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E-Waste Management And It's Challenges: Lessons To Be Shared Across The World

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ABSTRACT:
E-waste across the world is increasing at a very fast pace with the advent of digitisation of every business and it is rising to the alarming levels that there is a need for us to address the problem seriously otherwise, we will be left with highly polluted water, soil, air, acid rains, diseases, etc. This research is a secondary data-based research which attract the attention of countries, technologists, and researchers to think about it deeply and start working on Green Solutions to save this world from piles of E-waste. Some of the developed nations like America, Japan, Korea have already started working on it but it's the developing nations like India, China, Bangladesh, etc needs to gear-up. Thus, there is a need for more research and innovation on technology, values, patents, generating awareness among people about harmful effects of e-waste on the health. To me, the best is to reduce domestic waste (because charity begins at home), packaging waste, food waste and industrial waste to start with and then it can be taken to the level of the whole nation. Everyone should work towards not letting any waste go to landfills and buy only green products even if they are costlier. World, as per Vedas and Upanishads (Indian Spiritual, Vedic Books) is a one single family and we all can get affected by our Karmas(Actions) ,so ,we need to set it right as early as possible.
KEYWORDS: *E-Waste (Electronic waste),5R's of waste management, Green Electronics, Patenting, Vedas and Upanishads, Circular Economy.*

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I. INTRODUCTION:

With the huge number of devices being produced and discarded, a new environmental issue has appeared which is called 'E-waste'. E-waste is Old electronics that are either broken or unwanted and filling up landfills very fast. Humans generated about 44.7 million metric tonnes of electronic waste (e-waste) in 2016 which is equivalent to 4,500 Eiffel Towerssays a study. The trend is expected to continue further. These electric devices often contain hazardous materials that can endanger the environment and local communities, even getting into the air. Since India is highly deficient in precious mineral resources and if the untreated e-waste keep on going to landfills,it will increase the problem further. The Ground water gets polluted, Soil gets polluted and so on. Therefore, there is need for a well-designed, regulated e-waste recovery regime which would generate jobs as well as health & wealth.

A report on the study — carried out by the International Telecommunication Union, the UN University (UNU) and the International Solid Waste Association — published in The Global E-waste Monitor 2017, says thateveryday falling prices has made electronic devices affordable and easily available. In developing countries, increasing disposable incomes with middle class, more electronic goods are being bought and replaced more frequently, according to the study. Asia is a fast growing economies that accounts for more than 40 per cent of the e-waste generated globally and e-waste is managed by the informal sector with backyard techniques, often at the cost of the health of the workers.(See Graph2)

1.1 The common e-waste items:

Following is the list of some common e-waste items: Television, Computer hardware& software, microwaves, cookers, coffee machine, transistors, heaters, refrigerators, geysers, fans, laptops, circuit boards, hard drive, fax machines, printers, video games, lights, wi-fi dongles, medical equipments, any kind of old technology, etc. (See Graph 1)

1.2 Toxic Materials associated with E-wastes:

Most electronics contain some form of toxic materials, including Lead, Mercury, Cadmium, Arsenic, Brominated Flame Retardant, Cadmium, Perfluorooctanoic Acid, Polyvinyl Chloride, Thallium, which pose serious environmental risks to our soil, water, air, and wildlife. When E-waste gets buried at a landfill, it can dissolve in microscopic traces into the gross sludge that permeates at the landfill. Eventually, these traces of toxic materials pool into the ground below the landfill. This is known as leaching. The more E-waste and metals at the landfill, the more of these trace toxic materials show up in the groundwater and Soil. These chemicals can have adverse health effects such as: neurological damage, trouble breathing, cancer, miscarriages, and more.

When we want a metal, we try to mine from our natural resources, so in a way we extract new batch of metal which we can get from recycling old ,discarded Electrical and Electronic Equipments(EEE). So, we can prevent it going to landfill and also prevent fresh extraction by recycling (https://www.ewaste1.com/what-is-e-waste/). So , how can this problem be handled?

II. LITERATURE REVIEW:

According to the Global E-Waste Monitor 2017,In 2016, Asia generated the largest amount of e-waste (18.2 Mt), followed by Europe (12.3 Mt), the Americas (11.3 Mt), Africa (2.2 Mt), and Oceania (0.7 Mt). India generates about 2 million tonnes (MT) of e-waste annually and ranks fifth among e-waste producing countries, after the US, China, Japan and Germany. In 2016-17, India treated only 0.036 MT of its e-waste.

About 95 per cent of India's e-waste is recycled in the informal sector and in a crude manner. A report on e-waste presented by the United Nations (UN) in World Economic Forum on January 24, 2019 points out that the waste stream reached 48.5 MT in 2018 and these numbers is expected to rise if things will remain the same.

Only 20 per cent of global e-waste is recycled. The UN report indicates that due to poor extraction techniques, the total recovery rate of cobalt (the metal which is in great demand for laptop, smart phone and electric car batteries) from e-waste is only 30 per cent.

The report cites that a recycler in Chinaproduces more cobalt (by recycling) than what the country mines in one year. Recycled metals are also 2 to 10 times more energy-efficient than metals smelted from virgin ore. The Ministry of Environment, Forest and Climate ,India has notified the e-waste Management Rules-2016 which decides about who will collect, creating awareness, how the waste will be collected and how it will be carried to the premises, etc. so that best management can take place of the e-waste and best disposal ,without any harmful effects on people and environment.

The total waste generated by obsolete or broken down electronic and electrical equipment was estimated to be 1,46,000 tonnes for the year 2005, which exceeded to 8,00,000 tonnes by 2012. However, according to the Greenpeace Report, in 2007, India generated 380,000 tonnes of e-waste. Only 3% of this made it to the authorised recyclers. One of the reasons for this is that the India has also become a dumping ground for many developed nations. The Basel Action Network (BAN) report that 50-80% of e-waste collected by the USA is exported to India, China, Pakistan, Taiwan, and other African countries. India is one of the fastest growing economies of the world and thedemand for consumer durables has been shooting. From 1998 to 2002, there was a 53.1% increase in the sales of domestic household appliances, both large and small all over the world. Another report estimated that in India, business and individual households make approximately 1.38 million personal computers obsolete every year, pushing the rate of e-waste generation, which is around 10% annuall which in turn going to affect the environmental health.

