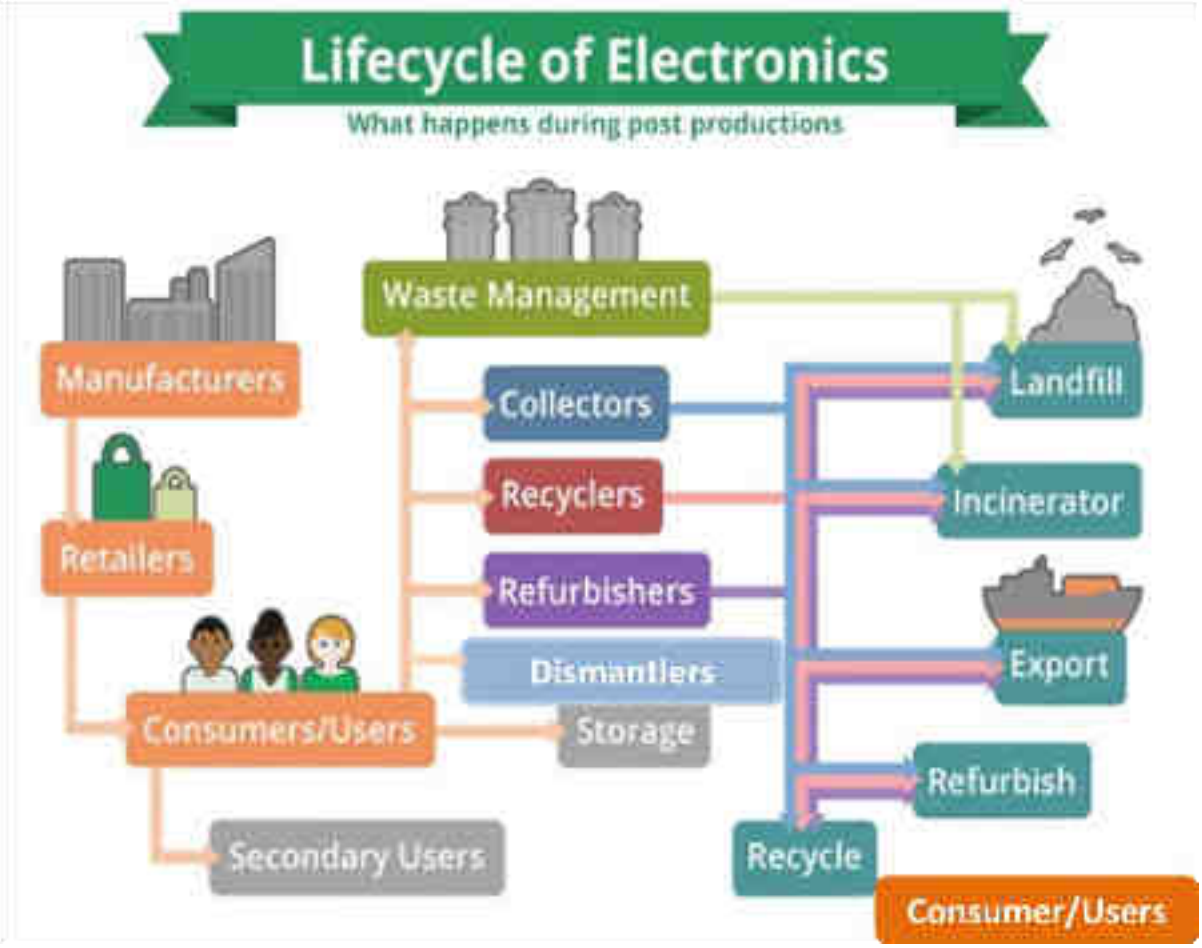


Figure 5: Lifecycle of Electronics
(Source: http://greatforest.com/sustainability101/uncategorized/e-waste-recycled-video/)

Main contributors to e-waste

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 rate. The increasing "market penetration" in developing countries, "replacement market" in developed countries and "high obsolescence rate" make WEEE/E-waste one of the fastest growing waste streams. Main contributors of e-waste 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.

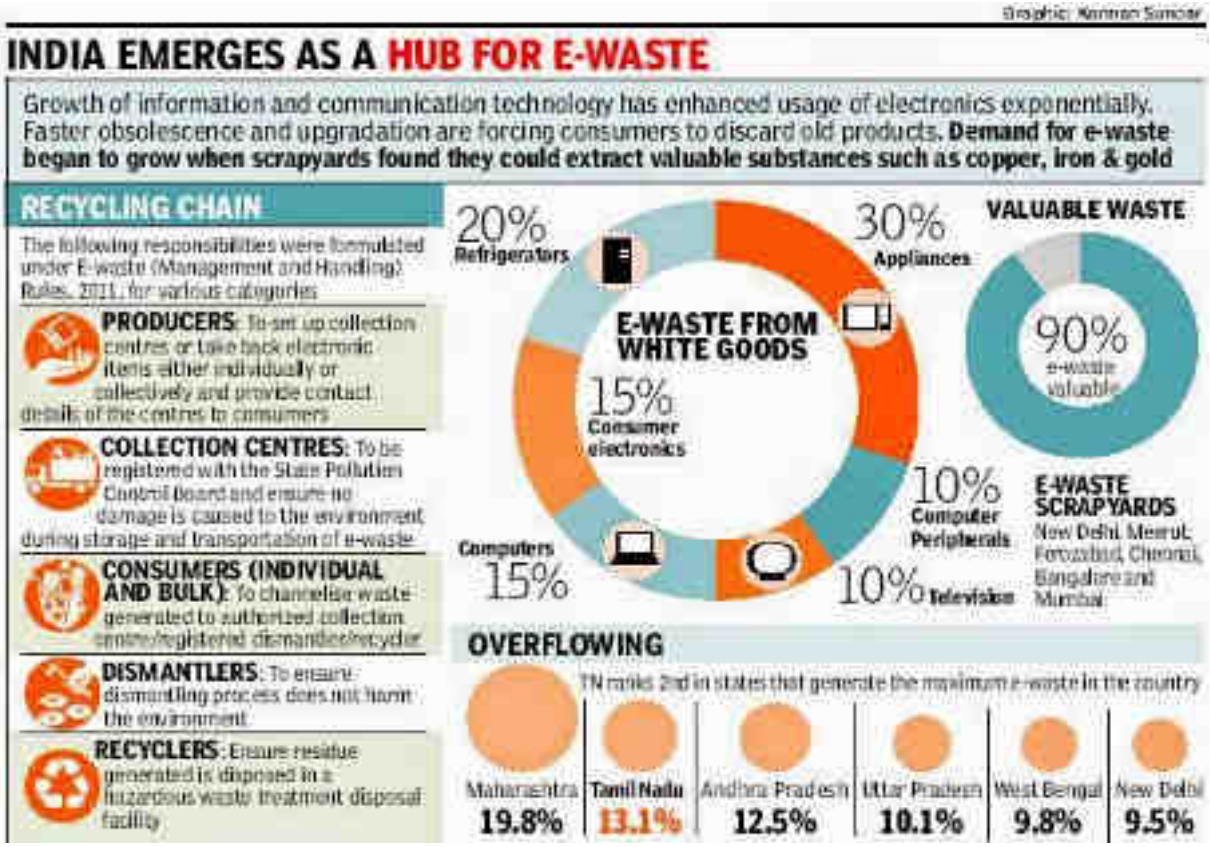


Figure 6: e-waste generation in India

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 7: e-waste generation across the world

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, aluminum 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

How to dispose e-waste

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

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

[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;

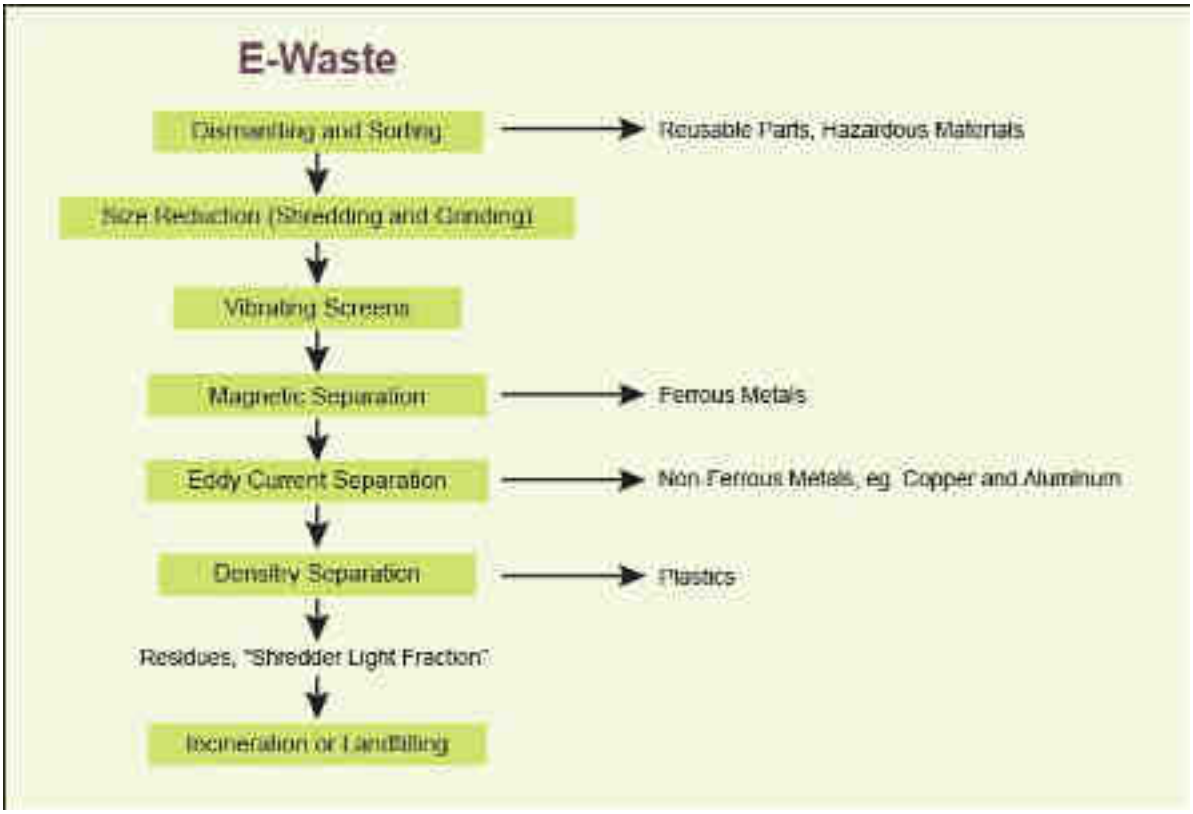


Figure 8: Treatment of e-waste

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

Central Pollution Control Board (CPCB)
http://cpcb.nic.in/

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.

Constituents of E-Waste

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 printers, keyboards, monitors etc	Plasticizer bisephenol-A(or BPA) as well DEHP and DBP Plastic compound known as phthalates	Chlorinated plastic 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.	Risk in developing 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