III. E-WASTE MANAGEMENT IN WORLD:

European and American companies have been disposing their electronic waste to other countries such as China and India and therefore, developing countries have become toxic dump yards of e-waste. South Korea, Taiwan, and southern China all excelled in finding "retained value" in used goods, andhave set up billion-dollar industries in refurbishing used ink cartridges, single-use cameras, and working CRTs(Cathode Ray Tubes).

Countries like Australia and New Zealand generated 17.3 kilograms of e-waste per person in 2016, which was the highest in the region in contrast to African countries that generated only 1.9 kg of e-waste per person.

As far as the Information about the discarded equipment worldwide, there is very little available but according to a study, only 20 percent of e-waste is "documented to be collected and properly recycled". "Formal waste management ensures that recyclables are recovered, and the toxic parts are safely disposed of," explains Balde Kees, study leader and associate program officer at UNU.

P. Parthasarathy, managing director of E-Parisara Pvt. Ltd., a recycling firm in Bangalore, India, believes that efforts need to be made to educate the informal recycling sector and regularise it. "The government and NGOs could run programs to educate the informal sector and provide it with technical and financial support."

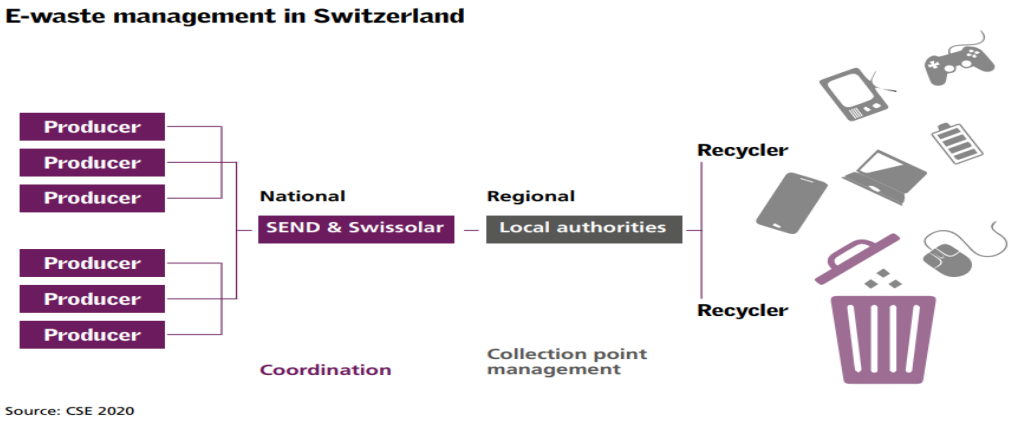
GLOBAL BEST PRACTICES:

EUROPE:

The majority of e-waste is regulated by the WEEE Directive (2012/19EU). The WEEE directive sets collection, recycling, reuse, and recovery targets for six categories of e-waste. From 2018 onwards, Article 7 of the Directive states that the minimum collection rates to be achieved annually shall be either 65 per cent of the average weight of the EEE in the three preceding years or 85 per cent of the e-waste generated on the territory of a member state in 2018.

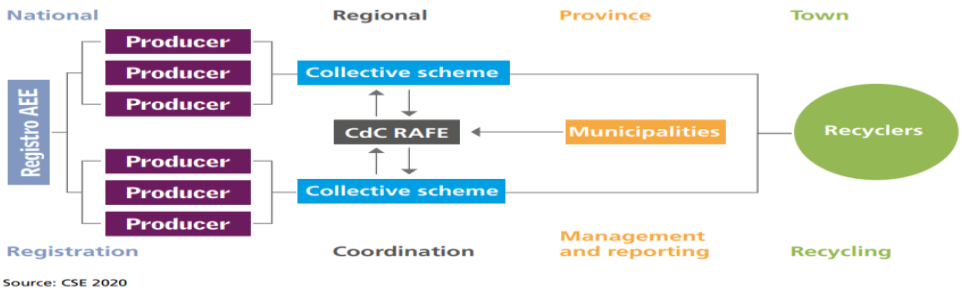
SWITZERLAND:

Switzerland has an estimated 8–10 million smartphones lying unused in homes with population of just 8.4millionin the country. Per capita generation of e-waste is 23.4 kg. The country is collecting and recycling 75 per cent of discarded electronic material through a voluntary take-back system which channelizes waste to dedicated recycling and collection points.



ITALY:

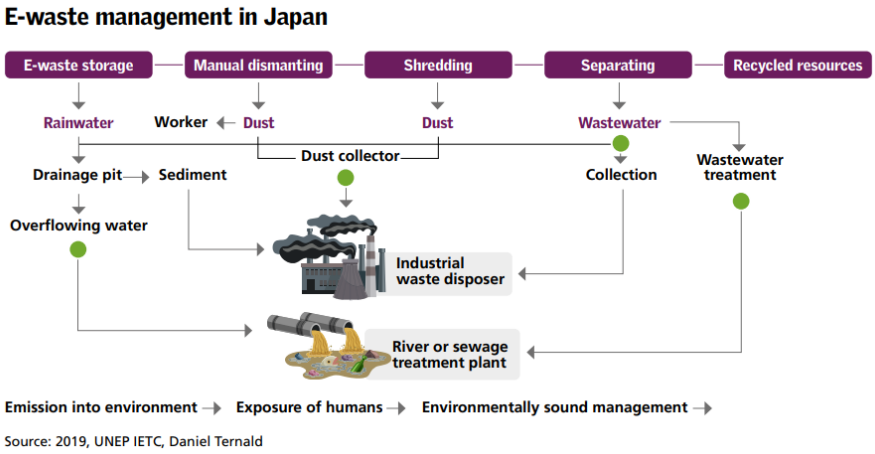
Italy has a population of over 60 million and the per capita generation of e-waste is 17.5 kg. The WEEE (Waste Electronic and Electrical Equipment) Coordination Center is the central body. It takes care of optimizing the collection, recycling, and management of WEEE.All EEE and WEEE plants are to be compulsorily registered with it. In Italy, there are two different types of collection points : retailers collection points and municipal collection points. The WEEE Coordination Center contacts the collection scheme that is in charge of that specific collection point. PROs offer a service to pass them from the collection points to the recycler points. Producers are required to register, before placing EEE on the market. Registration must be made by electronic means through the official website. The WEEE RAFE is managed and governed by collective systems under the supervision of the Ministry of the Environment.