Source:
Indian Central Pollution Control Board 2008

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

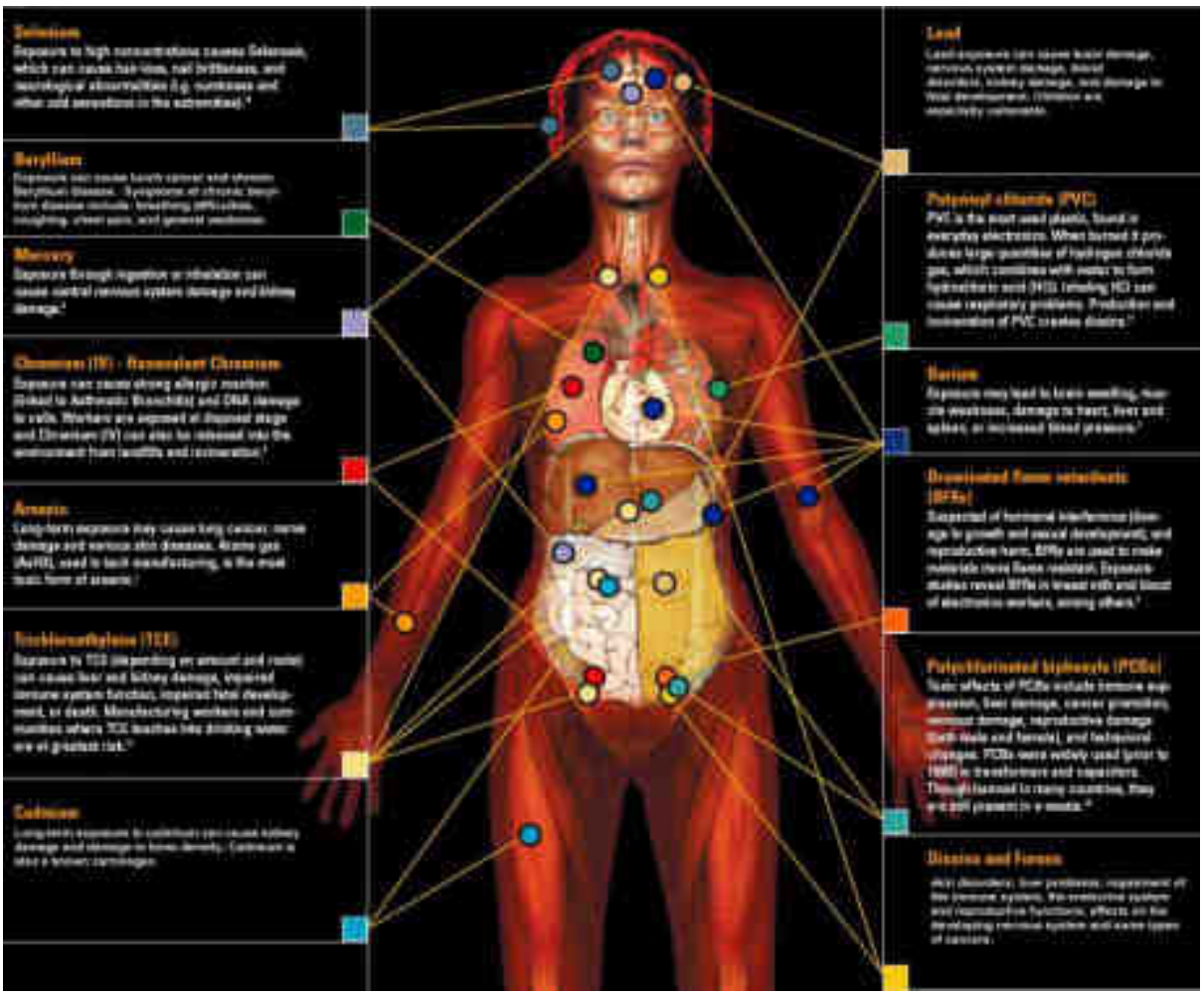


Figure 9: Adverse Impact of e-waste

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

Table 5: Recoverable quantities of elements in a TV (CSE Manual)

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

Table 6: Average weight and composition of WEEE of selected EEE commonly used

Appliances	Average weight(kg)	Iron(Fe) % weight	Non-Fe % metal weight	Glass % weight	Plastic % weight	Electronic component % weight	Others % weight
Refrigerators and freezers	48	64.4	6	1.4	13		15.1
Washing machine	40 to 47	59.8	4.6	2.6	1.5		31.5
PC	29.6	53.3	8.4	15	23.3	17.3	0.7
TV sets	36.2	5.3	5.4	62	22.9	0.9	3.5
Cellular phones	0.08 to 0.1	8	20	10.6	59.6		1.8

Source:
UNEP E-waste Assessment manual Vol I (1) Data compiled from waste from electrical and electronic equipment (WEEE)

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

The E-waste Management Rules specifies '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 in the rules. This 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

Example of how this can work for a Television is:

1. TV manufacturer ensures that restriction regarding hazardous substances is complied with. In addition an authorized collection center and recycling plant has been identified for the product.

2. The consumer purchases the product under "Deposit Refund Scheme" and is told that he is supposed to return the TV after he or she thinks it is to be discarded at any of the authorized e-waste collection centers of the company.

3. Even if the user has purchased the TV before the DRS mechanism was established the manufacturer must take back the discarded TV through its collection center and ensure it is recycled and non-recyclable components are disposed in an environmentally safe manner.

4. Once the consumer returns the TV at the collection center he is paid back the deposit he made at the time of purchase.

5. From the collection center the TV is sent to the dismantler who can also be a recycler.

6. The dismantled components of the TV undergo primary, secondary and tertiary treatment processes to extract useful materials. That may include the following processes for CRT based TV:
    - Cathode ray tube (CRT) glass contains a high concentration of lead. This means it can't go back into the normal glass recovery process like glass bottles. CRT glass is typically crushed and cleaned. Some CRT glass is used in manufacturing new television and computer monitors, but the move to LCD and plasma televisions means that new technologies and processes are being found to reuse this material.
    - Circuit boards are shredded down to a fine powder and separated into plastics and precious metals. This material can be reformed into a range of products.
    - Plastic casings are shredded and tested for their composition. Once identified, the plastics can be melted and extruded for use in new products.
    - Scrap metals are typically melted down to form new metal-based components.

7. The recycled plastics, metals and other substances are either sent for reuse to the industry or the components that cannot be reused or recycled are disposed in safe disposal sites.

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

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.

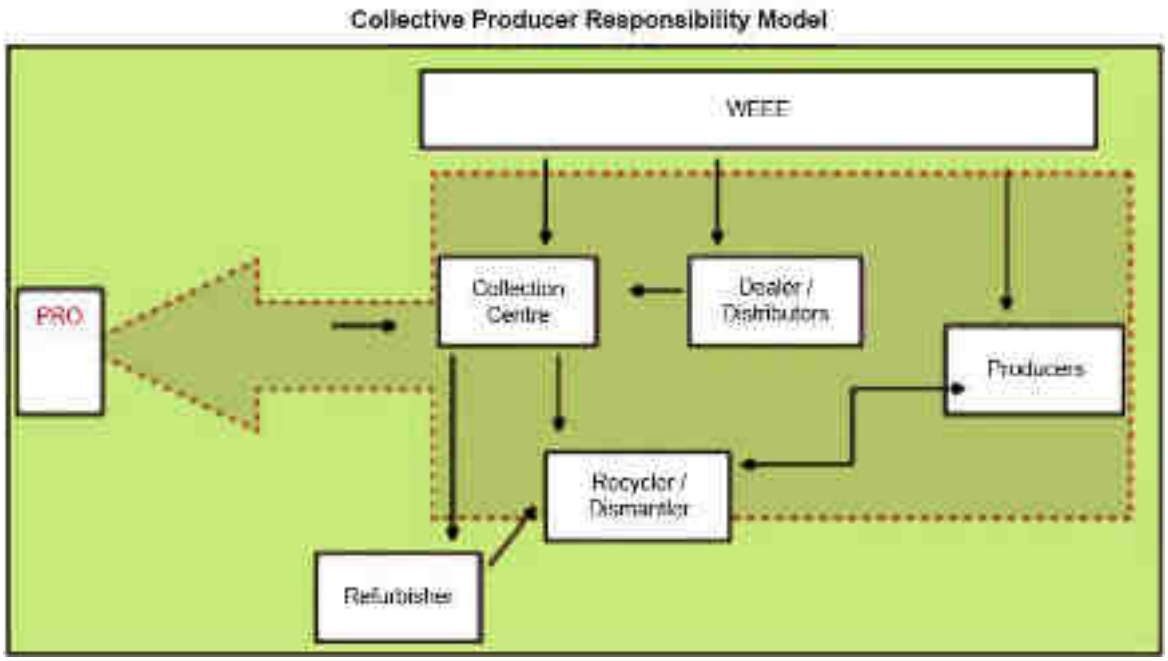


Figure 10: Collective Producer Responsibility Organisation (PRO) Model representation with role of collection center

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.

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 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.

e) 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/

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 • 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 – Policy for e—waste management in India • Theme 4 - Sustainable consumption	Discussion	1 hour

	and Lifestyles of health and sustainability (LOHAS) • Theme 5 Disposal and Recycling of e-waste • Theme 6 Carbon footprint and its reduction		
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. It's 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 Handout 1.1 What is e-waste? Handout 1.2 What are the 10 categories of e-waste? Handout 1.3 Generation of e-waste globally	**INSTRUCT:** Read the case study in small groups with participants reading the part of different characters **Damodar:** *You see my company realised that there is an amazing potential in sourcing metals from products which have reached their end of use. We planned about a year ago on setting up a recycling factory which will try and recover as much metals as possible from electronic products which have been discarded by their respective owners.* **Iqbal:** *So when and where is this factory coming up?*

Handout 1.4 Generation of e-waste in India 	**Damodar:** *You see in our neighborhood, Buradabad has huge potential for recycling. We planned to set the factory there. It should come up by the end of this year.* **Iqbal:** *What are the kinds of metals that you can recover from electronics? All I can think of are plastics and some aluminum and steel.* **Damodar:** *You will be amazed to know that a computer contains precious metals like gold and silver. There are also some rare metals in electronic items which are scarce and hence command a really high price like platinum and molybdenum.* **Iqbal:** *I am amazed to know that. This has been a really informative conversation Damodar.* **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: Theme 1 – Introduction to e-waste Theme 2 –Harmful effects of e-waste on human health and environment Theme 3 – Policy for e—waste management in India Theme 4 - Sustainable consumption and Lifestyles of health and sustainability (LOHAS) Theme 5 - Disposal and Recycling of e-waste Theme 6 - Carbon footprint and its reduction
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 it's 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, 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.	Case study	1 hour
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	Group work	1 hour

	• 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.		
I rld t	**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?
R - 	**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	**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

in e-waste Handout 2.2 Health impacts of e-waste Handout 2.3 Methods of treating e-waste 	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. **Shahid:** *Were you guys discussing about buying a new TV dad?* **Iqbal:** *No, it was about electronic waste and what happens after we dispose off our old electronic products.* **Shahid:** *Yeah me and Dilip have learnt a lot from uncle on this as well.* **Iqbal:** *Wow. You never told me anything about that son.* **Shahid:** *Hardly get to spend time with you dad other than our math's sessions every weekend.* **Iqbal:** *Yeah true. So what are you doing with the learnings* **Shahid:** *As part of the Green club, of which I am a member as you know, me and Dilip are preparing a presentation* **Iqbal:** *On e-waste?* **Shahid:** *Yes dad, and how we should try and dispose off our e-waste.* **Iqbal:** *How to dispose off e-waste? Is it so important that one needs to learn to dispose off something which is waste?* **Shahid:** *Yes dad. E-waste has a lot of hazardous substances which are a health hazard for humans as well as cause grave pollution to the environment. It is very important to it is disposed off in a proper manner so that these risks can be mitigated.* **Iqbal:** *But how does it become a health hazard son. I still don't understand.* **Shahid:** *You see dad, in Buradabad, there are a lot of people who work in waste. They take all the material and try and extract metals from e-waste by using acid baths which cause a great deal of pollution. This is a health hazard for them as well as causes environmental pollution.*
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 in order to generate a discussion with adolescents 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	**INSTRUCT**

CONNECT	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** It's 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 the e-waste policies and rules in India, responsibilities of different stakeholders and challenges in policy implementation.

Session 3: What are the Policies for E-waste Management in Our Country?

Purpose

This session seeks to build an understanding of the participants about the policies and rules governing e-waste in India. The session also helps participants identify the responsibilities of different stakeholders for effective implementation of the rules.

Session Objectives

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

Explain the policy, rules and important terms used in the Rules and their definition

Explain their responsibility as an e-waste facilitator and also the responsibility of other stakeholder groups for the implementation of the Rules

Identify the challenges in implementing the Rules

Summary Session Plan

Flow Step	Description	Methodology/ Tools	Duration
Mind Jog	**Connecting with the session objective** Quiz about the rules and policies **(Prepare a quiz with 6 questions)**	Quiz	20 minutes
Personal Connect	**Reflecting on personal responsibility as an e-waste training facilitator** My responsibility as an e-Waste training facilitator…..	Individual reflection	30 minutes
Information Exchange	**Defining different policies and rules wrt e-waste** 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. Sharing about e-waste policy by experts (1 speaker from the formal and another from the informal sector)	Case study Speakers	1 hour
Information Application	**Identifying different stakeholders** Group processing of the case study to identify the policy /rules for e-Waste • Make 4 small groups • Participants share individual written thoughts in small groups • As a group discuss the case study and bring out Policies/rules wrt e-waste in India • Each group presents to the larger group the policy/rules based on the case study.	Group work	1 hour

	• The facilitator sums up the discussion by sharing the policy /rules with the participants Based on your understanding of e-waste thus far create a list of 5 questions as a group. This is followed by group presentations of questions and also responses from the participants		
Real World Connect	**Exploring the importance of policy and rules in regulating e-waste** Read about the policies from other countries to do a comparative analysis- Facilitator to give suggested readings.		10 mins