JAPAN:

Japan population is 126 million with per capita e-waste generation at 20.4 kg. It has the most advanced e-waste legislations in Asia. Most e-waste is collected and recycled under the Act on Recycling of specified kinds of home appliances (2001) and the Act of Promotion of Recycling of Small EEE (2013). Japan was one of the first countries,in the world to implement the EPR (Extended Producer Responsibility) based system for e-waste. The laws for specified kinds of home appliances promotes ESM(Environmentally Sound Management) of e-waste and efficient use of recyclable sources for products like air conditioners, refrigerators and freezers, all

kinds of televisions, washing machines and clothes dryers. Responsibilities of all stakeholders have been fixed— consumers have to pay a recycling fee; retailers are responsible for collection of used home appliances and manufacturers are responsible for recycling of collected appliances. Consumers are responsible for delivering end-of-life products to the nearest collection point, retailers are responsible for proper channelisation and manufacturers are encouraged to use recycled materials in their products.



IV. E-WASTE MANAGEMENT INITIATIVE (IN INDIA):

India ranks 177 amongst 180 countries and is amongst the bottom five countries on the Environmental Performance Index 2018, as per a report released at the World Economic Forum 2018. Since 2018, India generates more than two million tonnes of e-waste annually and imports huge amounts of e-waste from other countries around the world. In India E-waste gathering, transportation, isolation, destroying, reusing and transfer is done physically by untrained works in casual part. E-waste contains reusable and valuable material.

Computer devices account for nearly 70% of e-waste, with the contribution of telecom sector being 12%, medical equipment being 8%, and electric equipments being 7% of the annual e- waste production. The Government, public sector companies, and private sector companies generate nearly 75% of electronic waste; with the contribution of individual household being only 16%. City-wise, Mumbai tops the list in producing electronic waste, followed by New Delhi, Bangalore and Chennai. State-wise Maharashtra ranks first in generation of electronic waste, followed by Tamil Nadu and Uttar Pradesh. Electronic waste account for 40% of lead and 70%of heavy metals found in landfills. These pollutants are responsible for groundwater contamination, air pollution and soil acidification. The Ministry of Environment, Forest and Climate Change has notified E-Waste (Management) Rules, 2016. The rules – for the first time in India introduced

Extended Producer Responsibility (EPR). EPR stipulates for collection 30% waste in first two years
and up to 70% in seven years. According to ASSOCHAM, an industrial body in India the Compound Annual Growth Rate (CAGR) of electronic waste is 30%.

As per the reports of NITI Aayog, (Government of India body), Dr Rajiv Kumar (Vice Chairperson), Amitabh Kant (CEO), Dr K Rajeswara Rao(Special Secretary), and Sunita Narain(CSE director general), "With rapid population growth in urban areas, capacities of local authorities often fall short of achieving the set goals of urban service delivery. Therefore, sector stakeholders must be equipped with adequate knowledge resources to plan efficient waste management systems,".

Three cities (out of the list of 28) Chhattisgarh's Ambikapur, Maharashtra's Chandrapur and Kerala's Taliparamba have adopted a "zero-landfill model" of development, to remove the dependency on new landfills. This achievement has come for the best waste management practices, 'Resource recovery' and 'Principles of Circular Economy', ensures maximum quantities of waste are subjected to scientific treatment and recycling, thus reducing the amount of residual solid waste and minimising the need to construct new landfills, as per the report released by NITI Aayog and the Centre for Science and Environment, Government of India.

V. INDIA (NATION WHERE TRADITIONS GIVE SOLUTIONS TO MOST OF THE CURRENT WORLD'S PROBLEMS)-Another Dimension to the world problem:

All the ancient scriptures like Upnishads, Ramayana, Mahabharata, Shraut Sutra, Dharma Sutra, Grih Sutra etc. confirm the traditional belief that the divine knowledge contained in the vedas is self-evident and needs no further proof of its authenticity and justness.

What is Karma? Karma is each action (by way of body, speech and mind) leads to karmic result that is reaction. Karmic result depends on good actions and negative actions. Once the action is over the result of the action is permanent and can't be reversed. So, one must have complete consciousness of one's action to reduce negative karma. If we do Good Karma (Think about environment/nature/mother earth), then we will get 'Good(Safe environment without chemicals)' in return. But if we keep on adding our wastes to nature, then we will get back same
(Floods, Acid rains, Landslides, Pollution, Glaciers melting, Volcanos, etc), in return. Therefore, I feel that there is a need for Ethical and Moral education to students so that they think for mother earth emotionally. There is no rebirth of human to suffer for past Karmas, it's only in this birth, we have to do Good or Bad and improve our life. If Good is done, we will get 'prosperity' back from Mother Earth and if we do Bad, 'sufferings' come back to us in this life only.

A.L. Basham said, we can't escape the law of Karma any more than we can escape the law of gravity or the passage of time, but by judgment and forethought we can utilize the law of Karma to our advantage." So, IT'S A CIRCULAR ECONOMY (What goes in, comes back). Now, how this all can be achieved?

Brhadaranyaka Upanishad states, "He who knows (the mystery of Brahman) become calm, restrained, satisfied, patient and confident and he sees himself in the (great) self, sees all things as self ... evil does not overcome him but he overcomes the evil (Waste) .... Free from the evil, free from decay, free from hatred, free from thirst, he becomes a (true) Brahman" (IV – 4- 23). Therefore, need for

a. People to be more contended (purchase less).
b. Reduce consumption and be free from thirst.
c. Think for mother earth.
d. Change their habit of using and throwing with every new thing comes-up.
e. Complete utilization of things to their maximum capacity (after repairs etc.), till it is unrepairable.
f. So that least waste is generated.

All this can be achieved through a connected efforts of all the dharmgurus who can push people through their talks and organize events for example, Sadguru working on "SAVE SOIL" mission across nations. People can be told about good things mentioned in our ancient literature and can be motivated to practice it.

In Buddhism and Jainism, in chapter 10 of Darmapada, "Everyone fears punishment; everyone fears death, just like you do. Therefore, do not kill or cause to kill. Everyone fears punishment; everyone loves life, as you do. Therefore, do not kill or cause to kill.", thus, the main perceptive is non – violence and non–injury. E-waste generation is like killing the nature and humans too. Therefore, we as humans should start now to stop these killings.

Gay Watson in his essay, "Buddha Meets Western Science" writes: "Buddhism has always been concerned about feelings, emotions, sensations and cognition. The Buddha points both to cognitive and emotional causes of suffering. The emotional cause is desire and its negative opposite, aversion. The cognitive cause is ignorance of the way things truly occur, or of three marks of existence: that all things are unsatisfactory, impermanent and without essential self." The consequence of an action, Karma depends on the intention more than action itself. Buddhism emphasizes; anguish such as anxiety, remorse, guilt etc, should be avoided in order to cultivate calm and peaceful mind.

The Vedic Aryans saw the answer in sacrifice, rites and rituals. They worshipped the Nature with sacrifice. They strongly believed that if the nature is furious then it has the power to destroy living mortals. To please the unknown forceful energy, they offered oblation. They composed most beautiful mantras in praise of the Universe. As Max – Muller says, "Nay, they (the Vedas) contain, by the side of simple, natural, childish thoughts, many ideas which to us sound decidedly modern."

All of this can be achieved through various awareness campaigns in schools, colleges, movies, theatre, social Responsibility initiatives by Corporates, Awards for such works, Social Recognition, Media stories, Strict Regulations by Government, Heavy penalties, etc.

VI. CHALLENGES OF E-WASTE MANAGEMENT:

Let's see some of the challenges for e-waste management:

Firstly, 5R'S OF WASTE MANAGEMENT :(Reduce, Reuse, Recycle, Recover, Reprocess)

Due to the increase in digitisation and post-pandemic, many waste materials coming from electronics and ICT (Information and Communication Technology) and are harming living plants, water, soil humans and animals. For managing such unwanted solid wastes, the 5R principle is introduced. 5R Principle is the widely used principle in solid waste management viz., reduce, reuse, recycle, recover, and reprocess.

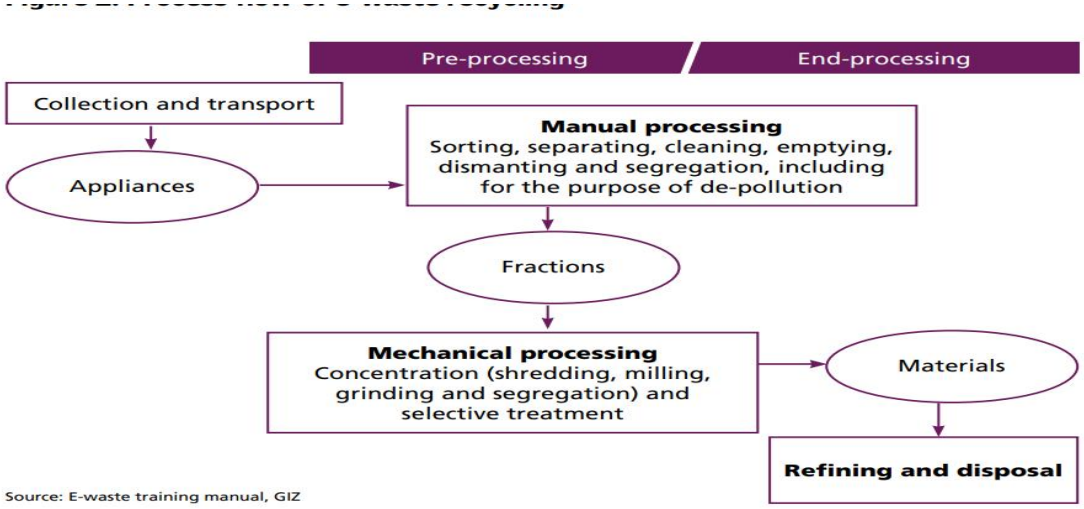
The recycling of e-waste is a very useful process to protect human and environmental health by keeping EEE devices out of landfills. All electronic waste contains some form of recyclable material like plastic, glass, and metals, which may be considered "junk" or "obsolete" to consumers but can be very useful, if recycled. For example, Circuit boards contain valuable metals like silver, tin, gold, palladium, and copper. Hard drives can be processed into aluminium ingots for use in the automotive industry.

In 1991, the first electronic waste recycling system was implemented in Switzerland to collect refrigerators and then later for other electric and electronic devices. A decade later, the European Union implemented a similar system called the Waste Electrical and Electronic Equipment Directive to establish e-waste recycling requirements for member nations.

Secondly, Security and Safety concerns:

There are various methods of disposal of EEE, but most of them aren't perfect. Physical destruction or dismantling of your electronics is the only sure-fire way to get it done. However, it should be done by professionals because laptop and smartphone batteries can explode if heavily damaged or dismantled incorrectly. Businesses can be held liable for the security of their clients and employee's data being misused or stolen. So, the safety of the Recycler and security of the data of the Recyclable EEE is a concern.