MIND JOG	**STATE:** Before we begin our session let's take a quick quiz **EXPLAIN:** • Please be ready with a paper and pencil • There will be total five questions • I will not repeat any of the questions • Maintain complete silence till the quiz gets over. You will write the responses to the questions and not speak about it **ASK:** • 'Are you ready?' If they are ready you begin administering the quiz Just wait for about half a minute between each question After asking all the questions then you can discuss the answers Clarify all the answers using the quiz paper
	ASK: How many of you have got more than five? Appreciate them quickly and… **ASK:** What do you think the quiz was about? **EXPLAIN:** • This quiz was about e-waste
PERSONAL CONNECT	**ASK:** What is your responsibility as an e-waste Facilitator? **EXPLAIN:** As e-waste facilitator what is your responsibility to uphold the rules and policy of the state
INFORMATION GE 3.1 National ent Policy Handout 3.2 e-waste (Management) Rules 2016	**INSTRUCT:** 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

Handout 3.3 Challenges of implementing the Rules	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 **Iqbal:** *But how does it become a health hazard son. I still don't understand.* **Shahid:** *You see dad, in Buradabad, there are a lot of people who work in waste. They take all the material and try and extract metals from e-waste by using acid baths which cause a great deal of pollution. This is a health hazard for them as well as causes environmental pollution.* **Iqbal:** *Oh, that's such a bad thing to do. But why do they do this?* **Shahid:** *It is their livelihood dad, which is why they do it. Also they have a lot of access to material since they collect door to door and we as citizens are not aware of proper disposal practices.* **Iqbal:** *I am very happy you are working on such an important subject. When is the presentation?* **Shahid:** *Its next week dad.* **Iqbal:** *And who are you presenting it to.* **Shahid:** *Well to start with it would be to the Green club members and some teachers and the principal as well.* **Iqbal:** *That's good. And what do you guys want to present.* **Shahid:** *We are trying to pitch for setting up of an e-waste collection center in our school.*
INFORMATION APPLICATION	**INSTRUCT:** Group processing of the case study plus the talks with the practitioners to identify the policy /rules available in the country Group processing of the case study to identify the policy /rules for e-Waste • Make 4 small groups • Participants share individual written thoughts in small groups • As a group discuss the case study and bring out policies/rules wrt e-waste in India • Each group presents to the larger group the policy/rules based on the case study. • The facilitator sums up the discussion by sharing the policy/ rules with the participants Based on your understanding of e-waste thus far create a list of 5 Questions as a group which adolescents may ask when you facilitate the session with them. This is followed by group presentations of questions and also responses from the participants
REAL WORLD CONNECT	Read about the policies from other countries to do a comparative analysis

Session 3 and Session 4
Transition Note:

In the last three sessions we have learnt about the concept of e-waste, harmful effects and also polices and rules governing the sector in India to address and manage the e-waste problem in the country. In this session, we will discuss sustainable consumption and lifestyles of health and sustainability.

Session 4: Sustainable consumption and Lifestyles of Health and Sustainability (LOHAS)

Purpose

This session seeks to give an introduction into Sustainable consumption and Lifestyles of Health and Sustainability (LOHAS).

Session Objectives

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

- Explain sustainable consumption and Lifestyles of Health and Sustainability
- Explain the interconnections between sustainable consumption and e-waste

- To apply strategies to mitigate e-waste in personal life

Flow Step	Description	Methodology/ Tools	Duration
Mind Jog	**Linking personal experiences of consumption and lifestyles with e-waste** My favorite gadget (ask people to place their watches/ phones/calculators in the centre) – participants need to pick up their favorite gadget and share the reason for choosing the same(We choose things because of appearance, brand, popularity, price) **OR** 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 Videogame	Game	10 minutes
Personal Connect	**Reflecting on personal choices** Ask each participant to write down the purpose of their favorite gadget and how it eases their life	Reflection and Group work	30 mins
Information Exchange	**Defining sustainable consumption and Lifestyles of Health and Sustainability (LOHAS)** 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	Group Work	1 hour

	have at least read it before they come and this is only a refresher.		
Information Application	**Learning about the strategies to mitigate e-waste** Group processing of the case study to identify sustainable consumption and LOHAS • Make 4 small groups • Participants share individual written thoughts in small groups • As a group discuss the case study and bring out sustainable consumption and LOHAS • Each group presents to the larger group the sustainable consumption based and LOHAS on the case study. • The facilitator sums up the discussion by sharing the sustainable consumption and LOHAs with the participants Group processing: Design a sustainable campaign objectives of the campaign, expected outcomes , stakeholders, plan to make it happen	Individual work on project and self	1 hour
Real World Connect	**Linking self-learnings with experiences of others** Collect stories of sustainable consumption from your community	Template for collecting stories	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 favorite gadget and how it eases their life
INFORMATION EXCHANGE Reference 4.1: LOHAS	**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. **Damodar:** *I will give you an example. You see all these flat screen TV's these days. Just 10 years ago, we used to watch TV on a CRT monitor. But slowly as the flat screen LCD, LED and Plasma screen TVs came around we switched to them.* **Iqbal:** *Yes we did. But then the picture quality of these TVs is far better than the CRT TVs. Isn't it?* **Damodar:** *Agreed. You see what I am trying to say is that if the CRT would have gone bust and then one would purchase a new one, then it would be termed as a need. But just replacing a working TV with something which offers better technology is something which I would refer to as a lifestyle purchase.* **Iqbal:** *Ok I get your point. But one gets value for an old TV as well and that is watched by someone who purchases it second hand. Isn't it?* **Damodar:** *Agreed. But you see every product has a lifecycle, especially electronic products. Some electronic products have a higher life cycle, like a TV, refrigerator or air conditioner, while some have a smaller one like mobile phones, laptops and computers. But it is important to bear in mind that all of these are made up of resources which are finite. Hence we must always try and use these products responsibly.* **Iqbal***: This is very interesting Damodar. I never thought about such things in such minute detail. But how did you come across this knowledge.*
INFORMATION APPLICATION	**SAY:** Group processing of the case study to identify sustainable consumption and LOHAS • Make 4 small groups • Participants share individual written thoughts in small groups • As a group discuss the case study and bring out sustainable consumption and LOHAS • Each group presents to the larger group their understanding on sustainable consumption and LOHAS based on the case study. • The facilitator sums up the discussion by sharing the sustainable consumption and LOHAs with the participants Group processing Design a sustainable campaign objectives of the campaign, expected outcomes, stakeholders, plan to make it happen

	Design and run a sustainable campaign – (IEC material – posters, mugs , batches) objectives of the campaign, expected outcomes, stakeholders, plan to make it happen.
REAL WORLD APPLICATION	Collect stories of sustainable consumption from your community

Session 4 and Session 5
Transition Note:

Thus far the curriculum has focused on building the understanding the participants on the concept of e-waste, impact of e-waste on health and environment, sustainable consumption and lifestyles of health and sustainability. Going forward, this session will delve deep into understanding the strategies for disposing of e-waste in an environmentally sound manner.