Thirdly, Disposal of E-waste:



The scientific and environment friendly disposal of e-waste is important. If not disposed of properly it could lead to serious negative environmental impacts. Developing countries,like Africa and Asia, are the primary destinations for e-waste dumping, and they don't even have the basic disposal technologies.

Fourthly, Collection, Treatment and Disposal systems:

Collection, treatment, and disposal systems are critical elements of e-waste management. Most developed countries have framed conventions, directives, and laws aimed at proper collection, treatment, and recycling of e- waste, as well as safe disposal of the non-recyclable components. These include the EPR, product stewardship, advance recycling fund (ARF), the 3Rs or Reduce, Reuse, Recycle initiative, etc. In Developing countries the disposal system is burning and dumping in open sites. E-waste is treated in backyard operations, using open sky incineration, cyanide leaching, and simple smelters to recover precious metals mainly copper, gold, and silver with comparatively low yields and discarding the rest with municipal solid waste at open dumps, into surface water bodies and landfills, thereby causing adverse environmental and health effects.

Fifthly, The Value system:

People now-a-days have the habit of buying new every day and throwing the old every day. Therefore, the value system is missing somewhere. The responsibility towards Mother earth and its beings is missing and there is definitely a need to make people more aware, responsible and answerable to the whole earth. As Indians, getting back to our basics "Vedas & Upanishads, Ramayana & Mahabharata, Shushruta, etc. teaches us to consume wisely and waste very less so that, we don't generate chaos in nature and don't disturb Mother Earth.

VII. POSSIBLE SOLUTIONS:

So, after a careful and deep analysis of the literature review and the researches done by various scientists across the country, I found that following could be the possible solutions for managing E-waste like Green Electronics, Take Back services-Company Responsibility, Patenting/ Develop New Indigenous Technology, Mass Awareness Campaigns (By Government, NGOs, Schools, TV, Newspapers, etc), Strict Regulations and Penalties, Buy less, and Organise what we have, etc.

7.1 GREEN ELECTRONICS:

Green electronics refer to electronics that are biodegradable, sustainable, and recyclable. When we usually think of biodegradable, we think of banana peels or apples; something that breaks down and disappears after a few days. Green electronics, though, are durable during use and biodegrade at end-of-life. Green electronics are the future we need in order to prevent widespread pollution from electronic devices.

Improper disposal of e-waste involves removing the non-degradable plastics to reach the valuable metals. These damaging processes include acid baths and open burning. This releases chemicals into the air which later seeps into our rain clouds.

7.2 ELECTRONIC TAKE-BACK SERVICES-COMPANY RESPONSIBILITY:

As per a Green Peace report approximately 20 brands carry business on electronic equipments in India. Out of the 20 companies, 9 have no take back service in India including Apple, Microsoft, Panasonic, PCS, Philips, Sharp, Godrej, Sony, Sony Ericsson, and Toshiba. Samsung claims to have a take-back service but only for mobile phones with only one collection point for the whole of India. Other brands such as HCL, Wipro, Acer, Nokia, etc., do have take back facilities but they are either not user-friendly or inadequate in terms of collection centres. Positions of other brands are not clear, and no brand has taken initiative in giving education and awareness to general customers on e-waste management. Few brands have taken little initiative to train their frontline staffs on take-back and recycling service. In the management and disposal of e-waste, technology plays a vital role. (See Table 3)

The overall collection targets for a period of five years for these brands are given in Graph 5: Collection targets for popular ITEW producers and Graph 6: Collection targets for popular ITEW(Information Technology and Communication) and CEEW(Council on Energy, Environment and Water) producers.

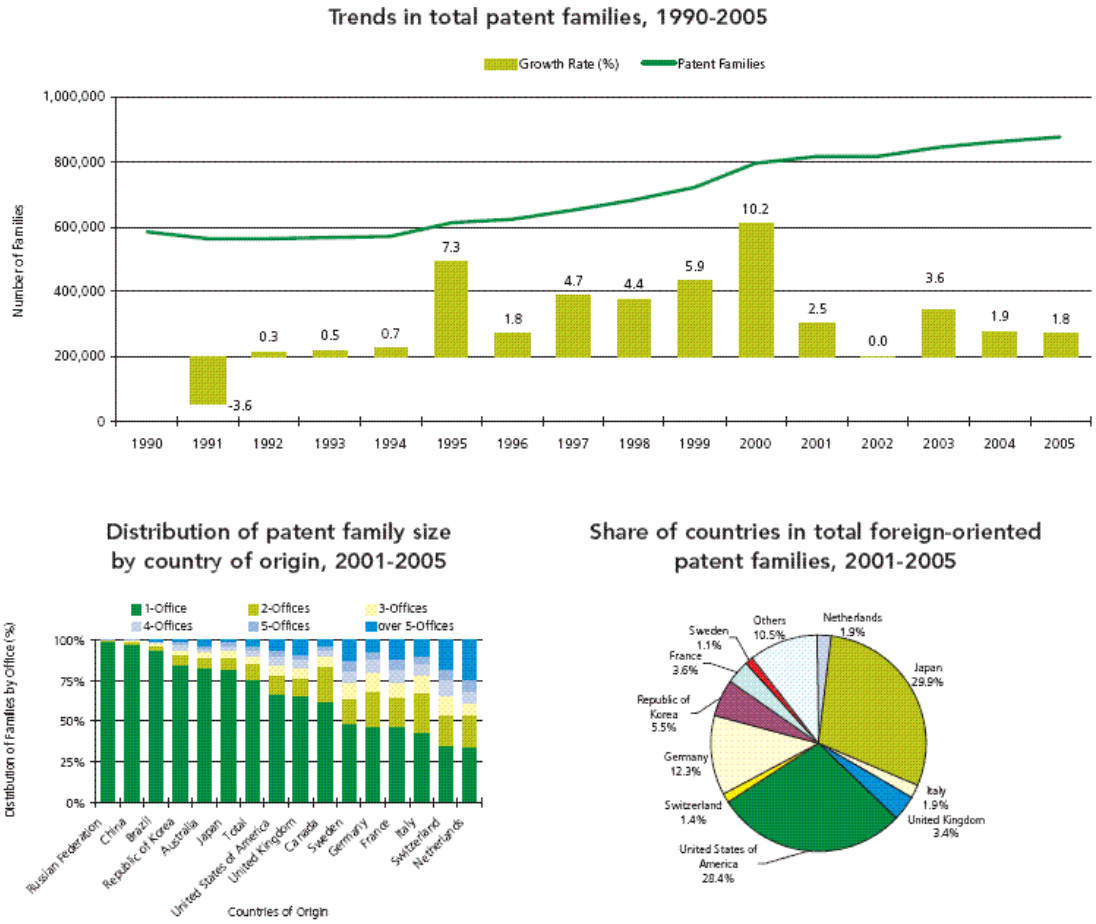
7.3 PATENTING/ DEVELOP NEW INDIGENOUS TECHNOLOGY:

India is the top country among other developed and fast developing nations to register for patenting through CSIR, followed by Peetambaram, etc. This helps in getting a good appropriate technology for handling e-waste.

7.4 MASS AWARENESS CAMPAIGN (By Government, NGOs, Schools, TV, Newspapers, etc):

With the help of government, twitter, facebook, youtube, green E-mascot, poster competition/RWA/Office Cluster/ Schools &Colleges/ HealthCheck-up Camps/Informal Sector

7.5 STRICT REGULATIONS AND PENALTIES:



Note: Country share is based on foreign-oriented patent families (i.e. patent families that include at least two patent offices).
Source: WIPO Statistics Database

The penalty and punishment for non-compliance were the same as mentioned under the sections 15 and 16 of the Environment (Protection) Act, 1986. The sections say that an imprisonment term that may extend to five years or a fine which may extend to Rs 1 lakh would be the penalty for non-compliance. (See Fig.1)

7.6 BUY LESS:

Buying things, we simply do not need is probably the biggest cause of e-waste. We need to stop (really, STOP) and ask ourselves if we even need a gadget or electronic item BEFORE we buy it.

7.7 ORGANISE WHAT WE HAVE:

If we don't organise your gadgets, wires, connectors and DVDs, we never really know what we have. The last thing we want is to buy something you think we need it, only to find a duplicate buried in your cabinet.

7.8 STRONG REPAIR (AFTER SALES SUPPORT) AND AVAILABILITY OF AUTHENTIC PARTS:

If the strong after sales support and repair facilities are available with all the genuine parts available, people will get motivated for repairs of the products which will increase the life of it and also lead to low e-waste.

Second-hand electronic market in India In 2015, the used-goods market was valued at Rs 115,000 crores by ASSOCHAM. In the past few years, major e-retailers like Amazon and Flipkart have also jumped into the business of selling 'refurbished' electronics. This is a positive sign from the resource utilisation point because it increases the life span of the product, ensures repair, reuse, and displays conscious consumerism.

7.9 STRONG RESEARCH CELL CAN BE STARTED WITH PUBLIC &PRIVATE PARTNERSHIP:

Australian scientists have found the Zophobas morio - commonly known as a superworm - can survive on a diet of polystyrene. They believe the beetle larvae digest the plastic through a gut enzyme.A species of insect larvae with a taste for plastic could help revolutionise recycling, researchers say.(Source: https://www.bbc.com/news/world-australia-61727942) .So this can revolutionalize plastic waste recycling but there are metals in E-Waste, what about that?

Similarly, Thermocol (Styrofoam) dissolves in acetone in a similar way to how sugar dissolves in water which is a physical, rather than a chemical reaction. Thermocol consists lot of air, and when the air in the foam leaves, it dissolves in acetone it completely loses its structure and becomes like a small piece of waste.

Thus, Strong and committed Research Wing can be started by Private and Public ownerships to undertake research in reducing the landfill by a set target and promoting technologies/grant and generate patents for achieving this target. Singapore has a 'Zero-waste mission' and kept a target of reducing the waste sent to landfill per capita per day by 30% by the year 2030. Singapore also plans to achieve 70% overall recycling rate of which 81% for non-domestic recycling rate and 30 % domestic recycling rate.

7.10 FROM TRASH TO TREASURE:

We should start working on the training and development of products from e-waste and for that, we need to start training and coaching waste collectors to know -how to collect useful waste, so that useful material can be extracted properly and nothing gets wasted. Refurbishing and developing fresh products through waste should be the key. It has already been started in the fabric technology. It should now start in the electronics industry as well.

7.11 TECHNOLOGY DEVELOPMENT:

Infrastructure for acquiring necessary Technology is the key. Also the government should take initiative in pushing people to set-up such recycling units with some incentives and exemptions so that more of recycling can happen and cost-effectiveness can take place.

VIII. CONCLUSIONS:

E-waste management seems to be an inevitable task with new electronic products coming up almost every day. The only solution seems to be the utilization of new technology, for only a technology can replace a technology. India definitely needs a strong legislation on e-waste management which can levy penalties and ensure e-waste is managed properly. Despite its economic importance, research on e-waste recycling has never gained priority and gets little respect within companies in India. The present study only confirms that electronic manufacturing companies in India are laggard rather than leaders in adopting new technologies and innovation on e-waste recycling.

The main focus in this research is to encourage entrepreneurs, R&D units and the government to take this challenge of management e-wastes head on and arrest the situation going out of control. Needless to say the India is also a major contributor to e-wastes and not only produces a huge amount of electronic and electrical equipments but also legally and illegally imports much larger quantities. A solution to the problem of managing and disposing e-waste is urgently required in the interest of society.