Session 5: 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:

- 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

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 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	Group Work	1 hour
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	Individual work on project and self	1 hour

	with the participants Exposure to a collection facility to understand the setting up and implementation of the collection centre		
Real World Connect	**Exploring the importance of collection centres:** Design a collection drive to be set-up and rolled in the school with adolescent groups		20 mins

MIND JOG	**ASK:** Participants to place their watches/ phones / calculators 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 favorite gadget and how it eases their life
INFORMATION EXCHANGE Ref. 5.1 List of dos and don'ts for setting up of the collection centres Ref. 5.2 Managing a collection centre Ref. 5.3 List of agencies which can support you in organizing such a collection and	**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. ***Shahid****: Well to start with it would be to the Green club members and some teachers and the principal as well.* ***Iqbal****: That's good. And what do you guys want to present.* ***Shahid****: We are trying to pitch for setting up of an e-waste collection center in our school.* ***Iqbal****: Wow. That would be great. But the target group would be*

awareness drive Ref. 5.4 List of e-waste collection centres in your city	*students.* ***Shahid**: Yes dad, which is why we are also planning to make it interesting for them. Me and Dilip are travelling with Damodar uncle on the weekend to Buradabad. We will be making a short video on how people are working with e-waste and when we present to the group, we would like to take them through the video as well.* ***Iqbal**: Once you shoot that video, show it to me as well. Let me see if I can take the RWA members through the same too.*
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 run a sustainable campaign – (IEC material – posters , mugs , batches) objectives of the campaign , expected outcomes , stakeholders, plan to make it happen.
REAL WORLD APPLICATION	One personal action I will take which will help in accomplishing LOHAS

Session 5 and Session 6

Transition Note:

This session will introduce the participants to the concept of carbon footprint, understand the life-cycle of the product and how carbon footprint is created at various stages including sourcing, production, consumption and disposal

Session 6: What is Carbon Footprint? How to Measure Carbon Footprint?

Session Duration: 3 hours

Purpose

This session seeks to give an introduction into carbon footprint and how to measure carbon footprint.

Session Objectives

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

- Explain carbon footprint
- Explain the interconnections between production, consumption and recycling
- To apply strategies to mitigate carbon footprint in personal life

Flow Step	Description	Methodology/ Tools	Duration

Mind Jog	**Introduction to carbon footprint** Make 25 labels of different electronic products - toaster, mobile, car, laptop, refrigerator, fan, AC, iron, microwave, electric kettle, washing machine, music system, dvd player…… paste it on the back of each participant. Each participant has to guess what label is pasted on his/her back. They can ask only 2 questions (function of the product and how it eases life). The person who finds out first will be declared the winner.	Game	20 minutes
Personal Connect	**Linking personal lifestyle with carbon footprint** Now make a daily timetable for yourself and list down the products which you use in your daily life in home, school with friends and for entertainment. Sharing in small groups.	Reflection and Group work	30 mins
Information Exchange	**Understanding the dimensions of carbon footprint** 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. Explain the process of calculating the carbon footprint……. Encourage the participants to calculate the same.	Group Work	1 hour
Information Application	**Understanding the importance of reducing carbon footprint** Group processing of the case study to understand what is carbon footprint and how to measure the same Make 4 small groups Participants share individual written thoughts in small groups As a group discuss the case study and build understanding about carbon footprint Each group presents to the larger group their understanding of carbon footprint	Individual work on project and self	1 hour

	based on the case study. The facilitator sums up the discussion by sharing what is carbon footprint and how does one measure carbon footprint with the participants Ask the participants to refer back to your timetables and measure the carbon footprint which you create on a daily basis.		
Real World Connect	**Reflecting on ways to mitigate carbon footprint** One action that you will take in personal life which will help mitigate carbon footprint in the environment.		20 mins

MIND JOG	**ASK:** Participants to stand in a circle **INSTRUCT:** Each one of you will have sticker on your back. The task is that you have to find out what is written on your back by asking relevant questions. You can ask only 2 questions per person. Now please keep moving in the room……
PERSONAL CONNECT	Ask each participant to write down the purpose of their favorite gadget and how it eases their life
INFORMATION EXCHANGE Ref. 6.1 What is carbon footprint Ref. 6.2 How to measure carbon print? Ref. 6.3 What are the strategies to reduce carbon footprint?	**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 they have at least read it before they come and this is only a refresher. Explain the process of calculating the carbon footprint……. Encourage the participants to calculate the same. **Dilip:** *But before we come to that, we will be showing the video that we shoot so that students and teachers alike are aware of the environmental issues surrounding e-waste*. **Shahid:** *Yeah and the final bit would be about the carbon*

	footprint that we leave when we consume resources so that we become responsible towards whatever we purchase and whenever we dispose of such items. (Ref. on carbon footprint along with references of websites with carbon footprint calculator) **Dilip:** *So how does everyone feel about this structure?* *All: We think its fine, let's take this step and I am sure many people around us will learn from this as well.*
INFORMATION APPLICATION	**SAY:** Group processing of the case study to identify the major themes of curriculum Group processing of the case study to understand what is carbon footprint and how to measure the same Make 4 small groups Participants share individual written thoughts in small groups As a group discuss the case study and build understanding about carbon footprint Each group presents to the larger group their understanding of carbon footprint based on the case study. The facilitator sums up the discussion by sharing what is carbon footprint and how does one measure the same with the participants Refer back to your timetables and think of ways to reduce, reuse and recycle. Design and run a sustainable campaign – (IEC material – posters, mugs, batches) objectives of the campaign, expected outcomes, stakeholders, plan to make it happen.
REAL WORLD APPLICATION	One action that you will take in personal life which will help mitigate carbon footprint in the environment

6. Additional Awareness Materials and Sources of Information / References:

For students:

Methods of identification of toxic substances in e-waste:
http://ewasteguide.info/hazardous-substances
http://www.who.int/ceh/risks/ewaste/en/

Kumar Binay. IRSEE / Prof. (Network Management) / NAIR, Vadodara: “e-Waste – Environment and Human Health Hazards and Management”
http://www.nair.indianrailways.gov.in/uploads/files/1410168855632-PNM%20E-wast%20mgt_Abhivyakti.pdf