With the European and the American traders trying to flow e-waste into India it is time to realise the size of the problem. India as a country of Vedas, Upanishads, Ramayana, and Mahabharata, Hinduism and Buddhism, teaches about good karma (Social Work) will bring back happiness and prosperity (healthy environment) and world is a one big family which should work together to save the Mother Earth.

On the other end, we can associate the use of Electronics to Moral Values so that less waste gets generated, people start recycling, and less waste goes to landfills.

IX. PROPOSED E-WASTE MANAGEMENT MODEL

I propose a model for E-waste management after all the research analysis and after talking with some of the friends ,family, teachers, etc. that

1. The awareness is still very low
2. People still lack the sense of responsibility for reducing e-waste
3. There is lack of nearby and convenient locations for giving away the e-waste.
4. Waste collectors should be given an equipment to identify the electronic and metallic waste from the garbage. This equipment can have a sensor system to identify the metal or chemical waste.

(I have developed a sensor based identification equipment for this purpose)

5. The economical value associated with giving old model of phone for buying a new one is very less. So lack of encouragement for exchanging old with new.

6. People have lost their value-system and there is no-one to reinforce it in a proper way. There should be a regular value-talk sessions to be organised at School(in Morning Assembly), Offices, Hospitals, Social - Media, etc. This way, People will become more sensible towards generating E-waste, discourages for buying more and more, Recycle more and more, share more and more, and waste the least.
7. Lack of Infrastructure for recycling and Green Product Manufacturing.

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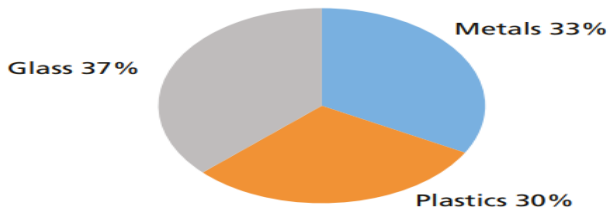
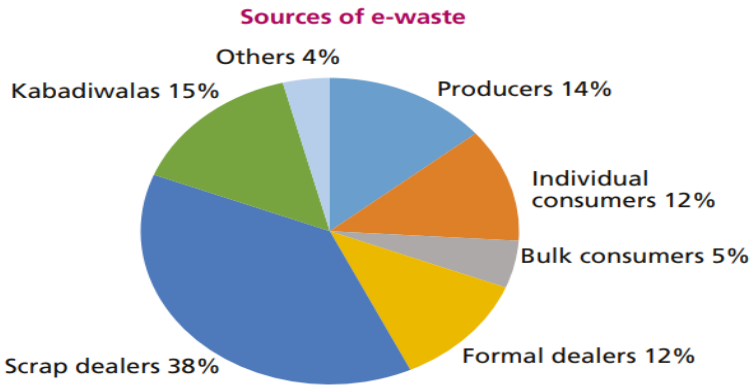
XI. GRAPHS AND TABLES:

Graph 1: Components of e-waste

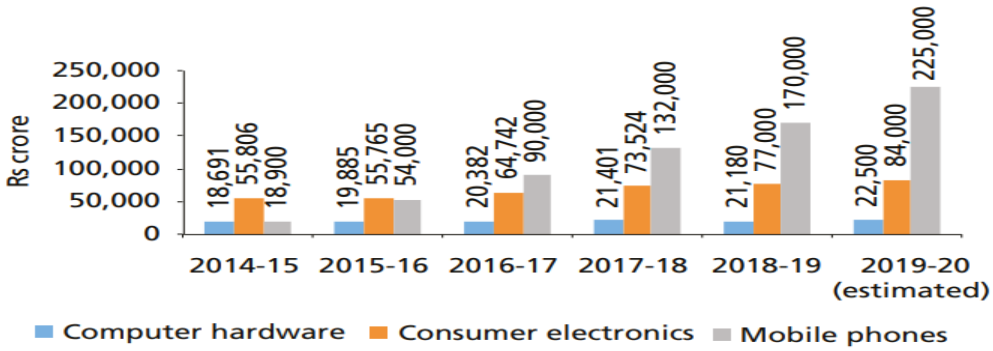


Source: Electricals and Electronics manufacturing in India, ASSOCHAM, NEC technologies, 2018

Graph 2: Sources of E-waste:



Graph 3: Production profile for electronics in India



Source: Annual Report MeitY, 2019–20

Table 2: Statistics of top five e-waste generating countries in 2019

Rank	Country and rank in e-waste generation	EEE placed on the market (kg/capita)	E-waste generation (kg/capita)	E-waste collection rate (per cent)
1	China	13.3	7.2	16
2	USA	25.3	21	15
3	India	5.8	2.4	1
4	Japan	21.3	20.4	22
5	Germany	18.2	19.4	52

Source: CSE 2020

Table 1: Categories of e-waste and average life of EEE

Information technology and communication			Consumer electrical and electronics		
EEE code	ITEW	Average life span (z) in years	EEE code	CEEW	Average life span (z) in years
ITEW 1	Centralized data processing: Mainframes and minicomputers	Ten years for mainframes and five years for mini-computers	CEEW 1	Television sets (including sets based on Liquid Crystal Display and Light Emitting Diode technology)	Nine years
ITEW 2	Personal computing: Personal computers (central processing unit with input and output devices)	Six years	CEEW 2	Refrigerators	Ten years
ITEW 3	Personal computing: Laptop computers (central processing unit with input and output devices)	Five years	CEEW 3	Washing machines	Nine years
ITEW 4	Personal computing: Notebook computers	Five years	CEEW 4	Air-conditioners excluding centralized air conditioning plants	11 years
ITEW 5	Personal computing: Notepad computers	Five years	CEEW 5	Fluorescent and other mercury containing lamps	–
ITEW 6	Printers including cartridges	Ten years			
ITEW 7	Copying equipment	Eight years			
ITEW 8	Electrical and electronic typewriters	Five years			
ITEW 9	User terminals and systems	Six years			
ITEW 10	Facsimile (fax)	12 years			
ITEW 11	Telex	Five years			
ITEW 12	Telephones	Nine years			
ITEW 13	Pay telephones	Nine years			
ITEW 14	Cordless telephones	Nine years			
ITEW 15	Cellular telephones	Ten years for feature phones and seven years for smart phones			
ITEW 16	Answering systems	Five years			