Patent Landscape Report on E-waste Recycling Technologies, 2013
http://www.wipo.int/edocs/pubdocs/en/patents/948/wipo_pub_948_4.pdf

Violet N. Pinto, Indian J Occup Environ Med. 2008 Aug; 12(2): 65–70: E-waste hazard: The impending challenge
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2796756/?report=classic

Ramachandra T.V., Saira Varghese K. Energy and Wetlands Group, Center Ecological Sciences, Indian Institute of Science, Bangalore; Envis Journal of Human Settlements, March 2004 : Environmentally Sound Options for E-waste Management

http://www.ces.iisc.ernet.in/energy/paper/ewaste/ewaste.html

Recycling of e-waste specific to different materials of its composition

CPCB E-waste document: http://www.cpcb.nic.in/TEXT/AS/Final-Ewaste-Documents/full-text.pdf

Naturvardsverket Report Recycling and Disposal of E-waste Health Hazards and Environmental Impacts, March 2011:
https://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6417-4.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
UNU-IAS: THE GLOBAL E-WASTE MONITOR, 2014, Quantities, flows and resources
http://i.unu.edu/media/unu.edu/news/52624/UNU-1stGlobal-E-Waste-Monitor-2014-small.pdf

Resource Consumption (what is the rate of resource consumption? Any specifics with respect to e-waste? What are the estimates of resources that we consume in electronic substances that are left on earth?)

Environment Alert Bulletin of UNEP: E-waste, the hidden side of IT equipment's manufacturing and use
http://www.grid.unep.ch/products/3_Reports/ew_ewaste.en.pdf

Greenpeace Report, Green Gadgets: Designing the future The path to greener electronics, September, 2014
http://www.greenpeace.org/international/Global/international/publications/toxics/2014/Green%20Gadgets.pdf

UNEP, International Panel for Resource Management: Assessing the Environmental Impacts of Consumption and Production Priority Products and Materials
http://www.unep.org/resourcepanel/Portals/24102/PDFs/PriorityProductsAndMaterials_Report.pdf

Article I Energy consumption growth rate of China's electronic manufacturing industry gradually decline
http://www.readore.com/en/Newsdetail.asp?Newsid=118

Manufacturing resource productivity; June 2012 | by Stephan Mohr, Ken Somers, Steven Swartz, and Helga Vanthournout
http://www.mckinsey.com/insights/sustainability/manufacturing_resource_productivity

Article, What is the world's Scarcest Material; By Rachel Nuwer, 18 March 2014
http://www.bbc.com/future/story/20140314-the-worlds-scarcest-material

E-waste Recycle or Reuse: Infographs
https://fr.pinterest.com/pin/141159769542686136/

LOHAS and how to draw a personal action plan on LOHAS

CONSUMERS & INDIVIDUAL ACTION IN THE LOHAS SPACE: A GLOBAL PERSPECTIVE
http://www.lohas.com/consumers-individual-action-lohas-space-global-perspective

Green Marketing from Wikipedia
https://en.wikipedia.org/wiki/Green_marketing#LOHAS
European Commission report on Sustainable lifestyles baseline: SUSTAINABLE LIFESTYLES: TODAY'S FACTS & TOMORROW'S TRENDS
http://www.sustainable-lifestyles.eu/fileadmin/images/content/D1.1_Baseline_Report.pdf

Secondary Resources (Amount of secondary resources which are tapped, secondary resources which can be tapped from e-waste, recycling of e-waste and the amount of secondary resources that have been tapped till date)

Jalal Uddin M.D.; IOSR Journal of Mechanical and Civil Engineering (IOSRJMCE) ISSN: 2278-1684 Volume 2, Issue 1 (July-Aug 2012), PP 25-45: Journal And Confrence Paper On (Enviornment) E – Waste Management
http://iosrjournals.org/iosr-jmce/papers/vol2-issue1/C0212545.pdf?id=2627

Khaliq Abdul, Akbar Rhamdhani Muhammad, Brooks Geoffrey and Masood Syed; Resources 2014, 3, 152-179; doi:10.3390/resources3010152: Metal Extraction Processes for Electronic Waste and Existing Industrial Routes: A Review and Australian Perspective
https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwjJnMmgn-rKAhXWkY4KHeIOCIUQFggrMAE&url=http%3A%2F%2Fwww.mdpi.com%2F2079-9276%2F3%2F1%2F152%2Fpdf&usg=AFQjCNF-JVtkXmfnAdkE1L75p_pWNoFIrw&sig2=tfqV6g1nI2EX_u4u_SmskQ&bvm=bv.113943665,d.c2E

Output Australia | October 2011| Page 9; Secondary copper processing – a more sustainable solution
http://www.outotec.com/imagevaultfiles/id_567/cf_2/secondary_copper_processing.pdf

UNEP Report on Sustainable Innovation and Technology Transfer Industrial Sector Studies: RECYCLING – FROM E-WASTE TO RESOURCES

http://www.unep.org/pdf/Recycling_From_e-waste_to_resources.pdf

How do we set up a collection center? Space, legal framework, licenses, clearances, etc)

Implementation of E-Waste Rules 2011 Guidelines by MoEF and CPCB: http://www.cpcb.nic.in/ImplimentationE-Waste.pdf

Integrated Solid waste management Policy, 2012 by BBMP: http://218.248.45.169/download/engineering/iswmp.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

Establishing E-waste Channels to Enhance Environment Friendly Recycling Collection of E-waste by GIZ: http://weeerecycle.in/publications/project_visibility_materials/E-Waste_ToT_Collection_110822.pdf

What to look for when buying material to reduce obsolescence rates

Article by James Carbone, 2012: Buyers Need Strategies to Manage Obsolete Parts Managing component obsolescence requires strong relationships with semiconductor suppliers http://www.digikey.com/en/articles/techzone/2012/aug/buyers-need-strategies-to-manage-obsolete-parts

Planned Obsolescence: https://en.wikipedia.org/wiki/Planned_obsolescence

Pameet Singh, Peter Sandborn, Todd Geiser, David Lorenson; International Journal for Advanced Manufacturing Systems: Electronic Part Obsolescence Driven Product Redesign Planning http://www.enme.umd.edu/ESCML/Papers/IJAMS.pdf