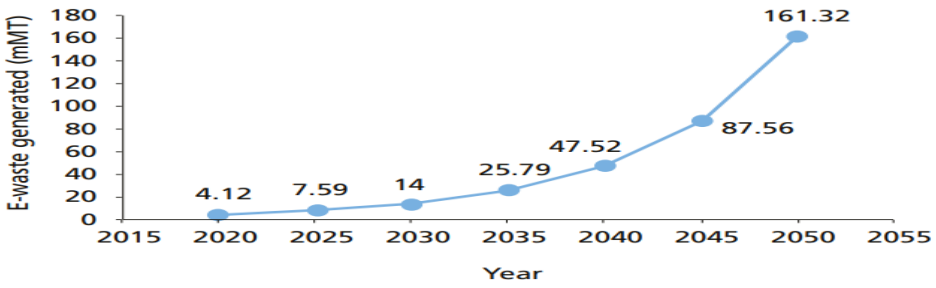
Source: Schedule I, E-waste (Management) Rules, 2016 and implementation guidelines for e-waste management rules 2016

Table 3: Year wise collection target of various brands:

Popular brands	Collection targets (in tonnes)					Total brand-wise collection target
	2017–18	2018–19	2019-20	2020–21	2021–22	
Xiaomi	0	0	123	197	344	664
Apple	148	184	294	368	0	994
HP	245	296	367	449	499	1,855
Microsoft	171	232	561	1,314	1,051	3,330
HCL	1,157	1,463	956	1178	759	5,513
Canon	500	766	1,554	2,170	3,079	8,070
Lenovo	1,787	1,829	2,649	3,564	2,283	12,112
Dell	2,939	2,879	4,363	5,096	250	15,527
Sony	3,757	2,090	3,904	3,900	4,506	18,158
Haier	3,159	4,734	6,422	130,581	9,570	36,943
Godrej & Boyce	9,508	11,775	19,528	20,806	24,771	86,388
Videocon	20,912	26,821	36,880	31,928	36,698	153,239
Samsung	36,708	44,121	66,829	64,696	70,078	282,433
Total year-wise collection target	80,991	97,191	144,431	148,725	153,889	625,226

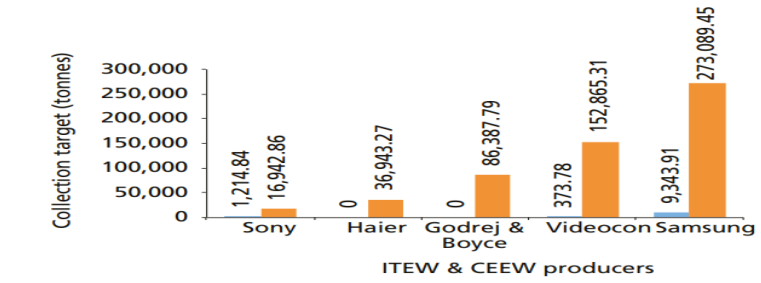
Source: CSE, 2020

Graph 4: Projected E-waste generation in India:



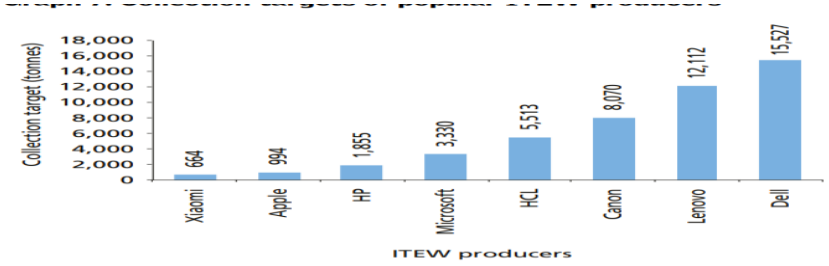
Source: CSE, 2020

Graph 5:



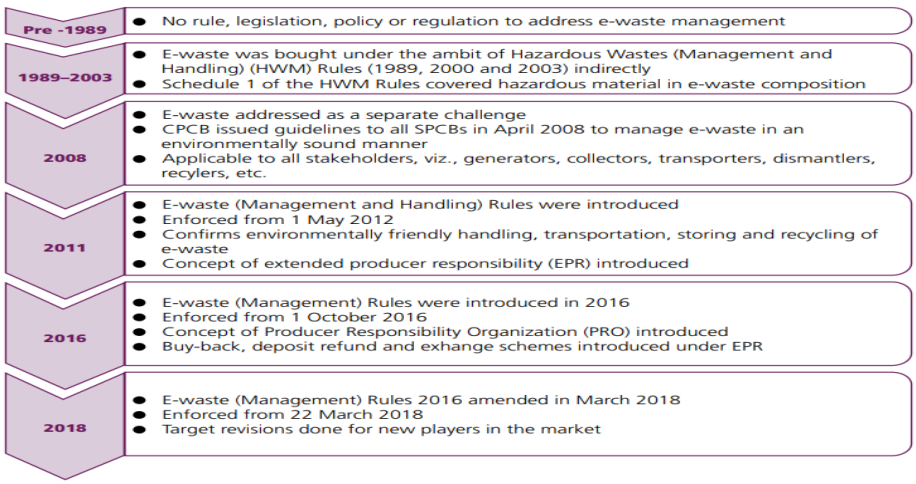
*From 2017 to 2022
Source: CSE, 2020

Graph 6:



*From 2017 to 2022
Source: CSE, 2020

Figure 1: Legislative progress on e-waste management



Source: CSE, 2020