What is E-Waste

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

Chatterjee, Dr. S. 2011: Electronic Waste and India. New Delhi: Department of Information Technology: http://deity.gov.in/sites/upload_files/dit/files/EWaste_Sep11_892011.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

Indian Ministry of Environment and Forests & Climate Change 2011. E-waste (Management and Handling) Rules, 2011. New Delhi, 12 May 2011
http://www.moef.nic.in/downloads/rules-and-regulations/1035e_eng.pdf

UNEP 2007a: E-waste - Volume I: Inventory Assessment Manual. Division of Technology, Industry and Economics International Environmental Technology Centre.Osaka/Shiga.
http://www.unep.or.jp/ietc/Publications/spc/EWasteManual_Vol1.pdf

Indian Central Pollution Control Board 2011: Implementation of E-Waste Rules 2011 – Guidelines, New Delhi.
http://www.cpcb.nic.in/ImplimentationE-Waste.pdf

Indian Central Pollution Control Board 2008: Guidelines for Environmentally Sound Management of E-Waste. New Delhi:
http://www.cpcb.nic.in/latest/27.06.08%20guidelines%20for%20E-Waste.pdf

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

What is Carbon Footprint

Better Understanding of Global Warming and the Green House effect:
http://earthguide.ucsd.edu/earthguide/diagrams/greenhouse/

Agence Francaise De Development February 2010: User Manual- The carbon footprint tool for industrial projects, small and medium size:
http://www.afd.fr/jahia/webdav/site/afd/shared/PORTAILS/SECTEURS/CLIMAT/Carbon%20footprint%20user%20manual%20v1.3.pdf

http://timeforchange.org/what-is-a-carbon-footprint-definition

https://www.carbonfund.org/reduce

http://www.footprintnetwork.org/en/index.php/GFN/page/carbon_footprint/

http://www.theguardian.com/environment/blog/2010/jun/04/carbon-footprint-definition

http://ijlct.oxfordjournals.org/content/early/2013/06/24/ijlct.ctt041.full

http://carbonfootprintofnations.com/category/new-research/

http://shrinkthatfootprint.com/what-is-a-carbon-footprint

What are the harmful effects of poor e-waste disposal?

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

Greenpeace.org. Report August 2008: Poisoning the poor Electronic Waste in Ghana: http://www.greenpeace.org/denmark/Global/denmark/p2/other/report/2008/poisoning-the-poor-electroni.pdf

Kumar, Shashi N. And Jain, Arun Kumar Jul 19th, 2014: E-Waste: Health Impacts in Developing Countries: EHS Journal- Practical Solutions for Environment, Health and Safety Professionals.: http://ehsjournal.org/http:/ehsjournal.org/shashi-n-kumar-and-arun-kumar-jain/e-waste-health-impacts-in-developing-countries/2014/

Needhidasan.S, Melvin Samuel, International Journal of Advance Research, IJOAR .org Volume 1, Issue 8,August 2013, Online: ISSN 2320-9100: ELECTRONIC WASTE – HEALTH AND ENVIRONMENTAL IMPACT AND RECYCLING PRACTICES file:///C:/Users/Administrator/Downloads/Electronic_Waste_Health_and_environmenta.pdf

Swedish Environmental Protection Agency 2011: Recycling and disposal of electronic waste - Healthhazards and environmental impacts. Report 6417, March 2011 http://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6417-4.pdf

Gupta, Mamta, Junior Engineer, Power Development Deptt. Jammu (J&K): Environmental Effects of Growing E Waste https://www.academia.edu/3551713/Management_Of_Hazardous_E_Waste_Environmental_Effects_of_Growing_E_waste

International Labour Office, Geneva: The global impact of e-waste Addressing the challenge: http://www.ilo.org/wcmsp5/groups/public/@ed_dialogue/@sector/documents/publication/wcms_196105.pdf

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

What are the OHS issues around improper e-waste disposal and handling:

Swedish Environmental Protection Agency 2011: Recycling and disposal of electronic waste – Health hazards and environmental impacts. Report 6417, March 2011. http://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6417-4.pdf

ITU: End-of-life management for ICT equipment: https://www.itu.int/dms_pub/itu-t/oth/4B/04/T4B0400000B0013PDFE.pdf

International Labour Office, Geneva: The global impact of e-waste Addressing the challenge: http://www.ilo.org/wcmsp5/groups/public/@ed_dialogue/@sector/documents/publication/wcms_196105.pdf
Violet N. Pinto, Indian J Occup Environ Med. 2008 Aug; 12(2): 65–70: E-waste hazard: The impending challenge: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2796756/

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

What are the policies and legislations around e-waste in India

MINISTRY OF ENVIRONMENT, FORESTS AND CLIMATE CHANGE, NOTIFICATION, New Delhi, the 10th March, 2015:
http://deity.gov.in/sites/upload_files/dit/files/e-waste%20notification.pdf

Agrawal Shekhar, Verma Devendra S. : International Journal of Science, Engineering and Technology Research (IJSETR), Volume 3, Issue 7, July 2014 : E-waste management in India: Problems and Legislations:
http://ijsetr.org/wp-content/uploads/2014/06/IJSETR-VOL-3-ISSUE-7-1910-1914.pdf

Anwesha Borthakur1, Pardeep Singh2 : INTERNATIONAL JOURNAL OF ENVIRONMENTAL SCIENCES Volume 3, No 1, 2012: Electronic waste in India: Problems and policies
https://www.researchgate.net/publication/257326111_Electronic_waste_in_India_Problems_and_policies

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

Priyadharshini.S, B.Haganesh, Dr.T.Meenambal, International Journal of Engineering Research & Technology (IJERT) Vol. 1 Issue 7, September – 2012, Overview of Ewaste Management Practices and their Legislations in India:
http://www.ijert.org/view-pdf/934/overview-of-ewaste-management-practices-and-their-legislations-in-india

Ramachandra T.V., *Saira Varghese K., March 2004: ENVIRONMENTALLY SOUND OPTIONS FOR E-WASTES MANAGEMENT. Energy and Wetlands Group, Center for Ecological Sciences, Indian Institute of Science, Bangalore,: Envis Journal of Human Settlements:
http://www.ces.iisc.ernet.in/energy/paper/ewaste/ewaste.html]

India introduces first e-waste laws, June 20, 2011 by Editorial Staff:
http://www.recyclinginternational.com/recycling-news/3695/research-and-legislation/india/india-introduces-first-e-waste-law

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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
CO2: 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 students, 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 students, 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 students 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 students 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 students 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 students by the trainer.